Regional Drainage Improvements for Redevelopment of Cedar Lane Preliminary Design Report

For

CROSSROADS COMPANIES, LLC

Proposed Mixed Use Redevelopment

Cedar Lane, American Legion Drive & Beverly Lane
Block 819, Lots 1; 13-14; 16-17
Block 707, Lots 1-5
Block 705, Lot 4.01
Township of Teaneck
Bergen County, New Jersey

Prepared by:

DYNAMIC ENGINEERING

1904 Main Street
Lake Como, NJ 07719
(732) 974-0198

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NJ Professional Engineer License #49266

February 2026
DEC # 0161-24-04879

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- Drainage Improvement Sketch, prepared by Dynamic Engineering Consultants, dated 12/2025
- Curve Number, Impervious Coverage, and Manning's N Value Model Coverage Mapping
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- Block 819 Boundary Location & Topographic Survey, prepared by Dynamic Survey, LLC, dated 03/14/2025, last revised 01/06/2026
- Belle Avenue Area Drainage Study, prepared by the Township of Teaneck, dated 04/05/2022
- Drainage Study; Belle Avenue, Beatrice Street & Beverly Road Area, prepared by Fastech Consulting Engineers
- HEC-RAS Model File (Submitted Electronically)

A. DESIGN OVERVIEW

Cedar Lane CBD Redevelopment Plan Scope of Improvements

The subject of this report is a multi-phase redevelopment project in Teaneck Township. The project encompasses approximately 9.42 acres across several non-contiguous parcels and is planned in three phases. Phase I involves the redevelopment of Block 819, Lots 1, 13-14, and 16-17, including the demolition of an existing municipal parking lot and construction of a four-story mixed-use building with 96 residential units, a 590-space parking garage, and 12,000 square feet of commercial space. Phase II, located on Block 707, includes site improvements around the existing Stop & Shop grocery store and demolition of an adjacent house of worship, followed by construction of a six-story residential building with 128 units and a 170-space parking garage. Phase III, situated on Block 705, Lot 4.01, proposes a four-story residential building with 94 units, 113 garage parking spaces, and 36 on-street parking spaces. The combined development area is bordered by Beverly Road to the north, American Legion Drive to the south, a Conrail railroad to the east, and Garrison and Chestnut Avenues to the west, with surrounding land uses consisting of residential, commercial, and mixed-use properties. A redevelopment plan is in the process of being established in regard to the proposed onsite and off-site improvements.

Off-Site Drainage Improvements Introduction

The proposed redevelopment project is located in a portion of Teaneck, NJ which has historically experienced drainage issues during higher frequency storm events. This Offsite Drainage Improvement Report has been prepared to define and analyze proposed solutions to the existing stormwater drainage issues reported along Belle Avenue between Claremont Avenue and Beverly Road. The municipal stormwater system runs through the redevelopment project from Beverly Road to Cedar Lane and continues down American Legion Drive to a discharge point near Terhune Street. It is our understanding that the existing stormwater infrastructure is undersized and constrained by shallow slopes, contributing to recurring flooding concerns within this low-lying area. Further, the Belle Avenue area serves as a regional drainage path for a significant tributary area, approximately 175 acres, and its limitations have been documented in the Belle Avenue Area Drainage Study, prepared by the Township of Teaneck, dated 04/05/2022.

To help improve these existing drainage issues, our office has prepared this report to conduct a comprehensive evaluation of existing drainage conditions and infrastructure, confirm previously identified conflict points, and assess potential offsite drainage improvements. This analysis includes a review of historical data, hydrologic and hydraulic modeling, and consideration of feasible design alternatives aimed at improving flooding conditions and improving the stormwater infrastructure’s effectiveness.

B. EXISTING DRAINAGE BACKGROUND

Per the Belle Avenue Area Drainage Study, prepared by the Township of Teaneck, dated April 5th, 2022 (refer to the Appendix of this report), the existing 36-inch stormwater trunk line along Belle Avenue, between Sagamore Avenue and Beverly Road, is currently lacking adequate capacity and further restricted by shallow slopes. In addition to the limitations posed by undersized and shallow-sloped pipes, the system's performance is further hindered by two abrupt 90-degree bends in the stormwater conveyance line along Beverly Road. These bends contribute to significant energy losses, which appear to exacerbate upstream flooding within the Belle Avenue pipe network.

This portion of the drainage system lies within a regional low point that collects runoff from an approximately 175-acre tributary area characterized by relatively flat topography. Cedar Lane effectively creates a ridge line which limits the ability for stormwater to flow overland when the existing stormwater conveyance system reaches maximum capacity. Over recent decades, the sub-watershed has undergone substantial development, increasing impervious surfaces and, consequently, stormwater runoff directed toward this low-lying area.

The Belle Avenue Area Drainage Study further notes that increasing capacity south of Cedar Lane (CR 60) is not anticipated to be necessary, as the existing infrastructure in that area appears to have adequate capacity. However, comprehensive hydrologic and hydraulic analyses have been performed in conjunction with the proposed improvement options outlined later in this report to confirm overall system adequacy.

In summary, the pluvial flooding issues from the existing drainage infrastructure along Belle Avenue between Beverly Road and Claremont Avenue appear to be caused by undersized drainage pipes, shallow drainage pipe slopes constrained by the relatively flat topography in the regional low-lying area, and the several 90-degree pipe bends throughout the existing stormwater infrastructure pathways.

The Township of Teaneck has initiated improvements to the stormwater conveyance system to address the issues identified above. In February 2023, a 30,000-gallon, 9-foot by 4-foot underground culvert was installed at the Belle Avenue and Beverly Road intersection to increase stormwater capacity. Later, in September 2025, an approximately 187,000-gallon underground stormwater detention system was installed beneath Sagamore Park to temporarily store stormwater and allow the existing pipe network additional time to process rainfall runoff.

It is important to note that the existing conditions in the following analysis and modeling account for these improvements. The proposed conditions will present a further improvement to what has already been constructed.

C. HYDROLOGIC AND HYDRAULIC MODELING SUMMARY

An analysis of the drainage system was performed using HEC-RAS 6.6 – 2D Unsteady Flow analysis with Pipe Network. This model requires geometric data of the ground surface, including runoff parameters as well as pipe network. The following summarizes the input information and detailed calculations are included in the Appendix.

Geometry Data:

A 2D mesh was established for the drainage area of the pipe network. The drainage area for the pipe network is approximately 171 acres and extends approximately to Reis Avenue to the north, to Kensington Road and the railroad to the east, Terhune Street to the south, and Linden Avenue, Garrison Avenue, and Trafalgar Street to the west.

The 2D mesh was set globally as a 20’ x 20’ grid with additional grid refinement along the road networks consisting of 3’x3’ grids along the road network that extends approximately 12 feet on each side of the centerline of the roadway. USGS Topographic data was utilized with a 1 meter resolution of the drainage area to establish the topography of the 2D mesh.

The following variables were established for the 2D mesh based on land cover data and aerial imagery, mapping for each variable is included in the Appendix:

Variable	Minimum Value	Maximum Value
Manning’s n	0.02	0.1
Curve Number	30	98
% Impervious	0%	100%

These values were assigned based on values from the HEC-RAS User’s Manual. Note that the initial abstraction was set to 0.2.

In addition to the 2D mesh, a storage area was defined for the recently constructed Sagamore Park underground basin. The storage area provides 0.583 acre-feet of storage and is hydraulically connected to the pipe system in Belle Avenue. The elevation-storage data was obtained from Fastech Consulting Engineers.

A pipe network was also created in the HEC-RAS model which connects the overland flow of the 2D mesh to the pipe system. Township survey information was utilized for size, shape, material, and inverts of the pipe system. In addition manning’s n values were assigned based on pipe material. Inlet structures, junctions, and manholes were assumed to be 4’ x 4’ structures.

Boundary Conditions were established along the perimeter of the drainage area for the discharge of stormwater outside of the study area.

Rainfall Data:

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data for Bergen County was utilized to develop a precipitation hydrograph for the drainage area. The 25-year, 24 hour duration storm event was utilized with a rainfall depth of 6.28 inches. A rainfall distribution was established in 6-minute increments for the entire duration of the storm utilizing the NOAA Type D rainfall distribution.

The rainfall was applied uniformly to the entire drainage area. No other sources of stormwater runoff was introduced to the system.

Time Step and Computation Settings:

A computational interval of 0.1 seconds was established for the model, with an output interval of 5 minutes for Mapping, Hydrograph and Detailed Output. The Diffusion Wave equation was utilized for both the 2D flow and pipe system. The model simulation time was set at 30 hours starting at the beginning of the storm event and extending 6 hours past the end of the storm event.

Existing Conditions:

The model was run with the parameters described above to establish baseline conditions for the drainage area. The results were compared against known impacted locations in the drainage area for validity of the model. It was found that the locations where flooding was historically found were consistent with the model results.

As referenced in Section B above, the Township of Teaneck installed two (2) separate improvements to the stormwater conveyance system. These improvements have been incorporated into the existing conditions model and have not been credited under the proposed conditions to ensure that all proposed improvements will present further benefits beyond what has already been constructed.

Proposed Conditions:

The proposed conditions utilized an iterative process to modify the existing conditions model by supplementing proposed pipe to increase the capacity of the storm network and reduce flooding of the impacted area noted earlier in this report. It was found that a parallel pipe system in the vicinity of the redevelopment area provided a reduction in the depth of flooding in the impacted area. The extent of the proposed improvements include seven proposed parallel pipes extending from the existing underground culvert located at the intersection of Beverly Road and Belle Avenue. The parallel pipping system continues through the Block 819 redevelopment area, across Cedar Lane, and continues along American Legion Drive to the southern limit of the Block 707 redevelopment.

D. DESIGN SUMMARY AND CONCLUSION

Stormwater Conveyance System Pipe Capacity:

The hydrologic and hydraulic model was run using the parameters and proposed improvements described above to establish a parallel pipe system supplementing the existing conveyance infrastructure in the vicinity of the redevelopment area. Under existing conditions, which include the Township of Teaneck's Sagamore Park basin, the stormwater conveyance system's pipe flow is calculated at 5,001.48 cubic feet per second (CFS). In the proposed conditions model, incorporating the Cedar Lane CBD Redevelopment off-site drainage improvements, the stormwater conveyance system achieves a flow rate of 5,755.46 CFS, representing an improvement of 15.10% compared to existing conditions for the 25-year rainfall.

In addition to improving performance during the 25-year storm event, the expanded stormwater conveyance system, including the installation of additional parallel piping, creates additional subsurface storage and flow capacity, allowing the system to temporarily detain and transport higher volumes of runoff during the smaller and more frequent rainfall events. Further, the proposed project is reducing impervious cover on-site. As a result, above-ground flooding volumes and extents are reduced, and overall system capacity is improved.

To demonstrate how a smaller, and more common storm performs in this new system, our office simulated a recent rainfall event, shown in the table below, to provide a real-world example of the reduction in above-ground flooding areas under the proposed improvements. The simulated event corresponds to October 30, 2025 rainfall, and the effectiveness of the proposed improvements is presented as a percentage reduction in the fourth column.

Flood Depth	Existing (SF)	Proposed (SF)	% Reduction in Area
< 0.25	487,713	396,446	18.7%
< 0.50	312,707	190,308	39.1%
< 1.00	237,767	116,681	50.9%
< 3.00	131,241	38,456	70.7%
> 3.00	86	11	87.5%

Table 1. Proposed Drainage Improvement Model (2025 - Halloween Storm)

These upgrades to the stormwater conveyance system increase subsurface storage and overall conveyance capacity, which in turn reduces above-ground flooding volumes and extents throughout a wide range of storm events.

Overall, the expanded conveyance capacity is expected to reduce localized flooding and enhance system performance, specifically related to flow rate, for the 25-year rainfall event as well as smaller and more frequent design storms.

Conclusion:

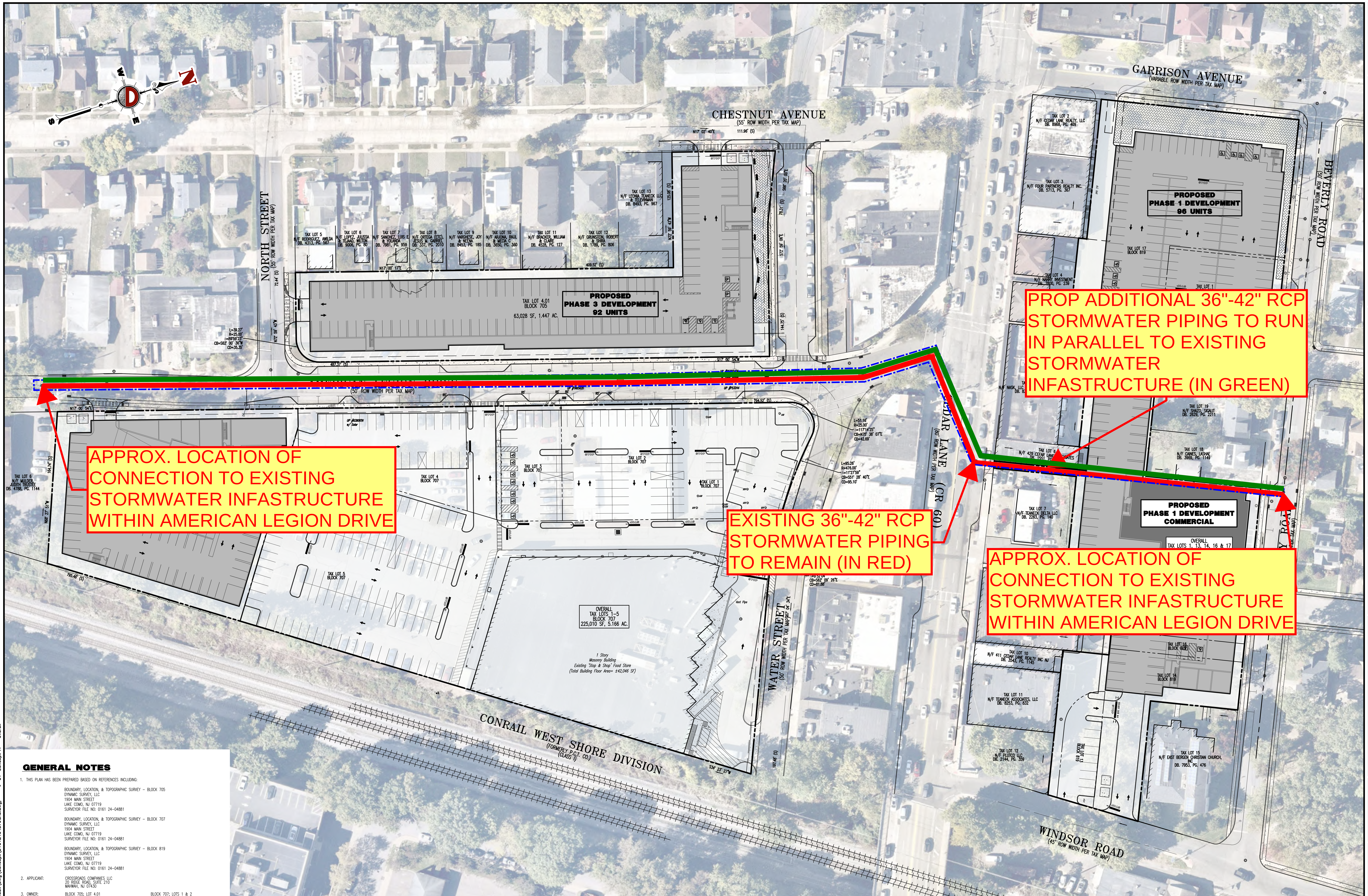
Based on the hydrologic and hydraulic modeling completed for both existing and proposed conditions, the implementation of a parallel pipe system, working in coordination with the existing stormwater conveyance infrastructure, demonstrates clear improvements to stormwater management within the surrounding redevelopment area. The proposed design results in the following key enhancements:

- An increase in system capacity and compliance with the specified performance criteria
- An increase in landscaping and vegetative areas throughout the proposed development
- An increase in the runoff capacity of the stormwater conveyance system
- A reduction in flooding depth in the immediate surrounding Belle Avenue area
- A reduction in impervious and motor vehicle coverage when compared to existing conditions
- Substantial compliance with local and state stormwater management regulations. Specifically , the project will achieve
    - Compliance with NJAC 7:8 Stormwater Runoff Quality Standards (NJAC 7:8-5.5)
    - Compliance with NJAC 7:8 Stormwater Runoff Quantity Standards (NJAC 7:8-5.6)
    - Compliance with NJAC 7:8 Stormwater Runoff Green Infrastructure Standards (NJAC 7:8-5.3)
    - Compliance with NJAC 7:8 Groundwater Recharge Standards (NJAC 7:8-5.4)
    - Compliance with Teaneck Township Stormwater Management Ordinance requirements (§38-3)

The proposed improvements introduce approximately 1,350 LF of parallel pipe extending from Beverly Road through the Block 819 redevelopment area and continuing along American Legion Drive to the Block 707 redevelopment limits. These additions provide extra capacity in the portion where the bottleneck occurs, representing an approximate 15.10% increase during the 25-year rainfall event, and delivers significant performance enhancements during smaller, more frequent storm events. Overall, these improvements effectively improve flooding conditions within Belle Avenue and the immediate vicinity.

APPENDIX

DRAINAGE IMPROVEMENT SKETCH, PREPARED BY DYNAMIC ENGINEERING CONSULTANTS, DATED 12/2025



GENERAL NOTES

1. THIS PLAN HAS BEEN PREPARED BASED ON REFERENCES INCLUDING:

   BOUNDARY, LOCATION, & TOPOGRAPHIC SURVEY – BLOCK 705
   DYNAMIC SURVEY, LLC
   1904 MAIN STREET
   LAKE COMO, NJ 07719
   SURVEYOR FILE NO: 0161 24–04881

   BOUNDARY, LOCATION, & TOPOGRAPHIC SURVEY – BLOCK 707
   DYNAMIC SURVEY, LLC
   1904 MAIN STREET
   LAKE COMO, NJ 07719
   SURVEYOR FILE NO: 0161 24–04881

   BOUNDARY, LOCATION, & TOPOGRAPHIC SURVEY – BLOCK 819
   DYNAMIC SURVEY, LLC
   1904 MAIN STREET
   LAKE COMO, NJ 07719
   SURVEYOR FILE NO: 0161 24–04881

2. APPLICANT: CROSSROADS COMPANIES LLC
   20 RIDGE ROAD, SUITE 210
   MAHWAH, NJ 07430

3. OWNER:
   BLOCK 705; LOT 4.01
   BLOCK 819; LOTS 1, 14, 16–17
   TOWNSHIP OF TEANECK
   818 TEANECK ROAD
   TEANECK, NJ 07666–4599

   BLOCK 707; LOTS 1 & 2
   719 TEANECK LLC
   20 RIDGE ROAD, SUITE 210
   MAHWAH, NJ 07430

   BLOCK 707; LOTS 3 & 4
   C/O AFS–LEASE ACCOUNTING
   PO BOX 6500
   CARLISLE, PA 17013–0902

   BLOCK 707; LOT 5
   NNN TEANECK NJ C/O ENGIE INSIGHT
   PO BOX 2440
   SPOKANE, WA 99210–2440

   BLOCK 819; LOT 13
   TEANECK ASSOCIATES, LLC
   2083 E. 13TH STREET
   BROOKLYN, NY 11229

4. PARCEL DATA: CEDAR LANE, AMERICAN LEGION DRIVE & BEVERLY LANE
   BLOCK 705; LOT 4.01
   BLOCK 707; LOTS 1–5
   BLOCK 819; LOTS 1, 13–14, 16–17
   TOWNSHIP OF TEANECK
   BERGEN COUNTY, NEW JERSEY

5. ZONE: EXISTING:
   B–1 (BUSSINESS–RETAIL) ZONE (BLOCK 819; LOTS 1, 13–14, 16–17)
   B–2 (BUSSINESS–OFFICE) ZONE (BLOCK 705; LOT 4.01 & BLOCK 707; LOTS 1–5)

   PROPOSED: AMERICAN LEGION DRIVE REDEVELOPMENT PLAN

6. THIS PLAN IS INTENDED FOR CONCEPTUAL REVIEW PURPOSES ONLY.
7. THIS PLAN IS NOT DEPICTING ENVIRONMENTAL CONDITIONS OR A CERTIFICATION/WARRANTY REGARDING THE PRESENCE OR ABSENCE OF ENVIRONMENTALLY IMPACTED SITE CONDITIONS. DYNAMIC ENGINEERING CONSULTANTS, PC HAS PERFORMED NO EXPLORATORY OR TESTING SERVICES, INTERPRETATIONS, CONCLUSIONS OR OTHER SITE ENVIRONMENTAL SERVICES RELATED TO THE DETERMINATION OF THE POTENTIAL FOR CHEMICAL, TOXIC, RADIOACTIVE OR OTHER TYPE OF CONTAMINANTS AFFECTING THE PROPERTY AND THE UNDERSIGNED PROFESSIONAL IS NOT QUALIFIED TO DETERMINE THE EXISTENCE OF SAME. SHOULD ENVIRONMENTAL CONTAMINATION OR WASTE BE DISCOVERED, THE OWNER AND CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH ALL APPLICABLE LAWS AND REGULATIONS.
8. DYNAMIC ENGINEERING CONSULTANTS, PC MAKES NO GUARANTEES AS TO THE FINAL YIELD THAT WILL ULTIMATELY BE GRANTED BY THE MUNICIPALITY AND/OR OTHER REVIEWING AGENCIES AT THE END OF THE APPROVAL PROCESS. YIELD IS ULTIMATELY DETERMINED BY MANY FACTORS AMONG THEM ARE LOCAL, POLITICAL ISSUES AND SITE CONDITIONS RELATED TO SOILS, SLOPES, WETLANDS, WATER BODIES, FLOOD PLAINS, ENVIRONMENTAL CONDITIONS, ARCHEOLOGICAL/HISTORIC DISCOVERIES, AVAILABILITY OF UTILITY SERVICES, SITE CONTAMINATION, ETC., WHICH ARE BEYOND THE CONTROL OF THE CONSULTANT.
9. THE DEVELOPMENT YIELD REPRESENTED ON THIS PLAN IS BASED ON LIMITED INFORMATION AND MAY EXCEED ACTUAL BUILD OUT POTENTIAL DUE TO FACTORS INCLUDING BUT NOT LIMITED TO GREEN INFRASTRUCTURE, WATER QUALITY, GROUNDWATER RECHARGE AND OTHER STORMWATER MANAGEMENT REQUIREMENTS. SITE TOPOGRAPHY, SOILS TESTING, SEASONAL HIGH WATER TABLE AND RELATED INFORMATION MUST BE ACQUIRED IN ORDER TO ESTABLISH THE SIZES AND LOCATIONS OF STORMWATER MANAGEMENT FACILITIES THAT WILL BE REQUIRED FOR THIS DEVELOPMENT. ACTUAL DEVELOPMENT YIELD FOR THIS PROPERTY IS SUBJECT TO REDUCTION FROM WHAT IS ILLUSTRATED ON THIS PLAN.

SEE SHEET 4 FOR PHASE 1 GENERAL NOTES

SEE SHEET 2 FOR PHASE 2 GENERAL NOTES

SEE SHEET 3 FOR PHASE 3 GENERAL NOTES

THIS OVERALL CONCEPTUAL PLAN IS FOR SCHEMATIC PURPOSES ONLY

GRAPHIC SCALE
-40 0 20 40 80 160
(IN FEET)
1 INCH = 40 FT.

THE AERIAL IMAGE DEPICTED ON THIS PLAN IS BASED ON IMAGERY FURNISHED BY "NEARMAP, HERE" AND DATED 10/04/24. THE CONDITIONS OF THE SITE AND SURROUNDING AREAS MAY HAVE CHANGED SINCE THE DATE OF AERIAL PHOTOGRAPHY AND THEREFORE THIS PLAN MAY NOT ACCURATELY REFLECT ALL CURRENT EXISTING CONDITIONS.

Plotted: 04/21/25 – 10:26 AM, By: dboyd, – Product Ver: 25.0s (LMS Tech)
File: P:\DECPC PROJECTS\0161 Crossroads Companies LLC\24-04879 Teaneck\Dwg\Concept\D16124048 79CA0.dwg, ---> 01-Concept A – Overall

REV.	DATE	COMMENTS	BY

THIS PLAN SET IS FOR PERMITTING PURPOSES ONLY AND MAY NOT BE USED FOR CONSTRUCTION

DRAWN BY: DJB | DESIGNED BY: ALC | CHECKED BY: JEH | CHECKED BY: –

PROJECT: **CROSSROADS COMPANIES, LLC**
PROPOSED REDEVELOPMENT PLAN
BLOCK 819, LOTS 1, 13–14,16–17; BLOCK 707, LOTS 1–5; BLOCK 705, LOT 4.01
CEDAR LANE, AMERICAN LEGION DRIVE & BEVERLY LANE
TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY

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JAMES E. HENRY
PROFESSIONAL ENGINEER
NEW JERSEY LICENSE No. 49266

BRETT W. S
PROFESSIONAL ENGINEER
NEW JERSEY LICENSE No. 41985

DRAFT

TITLE:
DRAINAGE IMPROVEMENT SKETCH

SCALE: (H) 1"=40' (V)
DATE: 12/2025
PROJECT No: 0161–24–04879
SHEET No: 1 OF 4
Rev. #: 0

CURVE NUMBER, IMPERVIOUS COVERAGE, AND MANNING'S N VALUE MODEL COVERAGE MAPPING

Selected: 'InfiltrationSCS'

Curve Number
0
30
39
46
51
61
70
74
77
80
81
82
83
84
87
89
90
92
93
94
95
98

1000 ft

Selected: 'Final Values'

Percent Impervious

100
90
80
70
60
50
40
30
20
10
0

1000 ft

Selected: 'LandCover (1)'

ManningsN

0.020
0.030
0.030
0.030
0.035
0.035
0.040
0.040
0.040
0.080
0.080
0.080
0.100
0.100
0.100
0.100
0.100
0.100
0.100
0.100
0.100
0.100
0.100

1000 ft

BLOCK 705 AND 707 BOUNDARY LOCATION & TOPOGRAPHIC SURVEY, PREPARED BY DYNAMIC SURVEY, LLC, DATED 03/14/2025, LAST REVISED 04/18/2025

KEY MAP
1" = 2000'

GENERAL NOTES

1. THE LOT AND BLOCK NUMBERS SHOWN ARE BASED ON THE TAX MAP OF THE TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY, SHEET NO. 7 & 8.
2. HORIZONTAL DATUM – NAD 83 (2011), BASED ON GPS FIELD OBSERVATION PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 2025, UTILIZING THE LEICA RTK CORS NETWORK.
3. VERTICAL DATUM – NAVD 88 (GEOID 18), BASED ON GPS FIELD OBSERVATIONS PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 2025, UTILIZING THE LEICA RTK CORS NETWORK.
4. FIELD WORK PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 24, 25, 26 & 27, 2025. THE SITE WAS SNOW COVERED AT THE TIME OF SURVEY AND NOT ALL SITE FEATURES MAY HAVE BEEN VISIBLE AT THE TIME OF SURVEY.
5. A WRITTEN WAIVER AND DIRECTION NOT TO SET PROPERTY CORNERS HAS BEEN OBTAINED FROM THE ULTIMATE USER PURSUANT TO P.L. 2003, C.14 (C45:8-36.3) AND N.J.A.C. 13:40-5.1(D).
6. SUBSURFACE AND ENVIRONMENTAL CONDITIONS WERE NOT EXAMINED OR CONSIDERED AS PART OF THIS SURVEY. NO STATEMENT IS MADE CONCERNING THE EXISTENCE OF UNDERGROUND OR OVERHEAD CONDITIONS THAT MAY AFFECT THE USE OR DEVELOPMENT OF THIS TRACT. PROPERTY IS SUBJECT TO SUB-SURFACE CONDITIONS AND/OR ENCROACHMENTS NOT DISCLOSED BY PUBLIC RECORD, IF ANY.
7. DYNAMIC SURVEY MAKES NO GUARANTEES THAT ALL UTILITIES ARE SHOWN AND THAT THE SHOWN UTILITIES MAY NOT COMPRISE ALL UTILITIES EITHER IN SERVICE OR ABANDONED RELATED TO THE SITE. ANY LOCATIONS SHOWN ARE APPROXIMATE BASED ON VISIBLE STRUCTURES OR UTILITY MARKOUT UNLESS NOTED OTHERWISE. ALL UTILITY LOCATIONS MUST BE VERIFIED WITH THE PROPER UTILITY COMPANIES PRIOR TO ADDITIONAL DESIGN, EXCAVATION OR CONSTRUCTION. CONTACT UTILITIES TOLL FREE 1-800-272-1000.

   THE COLLECTION AND DEPICTION OF THE SUBSURFACE UTILITIES SHOWN HEREON ARE IN ACCORDANCE WITH STANDARD UTILITY QUALITY LEVEL GUIDELINES AS OUTLINED BELOW AND DEPICTED ON THE SURVEY BY LINE TYPES AS SHOWN IN THE DRAWING LEGEND.

   UTILITY QUALITY LEVEL A- HORIZONTAL AND VERTICAL LOCATION OF UTILITIES OBTAINED BY THE ACTUAL EXPOSURE (OR VERIFICATION OF PREVIOUSLY EXPOSED AND SURVEYED UTILITIES) AND SUBSEQUENT MEASUREMENT OF SUBSURFACE UTILITIES, USUALLY AT A SPECIFIC POINT. MINIMALLY INTRUSIVE EXCAVATION EQUIPMENT OR OTHER METHOD(S).

   UTILITY QUALITY LEVEL B- INFORMATION OBTAINED THROUGH THE APPLICATION OF APPROPRIATE SURFACE GEOPHYSICAL METHODS TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF SUBSURFACE UTILITIES. THIS INFORMATION IS SURVEYED AND REDUCED ONTO PLAN DOCUMENTS.

   UTILITY QUALITY LEVEL C- INFORMATION OBTAINED BY SURVEYING AND PLOTTING VISIBLE ABOVE-GROUND UTILITY FEATURES AND BY USING PROFESSIONAL JUDGEMENT IN CORRELATING THIS INFORMATION TO QUALITY LEVEL D INFORMATION.

   UTILITY QUALITY LEVEL D- INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS AND IS NOT FIELD VERIFIED.
8. NOT ALL LOT LINES OUTSIDE THE BOUNDARY OF THE SUBJECT PROPERTY SHOWN HEREON HAVE BEEN FIELD SURVEYED AND ARE SHOWN AS A GRAPHICAL REPRESENTATION OF EXISTING LOT LINES BASED ON DEED, FILED MAPS AND TAX MAP INFORMATION.
9. THIS SURVEY WAS PERFORMED BASED ON A TITLE SEARCH ISSUED BY NJ WORLD TITLE, LLC, TITLE NUMBER: 25NJ-SEARCH, ISSUED: MARCH 21, 2025, TITLE SEARCHED FROM 01/01/1929 TO 01/25/2025.
10. THIS PLAN RELIES UPON THE NOTED TITLE POLICY TO IDENTIFY ALL DOCUMENTS OF RECORD FOR REVIEW IN CONNECTION TO THIS SURVEY.
11. BY GRAPHICAL PLOTTING THE PREMISES IS LOCATED IN ZONE "X" (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) PER FLOOD INSURANCE RATE MAP NUMBER: 34003D0194H, COMMUNITY NAME: TOWNSHIP OF TEANECK, EFFECTIVE DATE: 08/28/2019.
12. NO WETLANDS DELINEATION MARKERS WERE OBSERVED IN THE PROCESS OF CONDUCTING THE FIELDWORK. THE EXISTENCE OR NONEXISTENCE OF WETLANDS OR OPEN WATERS THAT MAY BE REGULATED BY THE STATE OF NEW JERSEY AND/OR THE GOVERNMENT OF THE UNITED STATES IS NOT A PART OF THIS SURVEY.
13. NO ATTEMPT WAS MADE OR LIABILITY IS ASSUMED TO DETERMINE IF ANY PORTION OF THIS PROPERTY IS CLAIMED BY THE STATE OF NEW JERSEY AS TIDELANDS.
14. THE OFFSETS SHOWN ON THIS PLAN SHALL NOT BE USED AS THE BASIS FOR THE CONSTRUCTION OF FENCES OR ANY OTHER PERMANENT STRUCTURES.
15. SUBJECT TO ROAD RIGHT-OF-WAY, ALL EASEMENTS, ORDINANCES, COVENANTS AGREEMENTS AND/OR RESTRICTIONS OF RECORD. PERTINENT DOCUMENTS OF RECORD REVIEWED AND CONSIDERED AS A PART OF THIS SURVEY ARE NOTED HEREON. OTHER DOCUMENTS OF RECORD MAY EXIST THAT WOULD AFFECT THIS PARCEL.
16. ONLY COPIES OF THE ORIGINAL SURVEY WITH AN ORIGINAL LAND SURVEYOR'S EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID COPIES. SIGNATURE AND EMBOSSED SEAL SIGNIFY THAT THIS CERTIFICATION WAS PREPARED IN ACCORDANCE WITH THE EXISTING CODE OF PRACTICE ADOPTED BY THE NJ STATE BOARD OF PROFESSIONAL ENGINEERS AND LAND SURVEYORS. CERTIFICATIONS INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE CERTIFICATION IS PREPARED, AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS. UNAUTHORIZED ALTERATION OR ADDITION TO A CERTIFICATION BEARING A LICENSED LAND SURVEYOR'S SEAL IS ILLEGAL AND PUNISHABLE BY LAW. PROPERTY SUBJECT TO DOCUMENTS OF RECORD.

MAP REFERENCES

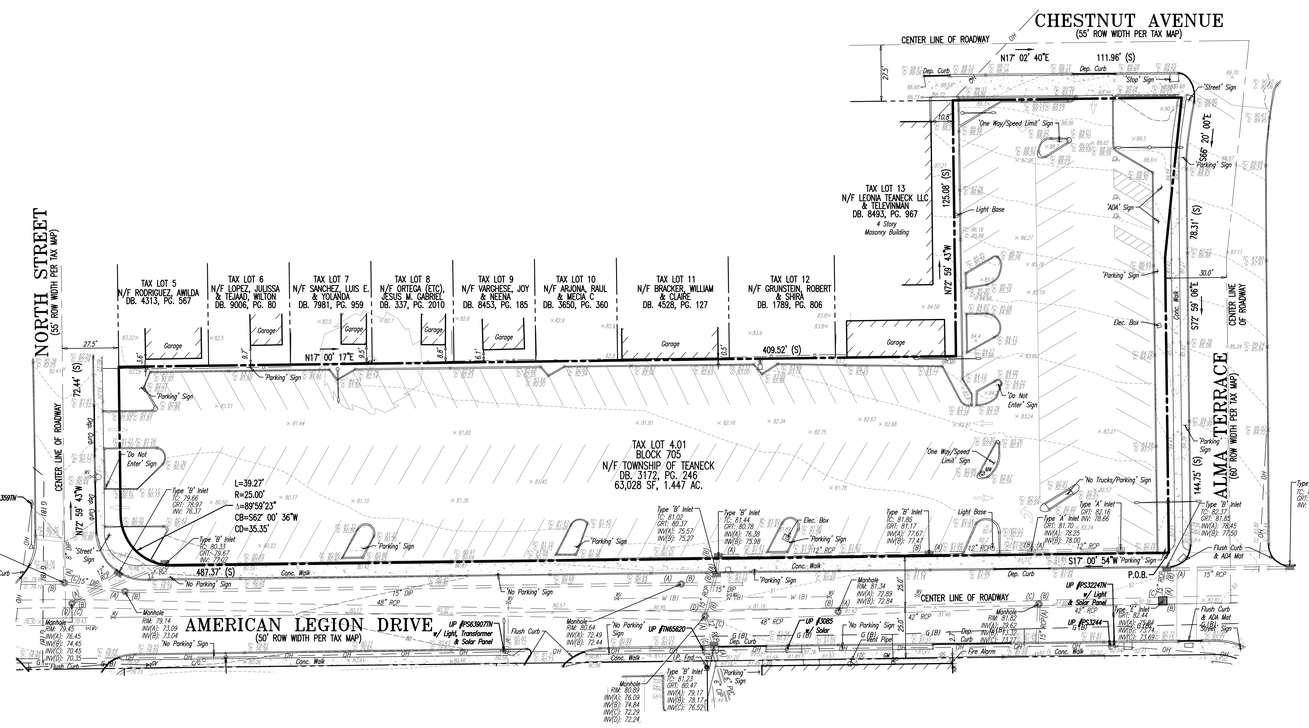
1. A PLAN ENTITLED "COMMUNITY STATE BANK, TOPOGRAPHIC, BOUNDARY SURVEY, BLOCK 819 LOT 9, 16, TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY", PREPARED BY LANGAN, DATED 5/15/96 AND REVISED THROUGH 5/17/96.
2. A PLAN ENTITLED "LOCATION SURVEY, BLOCK 819 – LOT 14, BEVERLY ROAD PARKING LOT FOR TOWNSHIP OF TEANECK, TOWNSHIP OF TEANECK, BERGEN CO., N.J.", PREPARED BY SCHWANEWEDE/HALS ENGINEERING, DATED 3/25/11.

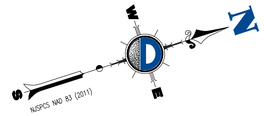
DEED REFERENCES

1. DEED BOOK 7206, PAGE 63 – LOT 1
2. DEED BOOK 8253, PAGE 832 – LOT 13
3. DEED BOOK 3889, PAGE 20 – LOT 14
4. DEED BOOK 7971, PAGE 974 – LOT 16
5. DEED BOOK 5333, PAGE 69 – LOT 17
6. DEED BOOK 8968, PAGE 409 – LOT 2
7. DEED BOOK 5713, PAGE 367 – LOT 3
8. DEED BOOK 7800, PAGE 239 – LOT 4
9. DEED BOOK 8352, PAGE 471 – LOT 5
10. DEED BOOK 2263, PAGE 140 – LOT 7
11. DEED BOOK 7953, PAGE 75 – LOT 9
12. DEED BOOK 8253, PAGE 832 – LOT 11
13. DEED BOOK 2144, PAGE 359 – LOT 12
14. DEED BOOK 7953, PAGE 476 – LOT 15
15. DEED BOOK 3969, PAGE 1149 – LOT 18
16. DEED BOOK 2629, PAGE 2211 – LOT 19
17. DEED BOOK 7867, PAGE 338 – LOT 20

SCHEDULE B - SECTION 2 EXCEPTIONS

NO RESTRICTIONS, GRANTS, EASEMENTS FOUND FOR PERIOD SEARCHED





DYNAMIC ENGINEERING • SURVEY • TRAFFIC

REV.	DATE	COMMENTS	BY
1	04/09/25	TITLE REVIEW	JAB

SURVEY LEGEND:

(MR)	MAP REFERENCE		BENCHMARK
(DR)	DEED REFERENCE		CONC. MONUMENT FND
(S)	SURVEY		CONC. MONUMENT SET
(BOS)	BOTTOM OF STRUCTURE		I.P. / I.B. FND.
(TOS)	TOP OF STRUCTURE		I.P. / I.B. SET
(AKA)	ALSO KNOWN AS		STAKE FND
(FKA)	FORMERLY KNOWN AS		STAKE SET
(C/L)	CENTERLINE		PK NAIL FND
× 0.00	SPOT ELEVATIONS		PK NAIL SET
×G 0.00	GUTTER ELEV.		DRILL HOLE FND
×TC 0.00	TOP OF CURB ELEV.		DRILL HOLE SET
×FF 0.00	FINISH FLOOR ELEV.		SURVEY STONE FND
×GF 0.00	GARAGE FLOOR ELEV.		SURVEY CAP FND
×BW 0.00	BOTTOM OF WALL ELEV.		CROSS CUT FOUND
×TW 0.00	TOP OF WALL ELEV.		CROSS CUT SET
×WSE 0.00	WATER SURFACE ELEV.		TRANSFORMER
	UTILITY POLE	MW	MONITORING WELL
	GUY WIRE	AP	AIR PUMP
	SIGN		FIRE HYDRANT
	SIGN DOUBLE POST	WV	WATER VALVE
	'A'-INLET	WM	WATER METER
	'B'-INLET	GV	GAS VALVE
	'C'-INLET	GM	GAS METER
	'E'-INLET	EM	ELECTRIC METER
	ROUND INLET	EBox	ELECTRIC BOX
	YARD INLET		WELL
	MANHOLE	WSO	CLEAN OUT
	FLARED END SECTION	DS	WATER SHUT OFF VALVE
	HEADWALL	TB	DOWN SPOUT
	DECIDUOUS TREE		TELEPHONE BOX
	EVERGREEN TREE		VALVE UNKNOWN
	SHRUB		EGRESS/INGRESS
	BOLLARD		WETLAND FLAG
	LIGHTED BOLLARD		BORING LOCATION
	LIGHT POLE		TEST PIT LOCATION
	BUILDING LIGHT		MAIL BOX
	SHOE BOX LIGHT		EXCEPTION
	COBRA LIGHT POLE		PARKING STALL COUNT
	TRAFFIC LIGHT	P.O.B.	POINT OF BEGINNING
		LSA	LANDSCAPE AREA

EXISTING MAJOR CONTOUR & ELEVATION	10
EXISTING MINOR CONTOUR & ELEVATION	12
APPROX. LOC. EXIST UNDERGROUND ELECTRIC LINES	E
APPROX. LOC. EXIST UNDERGROUND FIBER OPTIC LINES	FO
APPROX. LOC. EXIST UNDERGROUND GAS LINES	G
APPROX. LOC. EXIST OVERHEAD LINES	OH
APPROX. LOC. EXIST UNDERGROUND FIRE/MAIN LINES	FM
APPROX. LOC. EXIST UNDERGROUND FORCEMAIN LINES	S
APPROX. LOC. EXIST UNDERGROUND SANITARY SEWER LINES	SS
APPROX. LOC. EXIST UNDERGROUND STORM SEWER LINES	T
APPROX. LOC. EXIST UNDERGROUND TELEPHONE LINES	W
APPROX. LOC. EXIST UNDERGROUND WATER LINES	
UNDERGROUND UTILITY QUALITY LEVEL (A) (B) (C) (D)	

GRAPHIC SCALE
−30 0 15 30
(IN FEET)
1 INCH = 30 FT.

DYNAMIC SURVEY, LLC
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HYDROGRAPHIC SURVEY • CONSTRUCTION STAKEOUT
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PROJECT:
CROSSROADS COMPANIES LLC
BLOCK 705, LOT 4.01
AMERICAN LEGION DRIVE & ALMA TERRACE
TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY

JAMES A. CONWAY JR
PROFESSIONAL ENGINEER
No. GS043235
PROFESSIONAL ENGINEER & LICENSED LAND SURVEYOR
NEW JERSEY LICENSE NO. GS43235

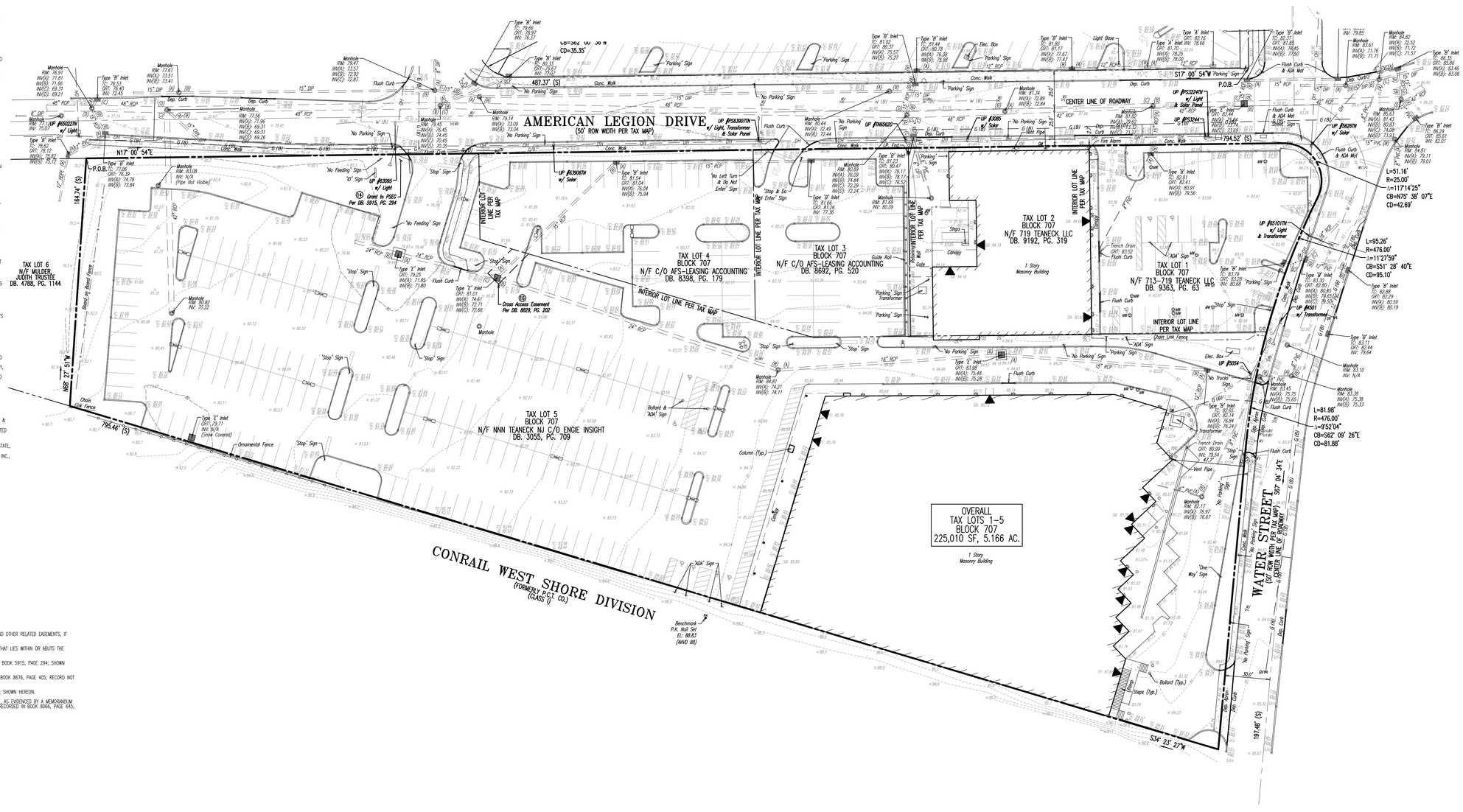
CRAIG BLACK
PROFESSIONAL ENGINEER & LAND SURVEYOR
NEW JERSEY LICENSE No. 24GB04257400

TITLE:
BOUNDARY LOCATION & TOPOGRAPHIC SURVEY

PROJECT No:	SCALE:	DATE:
0161 24-04881	1"=30'	03/14/2025
DRAWN BY: DCR	FIELD BY: CFK/TJP	CHECKED BY: JAC

SHEET No: 1 OF 1
Rev. #: 1

Plotted: 04/18/25 – 12:06 PM, By: jbarnes
File: V:\SURVEY PROJECTS\0161 Crossroads Companies LLC\24-04881 Teaneck\Dwg\0161240488151Y1.dwg, ----> 30x42 Block 705



KEY MAP

1" = 2000'

GENERAL NOTES

1. THE LOT AND BLOCK NUMBERS SHOWN ARE BASED ON THE TAX MAP OF THE TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY, SHEET NO. 7 & 8.
2. HORIZONTAL DATUM – NAD 83 (2011), BASED ON GPS FIELD OBSERVATION PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 2025, UTILIZING THE LEICA RTK CORS NETWORK.
3. VERTICAL DATUM – NAVD 88 (GEOID 18), BASED ON GPS FIELD OBSERVATIONS PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 2025, UTILIZING THE LEICA RTK CORS NETWORK.
4. FIELD WORK PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 24, 25, 26 & 27, 2025. THE SITE WAS SNOW COVERED AT THE TIME OF SURVEY AND NOT ALL SITE FEATURES MAY HAVE BEEN VISIBLE AT THE TIME OF SURVEY.
5. A WRITTEN WAIVER AND DIRECTION NOT TO SET PROPERTY CORNERS HAS BEEN OBTAINED FROM THE ULTIMATE USER PURSUANT TO P.L. 2003, C.14 (C45:8–36.3) AND N.J.A.C. 13:40–5.1(D).
6. SUBSURFACE AND ENVIRONMENTAL CONDITIONS WERE NOT EXAMINED OR CONSIDERED AS PART OF THIS SURVEY. NO STATEMENT IS MADE CONCERNING THE EXISTENCE OF UNDERGROUND OR OVERHEAD CONDITIONS THAT MAY AFFECT THE USE OR DEVELOPMENT OF THIS TRACT. PROPERTY IS SUBJECT TO SUB–SURFACE CONDITIONS AND/OR ENCROACHMENTS NOT DISCLOSED BY PUBLIC RECORD, IF ANY.
7. DYNAMIC SURVEY MAKES NO GUARANTEES THAT ALL UTILITIES ARE SHOWN AND THAT THE SHOWN UTILITIES MAY NOT COMPRISE ALL UTILITIES EITHER IN SERVICE OR ABANDONED RELATED TO THE SITE. ANY LOCATIONS SHOWN ARE APPROXIMATE BASED ON VISIBLE STRUCTURES OR UTILITY MARKOUT UNLESS NOTED OTHERWISE. ALL UTILITY LOCATIONS MUST BE VERIFIED WITH THE PROPER UTILITY COMPANIES PRIOR TO ADDITIONAL DESIGN, EXCAVATION OR CONSTRUCTION. CONTACT UTILITIES TOLL FREE 1–800–272–1000.

   THE COLLECTION AND DEPICTION OF THE SUBSURFACE UTILITIES SHOWN HEREON ARE IN ACCORDANCE WITH STANDARD UTILITY QUALITY LEVEL GUIDELINES AS OUTLINED BELOW AND DEPICTED ON THE SURVEY BY LINE TYPES AS SHOWN IN THE DRAWING LEGEND.

   UTILITY QUALITY LEVEL A: HORIZONTAL AND VERTICAL LOCATION OF UTILITIES OBTAINED BY THE ACTUAL EXPOSURE (OR VERIFICATION OF PREVIOUSLY EXPOSED AND SURVEYED UTILITIES) AND SUBSEQUENT MEASUREMENT OF SUBSURFACE UTILITIES, USUALLY AT A SPECIFIC POINT. MINIMALLY INTRUSIVE EXCAVATION EQUIPMENT OR OTHER METHOD(S).

   UTILITY QUALITY LEVEL B: INFORMATION OBTAINED THROUGH THE APPLICATION OF APPROPRIATE SURFACE GEOPHYSICAL METHODS TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF SUBSURFACE UTILITIES. THIS INFORMATION IS SURVEYED AND REDUCED ONTO PLAN DOCUMENTS.

   UTILITY QUALITY LEVEL C: INFORMATION OBTAINED BY SURVEYING AND PLOTTING VISIBLE ABOVE–GROUND UTILITY FEATURES AND BY USING PROFESSIONAL JUDGEMENT IN CORRELATING THIS INFORMATION TO QUALITY LEVEL D INFORMATION.

   UTILITY QUALITY LEVEL D: INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS AND IS NOT FIELD VERIFIED.
8. NOT ALL LOT LINES OUTSIDE THE BOUNDARY OF THE SUBJECT PROPERTY SHOWN HEREON HAVE BEEN FIELD SURVEYED AND ARE SHOWN AS A GRAPHICAL REPRESENTATION OF EXISTING LOT LINES BASED ON DEED, FILED MAPS AND TAX MAP INFORMATION.
9. THIS SURVEY WAS PERFORMED BASED ON A TITLE COMMITMENT ISSUED BY RIDGE TITLE AGENCY, LLC, TITLE NUMBER: RT–4623, EFFECTIVE COMMITMENT DATE: SEPTEMBER 28, 2022 AND A TITLE COMMITMENT ISSUED BY FIRST AMERICAN TITLE INSURANCE COMPANY, TITLE NUMBER: 5143178–F–NJ–CP–NLS, EFFECTIVE COMMITMENT DATE: MARCH 17, 2023.
10. THIS PLAN RELIES UPON THE NOTED TITLE POLICY TO IDENTIFY ALL DOCUMENTS OF RECORD FOR REVIEW IN CONNECTION TO THIS SURVEY.
11. BY GRAPHICAL PLOTTING THE PREMISES IS LOCATED IN ZONE 'X' (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) PER FLOOD INSURANCE RATE MAP NUMBER: 34003C0194H, COMMUNITY NAME: TOWNSHIP OF TEANECK, EFFECTIVE DATE: 08/28/2019.
12. NO WETLANDS DELINEATION MARKERS WERE OBSERVED IN THE PROCESS OF CONDUCTING THE FIELDWORK. THE EXISTENCE OR NONEXISTENCE OF WETLANDS OR OPEN WATERS THAT MAY BE REGULATED BY THE STATE OF NEW JERSEY AND/OR THE GOVERNMENT OF THE UNITED STATES IS NOT A PART OF THIS SURVEY.
13. NO ATTEMPT WAS MADE OR LIABILITY IS ASSUMED TO DETERMINE IF ANY PORTION OF THIS PROPERTY IS CLAIMED BY THE STATE OF NEW JERSEY AS TIDELANDS.
14. THE OFFSETS SHOWN ON THIS PLAN SHALL NOT BE USED AS THE BASIS FOR THE CONSTRUCTION OF FENCES OR ANY OTHER PERMANENT STRUCTURES.
15. SUBJECT TO ROAD RIGHT–OF–WAY, ALL EASEMENTS, ORDINANCES, COVENANTS AGREEMENTS AND/OR RESTRICTIONS OF RECORD. PERTINENT DOCUMENTS OF RECORD REVIEWED AND CONSIDERED AS A PART OF THIS SURVEY ARE NOTED HEREON. OTHER DOCUMENTS OF RECORD MAY EXIST THAT WOULD AFFECT THIS PARCEL.
16. ONLY COPIES OF THE ORIGINAL SURVEY WITH AN ORIGINAL LAND SURVEYOR'S EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID COPIES. SIGNATURE AND EMBOSSED SEAL SIGNIFY THAT THIS CERTIFICATION WAS PREPARED IN ACCORDANCE WITH THE EXISTING CODE OF PRACTICE ADOPTED BY THE NJ STATE BOARD OF PROFESSIONAL ENGINEERS AND LAND SURVEYORS. CERTIFICATIONS INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE CERTIFICATION IS PREPARED, AND ON HIS BEHALF TO THE TITLE COMPANY, GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON. CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS. UNAUTHORIZED ALTERATION OR ADDITION TO A CERTIFICATION BEARING A LICENSED LAND SURVEYOR'S SEAL IS ILLEGAL AND PUNISHABLE BY LAW. PROPERTY SUBJECT TO DOCUMENTS OF RECORD.

MAP REFERENCES

1. A PLAN ENTITLED 'BOUNDARY & TOPOGRAPHIC SURVEY, CROSSROADS COMPANIES, 713 & 719 AMERICAN LEGION DRIVE, LOTS 1 & 2, BLOCK 707, TEANECK TOWNSHIP, BERGEN COUNTY, STATE OF NEW JERSEY', PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 10/3/2013.
2. A PLAN ENTITLED 'ALTA/ACSM LAND TITLE SURVEY, CROSSROADS COMMERCIAL REAL ESTATE, 713 & 719 AMERICAN LEGION DRIVE, LOTS 1 & 2, BLOCK 707, TEANECK TOWNSHIP, BERGEN COUNTY, STATE OF NEW JERSEY', PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 10/9/06 AND REVISED THROUGH 11/9/06.

DEED REFERENCES

1. DEED BOOK 9363, PAGE 63 – LOT 1
2. DEED BOOK 9192, PAGE 319 – LOT 2
3. DEED BOOK 8692, PAGE 520 – LOT 3
4. DEED BOOK 8398, PAGE 179 – LOT 4
5. DEED BOOK 3055, PAGE 709 – LOT 5
6. DEED BOOK 4788, PAGE 1144 – LOT 6

SCHEDULE B - SECTION 2 EXCEPTIONS

COMMITMENT NO. RT–4623

NO SURVEY RELATED SECTION 2 EXCEPTIONS LISTED.

SCHEDULE B - SECTION 2 EXCEPTIONS

COMMITMENT NO. 5143178–F–NJ–CP–NLS

⑫ RIGHTS OF WAY FOR RAILROAD, SWITCH TRACKS, SPUR TRACKS, RAILWAY FACILITIES AND OTHER RELATED EASEMENTS, IF ANY, ON AND ACROSS THE LAND; RECORD NOT PROVIDED

⑬ SLOPE AND DRAINAGE RIGHTS IN AND TO THAT PORTION OF THE SUBJECT PREMISES THAT LIES WITHIN OR ABUTS THE RAILROAD; RECORD NOT PROVIDED.

⑭ EASEMENT GRANT TO PUBLIC SERVICE ELECTRIC AND GAS COMPANY AS SET FORTH IN BOOK 5915, PAGE 294; SHOWN HEREON.

⑮ DECLARATION OF NOTICE OF CONDITION OF SITE PLAN RESOLUTION AS SET FORTH IN BOOK 8676, PAGE 405; RECORD NOT PROVIDED.

⑯ CROSS ACCESS AND EASEMENT AGREEMENT AS SET FORTH IN BOOK 8829, PAGE 202; SHOWN HEREON.

⑰ TERMS AND CONDITIONS OF A LEASE WITH MAYFAIR SUPER MARKETS, INC., AS TENANT, AS EVIDENCED BY A MEMORANDUM OF LEASE RECORDED IN BOOK 7824, PAGE 204 AND BY A MEMORANDUM OF LEASE RECORDED IN BOOK 8066, PAGE 645; RECORD NOT PROVIDED.

SURVEY LEGEND:

(MR)	MAP REFERENCE	⊕	BENCHMARK
(DR)	DEED REFERENCE	▣	CONC. MONUMENT FND
(S)	SURVEY	■	CONC. MONUMENT SET
(BOS)	BOTTOM OF STRUCTURE	○	I.P. / I.B. FND
(TOS)	TOP OF STRUCTURE	●	I.P. / I.B. SET
(AKA)	ALSO KNOWN AS	☒	STAKE FND
(FKA)	FORMERLY KNOWN AS	■	STAKE SET
(C/L)	CENTERLINE	PK ○	PK NAIL FND
× 0.00	SPOT ELEVATIONS	PK ●	PK NAIL SET
× G: 0.00	GUTTER ELEV.	○	DRILL HOLE FND
× TC: 0.00	TOP OF CURB ELEV.	●	DRILL HOLE SET
× FF: 0.00	FINISH FLOOR ELEV.	♦	SURVEY STONE FND
× GF: 0.00	GARAGE FLOOR ELEV.	●	SURVEY CAP FND
× BW: 0.00	BOTTOM OF WALL ELEV.	✖	CROSS CUT FOUND
× TW: 0.00	TOP OF WALL ELEV.	✖	CROSS CUT SET
× WSE: 0.00	WATER SURFACE ELEV.	T	TRANSFORMER
	UTILITY POLE	MW	MONITORING WELL
▷	GUY WIRE	AIR □	AIR PUMP
	SIGN		FIRE HYDRANT
	SIGN DOUBLE POST	WV ⋈	WATER VALVE
	'A'–INLET	WM ○	WATER METER
	'B'–INLET	GV ⋈	GAS VALVE
	'E'–INLET	GM □	GAS METER
	ROUND INLET	EM □	ELECTRIC METER
	YARD INLET	Elbox □	ELECTRIC BOX
◎	MANHOLE	W	WELL
	FLARED END SECTION	C/O ○	CLEAN OUT
	HEADWALL	WSO ○	WATER SHUT OFF VALVE
	DECIDUOUS TREE	DS ○	DOWN SPOUT
	EVERGREEN TREE	TEL □	TELEPHONE BOX
	SHRUB	VUK ⋈	VALVE UNKNOWN
○	BOLLARD	◀	EGRESS/INGRESS
	LIGHTED BOLLARD	▲	WETLAND FLAG
	LIGHT POLE	⊕	BORING LOCATION
	BUILDING LIGHT	⊞	TEST PIT LOCATION
	SHOE BOX LIGHT		MAIL BOX
	COBRA LIGHT POLE	(#)	EXCEPTION
	TRAFFIC LIGHT	△#	PARKING STALL COUNT
		P.O.B.	POINT OF BEGINNING
		LSA	LANDSCAPE AREA

— — 15 — — EXISTING MAJOR CONTOUR & ELEVATION

– – 12 – – EXISTING MINOR CONTOUR & ELEVATION

— E — APPROX. LOC. EXIST UNDERGROUND ELECTRIC LINES

— FO — APPROX. LOC. EXIST UNDERGROUND FIBER OPTIC LINES

— G — APPROX. LOC. EXIST UNDERGROUND GAS LINES

— OH — APPROX. LOC. EXIST OVERHEAD LINES

— FM — APPROX. LOC. EXIST UNDERGROUND FORCEMAIN LINES

— S — APPROX. LOC. EXIST UNDERGROUND SANITARY SEWER LINES

— SS — APPROX. LOC. EXIST UNDERGROUND STORM SEWER LINES

— T — APPROX. LOC. EXIST UNDERGROUND TELEPHONE LINES

— W — APPROX. LOC. EXIST UNDERGROUND WATER LINES

UNDERGROUND UTILITY QUALITY LEVEL (A) (B) (C) (D)

GRAPHIC SCALE

-30 0 15 30

(IN FEET)
1 INCH = 30 FT.

REV.	DATE	COMMENTS	BY
1	04/08/25	TITLE REVIEW	JAB

DYNAMIC
• ENGINEERING • EARTH
• SURVEY • TRAFFIC

DYNAMIC
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PROJECT:
CROSSROADS
COMPANIES LLC
BLOCK 707, LOTS 1, 2, 3, 4 & 5
AMERICAN LEGION DRIVE & WATER STREET
TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY

JAMES A. CONWAY JR
No. GS043235
PROFESSIONAL LAND SURVEYOR
NEW JERSEY LICENSE No. 43235

CRAIG BLACK
PROFESSIONAL ENGINEER & LAND SURVEYOR
NEW JERSEY LICENSE No. 24GB04257400

TITLE:
BOUNDARY LOCATION & TOPOGRAPHIC SURVEY

PROJECT No:	SCALE:	DATE:
0161 24–04881	1"=30'	03/14/2025
DRAWN BY: DCR	FIELD BY: CFK/TJP	CHECKED BY: JAC

SHEET No: 1 OF 1

Rev. #: 1

Plotted: 04/18/25 – 12:06 PM, By: jbarnes
File: V:\DSURVEY PROJECTS\0161 Crossroads Companies LLC\24–04881 Teaneck\Dwg\016124048815V1.dwg, ---> 30x42 Block 707

BLOCK 819 BOUNDARY LOCATION & TOPOGRAPHIC SURVEY, PREPARED BY DYNAMIC SURVEY, LLC, DATED 03/14/2025, LAST REVISED 01/06/2026

KEY MAP
1" = 2000'

GENERAL NOTES

1. THE LOT AND BLOCK NUMBERS SHOWN ARE BASED ON THE TAX MAP OF THE TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY, SHEET NO. 17 & 8.
2. HORIZONTAL DATUM – NAD 83 (2011), BASED ON GPS FIELD OBSERVATION PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 2025, UTILIZING THE LEICA RTK CORS NETWORK.
3. VERTICAL DATUM – NAVD 88 (GEOID 18), BASED ON GPS FIELD OBSERVATIONS PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 2025, UTILIZING THE LEICA RTK CORS NETWORK.
4. FIELD WORK PERFORMED BY DYNAMIC SURVEY ON FEBRUARY 19, 24, 25, 26 & 27, 2025. THE SITE WAS SNOW COVERED AT THE TIME OF SURVEY AND NOT ALL SITE FEATURES MAY HAVE BEEN VISIBLE AT THE TIME OF SURVEY.
5. A WRITTEN WAIVER AND DIRECTION NOT TO SET PROPERTY CORNERS HAS BEEN OBTAINED FROM THE ULTIMATE USER PURSUANT TO P.L. 2003, C.14 (C45:8-36.3) AND N.J.A.C. 13:40-5.1(D).
6. SUBSURFACE AND ENVIRONMENTAL CONDITIONS WERE NOT EXAMINED OR CONSIDERED AS PART OF THIS SURVEY. NO STATEMENT IS MADE CONCERNING THE EXISTENCE OF UNDERGROUND OR OVERHEAD CONDITIONS THAT MAY AFFECT THE USE OR DEVELOPMENT OF THIS TRACT. PROPERTY IS SUBJECT TO SUB-SURFACE CONDITIONS AND/OR ENCROACHMENTS NOT DISCLOSED BY PUBLIC RECORD, IF ANY.
7. DYNAMIC SURVEY MAKES NO GUARANTEES THAT ALL UTILITIES ARE SHOWN AND THAT THE SHOWN UTILITIES MAY NOT COMPRISE ALL UTILITIES EITHER IN SERVICE OR ABANDONED RELATIVE TO THE SITE. ANY LOCATIONS SHOWN ARE APPROXIMATE BASED ON VISIBLE STRUCTURES OR UTILITY MARKOUT UNLESS NOTED OTHERWISE. ALL UTILITY LOCATIONS MUST BE VERIFIED WITH THE PROPER UTILITY COMPANIES PRIOR TO ADDITIONAL DESIGN, EXCAVATION OR CONSTRUCTION. CONTACT UTILITIES TOLL FREE 1-800-272-1000.

   THE COLLECTION AND DEPICTION OF THE SUBSURFACE UTILITIES SHOWN HEREON ARE IN ACCORDANCE WITH STANDARD UTILITY QUALITY LEVEL GUIDELINES AS OUTLINED BELOW AND DEPICTED ON THE SURVEY BY LINE TYPES AS SHOWN IN THE DRAWING LEGEND.

   UTILITY QUALITY LEVEL A: HORIZONTAL AND VERTICAL LOCATION OF UTILITIES OBTAINED BY THE ACTUAL EXPOSURE (OR VERIFICATION OF PREVIOUSLY EXPOSED AND SURVEYED UTILITIES) AND SUBSEQUENT MEASUREMENT OF SUBSURFACE UTILITIES, USUALLY AT A SPECIFIC POINT. MINIMALLY INTRUSIVE EXCAVATION EQUIPMENT OR OTHER METHOD(S).

   UTILITY QUALITY LEVEL B: INFORMATION OBTAINED THROUGH THE APPLICATION OF APPROPRIATE SURFACE GEOPHYSICAL METHODS TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF SUBSURFACE UTILITIES. THIS INFORMATION IS SURVEYED AND REDUCED ONTO PLAN DOCUMENTS.

   UTILITY QUALITY LEVEL C: INFORMATION OBTAINED BY SURVEYING AND PLOTTING VISIBLE ABOVE-GROUND UTILITY FEATURES AND BY USING PROFESSIONAL JUDGEMENT IN CORRELATING THIS INFORMATION TO QUALITY LEVEL D INFORMATION.

   UTILITY QUALITY LEVEL D: INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS AND IS NOT FIELD VERIFIED.
8. NOT ALL LOT LINES OUTSIDE THE BOUNDARY OF THE SUBJECT PROPERTY SHOWN HEREON HAVE BEEN FIELD SURVEYED AND ARE SHOWN AS A GRAPHICAL REPRESENTATION OF EXISTING LOT LINES BASED ON DEED, FILED MAPS AND TAX MAP INFORMATION.
9. THIS SURVEY WAS PERFORMED BASED ON A TITLE SEARCH ISSUED BY NJ WORLD TITLE LLC, TITLE NUMBER: 25NJ–SEARCH, ISSUED: MARCH 24, 2025, TITLE SEARCHED 01/01/1926 TO 01/25/2005.
10. THIS PLAN RELIES UPON THE NOTED TITLE POLICY TO IDENTIFY ALL DOCUMENTS OF RECORD FOR REVIEW IN CONNECTION TO THIS SURVEY.
11. BY GRAPHICAL PLOTTING THE PREMISES IS LOCATED IN ZONE "X" (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) PER FLOOD INSURANCE RATE MAP NUMBER: 34003C0219H, COMMUNITY NAME: TOWNSHIP OF TEANECK, EFFECTIVE DATE: 08/28/2019.
12. NO WETLANDS DELINEATION MARKERS WERE OBSERVED IN THE PROCESS OF CONDUCTING THE FIELDWORK. THE EXISTENCE OR NONEXISTENCE OF WETLANDS OR OPEN WATERS THAT MAY BE REGULATED BY THE STATE OF NEW JERSEY AND/OR THE GOVERNMENT OF THE UNITED STATES IS NOT A PART OF THIS SURVEY.
13. NO ATTEMPT WAS MADE OR LIABILITY IS ASSUMED TO DETERMINE IF ANY PORTION OF THIS PROPERTY IS CLAIMED BY THE STATE OF NEW JERSEY AS TIDELANDS.
14. THE OFFSETS SHOWN ON THIS PLAN SHALL NOT BE USED AS THE BASIS FOR THE CONSTRUCTION OF FENCES OR ANY OTHER PERMANENT STRUCTURES.
15. SUBJECT TO ROAD RIGHT-OF-WAY, ALL EASEMENTS, ORDINANCES, COVENANTS AGREEMENTS AND/OR RESTRICTIONS OF RECORD, PERTINENT DOCUMENTS OF RECORD REVIEWED AND CONSIDERED AS A PART OF THIS SURVEY ARE NOTED HEREON. OTHER DOCUMENTS OF RECORD MAY EXIST THAT WOULD AFFECT THIS PARCEL.
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MAP REFERENCES

1. A PLAN ENTITLED "COMMUNITY STATE BANK, TOPOGRAPHIC, BOUNDARY SURVEY, BLOCK 819 LOT 9, 16, TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY", PREPARED BY LANGAN, DATED 5/15/96 AND REVISED THROUGH 5/17/96.
2. A PLAN ENTITLED "LOCATION SURVEY, BLOCK 819 – LOT 14, BEVERLY ROAD PARKING LOT FOR TOWNSHIP OF TEANECK, TOWNSHIP OF TEANECK, BERGEN CO., N.J.", PREPARED BY SCHWANEWEDE/HALS ENGINEERING, DATED 3/25/11.

DEED REFERENCES

1. DEED BOOK 7206, PAGE 63 – LOT 1
2. DEED BOOK 8253, PAGE 832 – LOT 13
3. DEED BOOK 3889, PAGE 20 – LOT 14
4. DEED BOOK 7971, PAGE 974 – LOT 16
5. DEED BOOK 5333, PAGE 69 – LOT 17
6. DEED BOOK 8968, PAGE 409 – LOT 2
7. DEED BOOK 5713, PAGE 367 – LOT 3
8. DEED BOOK 7800, PAGE 239 – LOT 4
9. DEED BOOK 8352, PAGE 471 – LOT 5
10. DEED BOOK 2263, PAGE 140 – LOT 7
11. DEED BOOK 7953, PAGE 75 – LOT 9
12. DEED BOOK 8253, PAGE 832 – LOT 11
13. DEED BOOK 2144, PAGE 359 – LOT 12
14. DEED BOOK 7953, PAGE 476 – LOT 15
15. DEED BOOK 3969, PAGE 1149 – LOT 18
16. DEED BOOK 2629, PAGE 2211 – LOT 19
17. DEED BOOK 7867, PAGE 338 – LOT 20

SCHEDULE B - SECTION 2 EXCEPTIONS

(1) SUBJECT TO TERMS, CONDITIONS, DECLARATIONS, COVENANTS, AGREEMENTS, RESTRICTIONS, RESERVATIONS, EXCEPTIONS, REVERSIONS, EASEMENTS, SETBACKS, GRANTS, RIGHTS OF WAY(S), MAPS AND DRAWINGS CONTAINED AND/OR SET FORTH IN

A. DEED BOOK 1291, PAGE 26 ET SEQ.; UNABLE TO DETERMINE LOCATION,
B. DEED BOOK 1158, PAGE 661, ET SEQ.; NOT SURVEY RELATED,
C. DEED BOOK 1449, PAGE 518 ET SEQ.; SHOWN HEREON,
D. DEED BOOK 1449, PAGE 521, ET SEQ.; SHOWN HEREON,
E. DEED BOOK 1565, PAGE 338 ET SEQ.; SHOWN HEREON,
F. DEED BOOK 1786, PAGE 601, ET SEQ.; SHOWN HEREON,
G. DEED BOOK 2596, PAGE 164 ET SEQ.; SHOWN HEREON,
H. DEED BOOK 2960, PAGE 129, ET SEQ.; SHOWN HEREON,
I. DEED BOOK 2991, PAGE 372 ET SEQ.; SHOWEN HEREON,
J. DEED BOOK 3044, PAGE 451, ET SEQ.; NOT SURVEY RELATED,
K. DEED BOOK 3422, PAGE 315 ET SEQ.; DOCUMENT NOT PROVIDED,
L. DEED BOOK 3422, PAGE 319 ET SEQ.; SHOWN HEREON,
M. DEED BOOK 3506, PAGE 507 ET SEQ.; RIGHT OF INGRESS AND EGRESS, BLANKET IN NATURE,
N. DEED BOOK 3539, PAGE 154 ET SEQ.; REFERENCED DOCUMENTS ARE ADDRESSED DIRECTLY BY OTHER DOCUMENTS. RIGHTS IN STORM SEWER CROSSING PROPERTY, INSUFFICIENT INFORMATION; UNABLE TO DETERMINE LOCATION,
O. DEED BOOK 3554, PAGE 193 ET SEQ.; NOT SURVEY RELATED.

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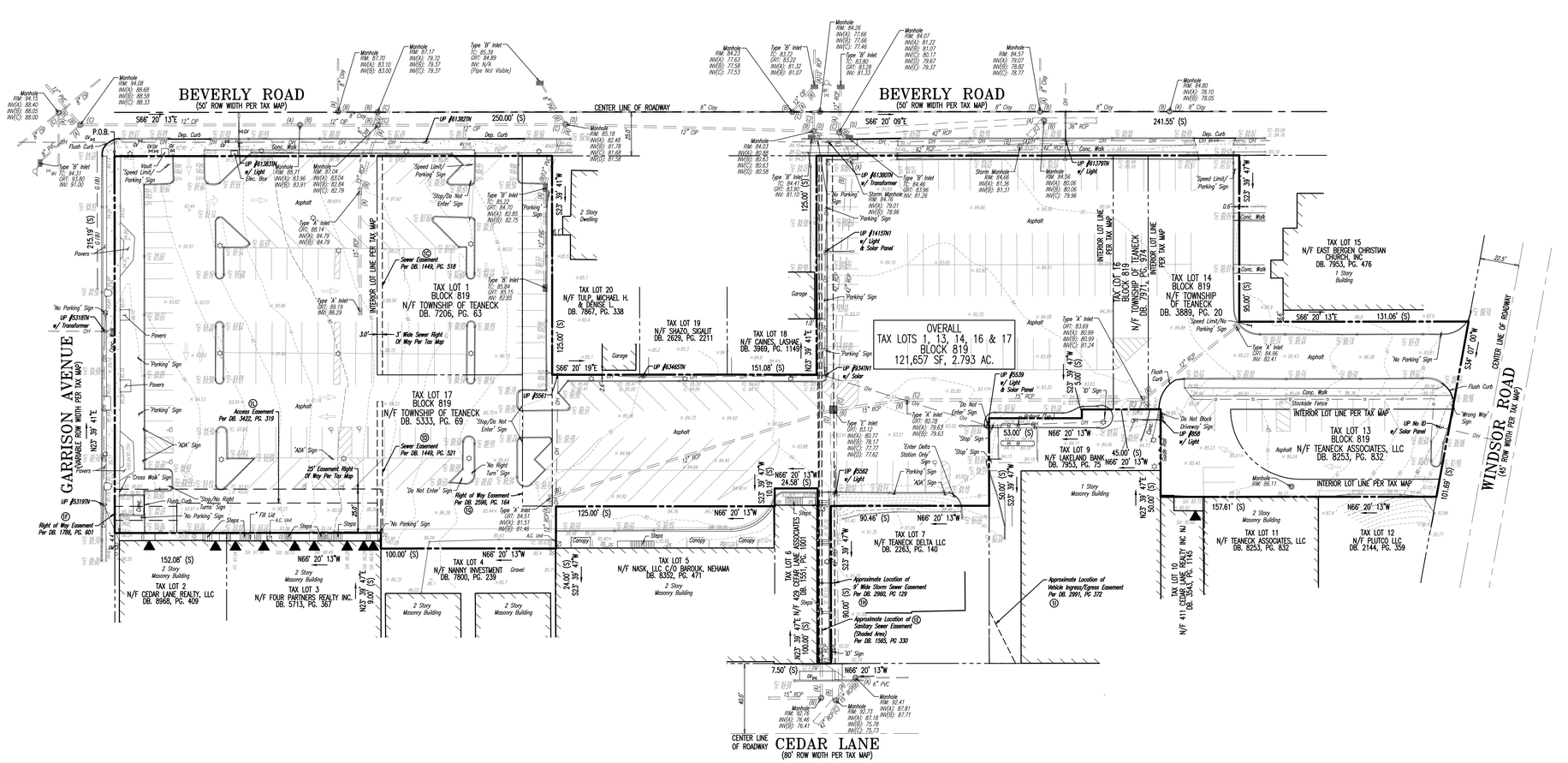

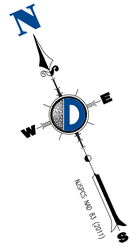

DYNAMIC ENGINEERING
SURVEY • TRAFFIC

BY	REV.	DATE	COMMENTS
DCR	5	01/06/26	REVISED BOUNDARY, MAP
JRS	4	06/05/25	REVISED TO CORRECT INVERT ELEVATIONS
TRB	3	05/13/25	EASEMENTS PLOTTED PER ADDITIONAL RESEARCH
JAB	2	05/14/25	EASEMENTS SHOWN PER ADDITIONAL RESEARCH
JAB	1	04/08/25	TITLE REVIEW

SURVEY LEGEND:

(MR)	MAP REFERENCE		BENCHMARK
(DR)	DEED REFERENCE		CONC. MONUMENT FND
(S)	SURVEY		CONC. MONUMENT SET
(BOS)	BOTTOM OF STRUCTURE		I.P. / I.B. FND.
(TOS)	TOP OF STRUCTURE		I.P. / I.B. SET
(AKA)	ALSO KNOWN AS		STAKE FND
(FKA)	FORMERLY KNOWN AS		STAKE SET
(C/L)	CENTERLINE		PK NAIL FND
× 0.00	SPOT ELEVATIONS		PK NAIL SET
× 0.00	GUTTER ELEV.		DRILL HOLE FND
× 0.00	TOP OF CURB ELEV.		DRILL HOLE SET
× 97.00	FINISH FLOOR ELEV.		SURVEY STONE FND
×GF 0.00	GARAGE FLOOR ELEV.		SURVEY CAP FND
×BM 0.00	BOTTOM OF WALL ELEV.		CROSS CUT FOUND
×TW 0.00	TOP OF WALL ELEV.		CROSS CUT SET
×WSE 0.00	WATER SURFACE ELEV.		TRANSFORMER
	UTILITY POLE		MONITORING WELL
	GUY WIRE		AIR PUMP
	SIGN		FIRE HYDRANT
	SIGN DOUBLE POST		WATER VALVE
	'A'–INLET		WATER METER
	'B'–INLET		GAS VALVE
	'C'–INLET		GAS METER
	ROUND INLET		ELECTRIC METER
	YARD INLET		ELECTRIC BOX
	MANHOLE		WELL
	FLARED END SECTION		CLEAN OUT
	HEADWALL		WATER SHUT OFF VALVE
	DECIDUOUS TREE		DOWN SPOUT
	EVERGREEN TREE		TELEPHONE BOX
	SHRUB		VALVE UNKNOWN
	BOLLARD		EGRESS/INGRESS
	LIGHTED BOLLARD		WETLAND FLAG
	LIGHT POLE		BORING LOCATION
	BUILDING LIGHT		TEST PIT LOCATION
	SHOE BOX LIGHT		MAIL BOX
			EXCEPTION
			PARKING STALL COUNT
		P.O.B.	POINT OF BEGINNING
		LSA	LANDSCAPE AREA
			GRAPHIC LIGHT
			COBRA LIGHT POLE
			SHOE BOX LIGHT

GRAPHIC SCALE
–30 0 15 30
(IN FEET)
1 INCH = 30 FT.

DYNAMIC SURVEY, LLC
BOUNDARY & TOPOGRAPHIC SURVEY • FINAL SURVEYS
HYDROGRAPHIC SURVEY • CONSTRUCTION STAKEOUT
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Lake Como, NJ 07719
T: 732.749.8780 | F: 732.974.3521
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PROJECT:
CROSSROADS COMPANIES LLC
BLOCK 819, LOTS 1, 13, 14, 16 & 17
BEVERLY ROAD & GARRISON AVENUE
TOWNSHIP OF TEANECK, BERGEN COUNTY, NEW JERSEY

JAMES A. CONWAY JR
No. GS0043235
PROFESSIONAL LAND SURVEYOR
NEW JERSEY LICENSE NO. GS0043235

CRAIG BLACK
PROFESSIONAL ENGINEER & LAND SURVEYOR
NEW JERSEY LICENSE No. 24GB04257400

TITLE:
BOUNDARY LOCATION & TOPOGRAPHIC SURVEY

PROJECT No:	SCALE:	DATE:
0161 24-04881	1"=30'	03/14/2025
DRAWN BY: DCR	FIELD BY: CFK/TJP	CHECKED BY: JAC

SHEET No: 1 OF 1 Rev. #: 5

Plotted: 01/06/26 – 4:26 PM, By: dregula
File: V:\SURVEY PROJECTS\0161 Crossroads Companies LLC\24-04881 Teaneck\Dwg\0161240488191S5.dwg, ----> 30x42 Block 819

BELLE AVENUE AREA DRAINAGE STUDY, PREPARED BY THE TOWNSHIP OF TEANECK, DATED 04/05/2022

Belle Avenue Area Drainage Study

Preliminary Report

Dean B. Kazinci, CPM CHR
Township Manager

Township of Teaneck
Engineering Department

Farah Gilani P.E. P.P. C.M.E.
Township Engineer

April 5th, 2022

Introduction

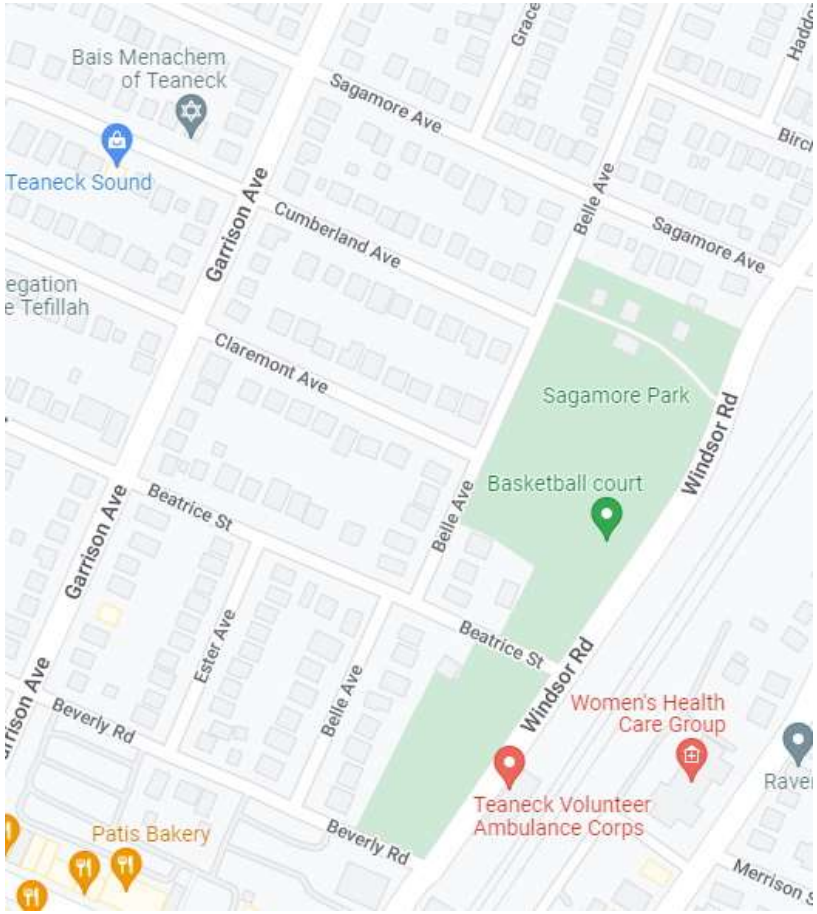
- There are drainage complaints in the area of Belle Ave/Beatrice Street and Belle Ave/Beverly Road and street flooding was reported during tropical storm Ida in 2021.
- The Township had a meeting with residents of the impacted area in second week of October 2021 and initiated this drainage study.
- The purpose of this draft presentation is to provide a brief update of the findings and conceptual recommendations to address the drainage issues. A final report will be issued which will provide a complete, detailed analysis and recommendations
- This stage of the project is not for the purpose of construction, but rather to provide the Township with an understanding of the existing conditions, proposed remedies, and ballpark costs for the proposed improvements.

Belle Ave Drainage Area

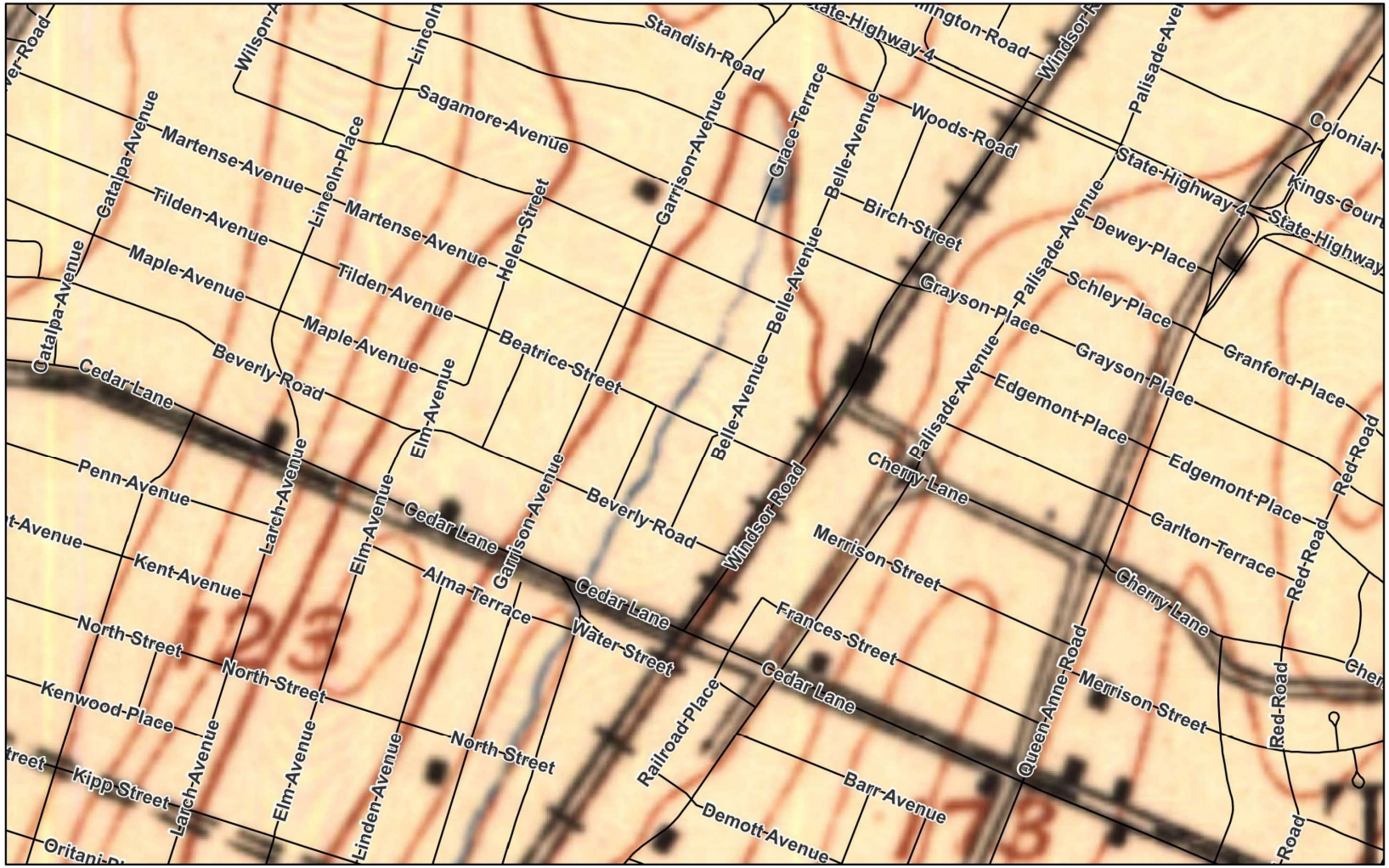
Belle Avenue Drainage Area
Consists of approximately
175 Acres of Land

Study Objective

- Although the total drainage area is approximately 175 acres, the study is focused on the areas where frequent flooding is reported.
- The existing piping network throughout the drainage basin is undersized and is unable to convey the storm water from the 25 years or the 100 year storm events. But fixing the whole piping network will be cost prohibitive.



NJ-GeoWeb


Standish-Road
Sagamore-Avenue
Martense-Avenue
Tilden-Avenue
Maple-Avenue
Beverly-Road
Cedar Lane
Penn-Avenue
Kent-Avenue
North-Street
Kenwood-Place
Kipp Street
Alma-Terrace
Water-Street
Beatrice-Street
Helen-Street
Lincoln-Place
Catalpa-Avenue
Larch-Avenue
Elm-Avenue
Linden-Avenue
Garrison-Avenue
Grace-Terrace
Belle-Avenue
Windsor Road
Railroad-Place
Barr-Avenue
Demott-Avenue
Woods-Road
Birch-Street
Grayson-Place
Dewey-Place
Schley-Place
Granford-Place
Edgemont-Place
Garlton-Terrace
Cherry Lane
Merrison-Street
Frances-Street
Palisade-Avenue
Queen-Anne-Road
Red-Road
State-Highway-4
Kings-Court
Colonial-

Tasks Completed

- A detailed topographic survey of the area was carried out
- An inventory of existing drainage facilities within the study area (confirmed pipe sizes, material, inverts/slopes, alignments, configurations etc.) was developed.
- Using the existing topography and existing drainage inventory, a baseline hydraulic model to analyze how the system performs under existing conditions was prepared.
- Impacted residents were surveyed to cross check computer model with actual experience
- A number of alternative drainage combinations were created and hydraulic analysis was done to come up with recommendations that will improve the flooding situation.

Existing Conditions

- There is a 36” drainage pipe running from Sagamore Avenue to Beverly Road
- There is almost no slope in this pipe from Belle Avenue to Beverly Road severely due to topology of the area impeding conveyance capability of this pipe
- Feeding pipes are directly connected to the main pipe without any structure causing hydraulic pressure in an uncontrolled fashion
- It has a number of 12” pipes feeding into it along the way
- It takes a sharp 90 degree turn on Beverly Road and another sharp 90 degree turn on Beverly Road Parking lot while converting into a 42” pipe
- Another 12” pipe merges into the main pipe at this juncture

Existing Conditions

Hydraulic Issues – Abrupt Alignment Changes

- Water flow within a pipe network can be easily compared to cars travelling along a highway – consider Route 78…
  - If the Department of Transportation were to construct a 90-degree bend in the middle of the free-flowing highway, there would be a significant traffic delay, as people apply the breaks to make the hard turn - this can be compared to water being forced to slow down in a pipe network.
  - However, unlike brakes slowing down a car, the rain cannot be stopped. As such, when the water is forced to slow down when making an abrupt deflection in the alignment, it will take the path of least resistance, which is often vertically.
  - This means that the water level is forced to rise, which can lead to stormwater surcharging above the rim of an inlet or manhole, and lead to flooding.

Hydraulic Issues – Undersized Pipes

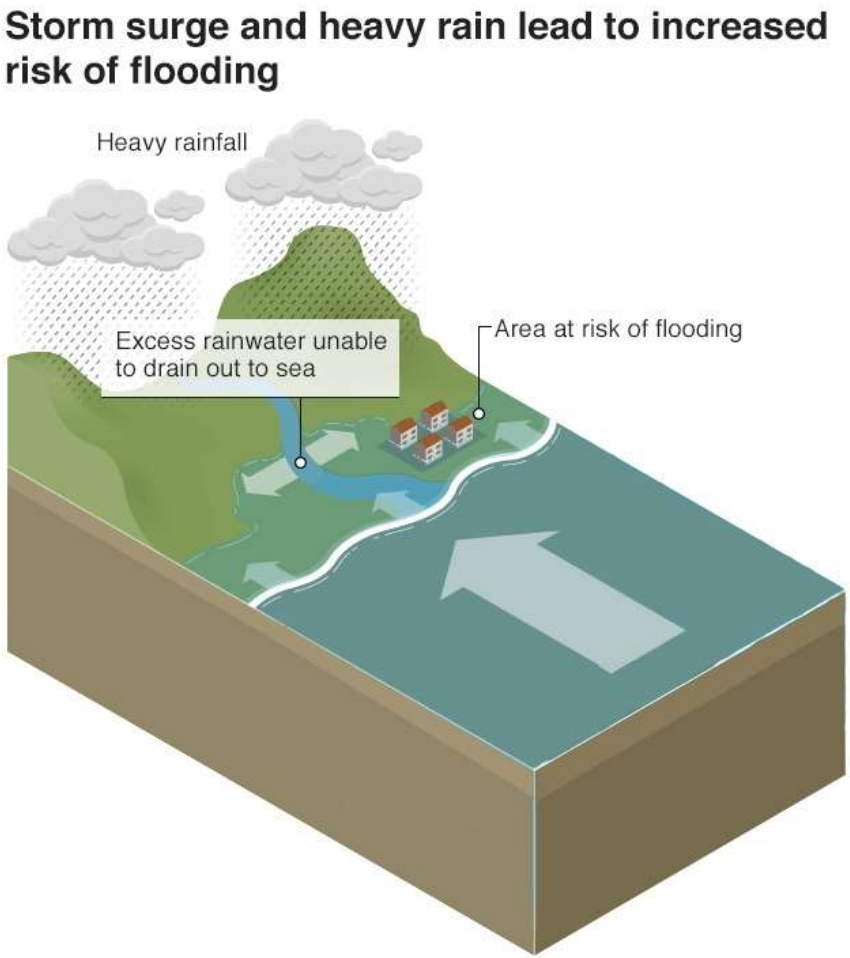
- Water flow within a pipe network can be easily compared to cars travelling along a highway – consider Route 78…
  - If the Department of Transportation merges multiple two-lane highways into a single two-lane highway, traffic flow would be severely impeded, leading to backups.
  - Similarly, an undersized drainage pipe will only permit a certain amount of flow through it, despite however much rain continues to fall. This wall cause water levels within the system to rise, surcharging water, forcing water to find alternate paths down the slope.
  - It should be noted that the engineering design standards likely in effect when the systems were constructed were not necessarily comparable to those of current practice. Additionally, the watershed itself may have been significantly more pervious, consisting of woods and open space rather than paved roads and driveways, houses, patios, etc., all of which contribute to additional stormwater runoff entering the drainage systems.
  - Current and future developments are held to much higher engineering standards related to stormwater than those even prior to 2004. Most development projects are often required to provide detention in order to reduce post-construction peak runoff rates below pre-construction runoff rates (N.J.A.C. 7:8, updated)

Hydraulic Issues – Lack of Slope

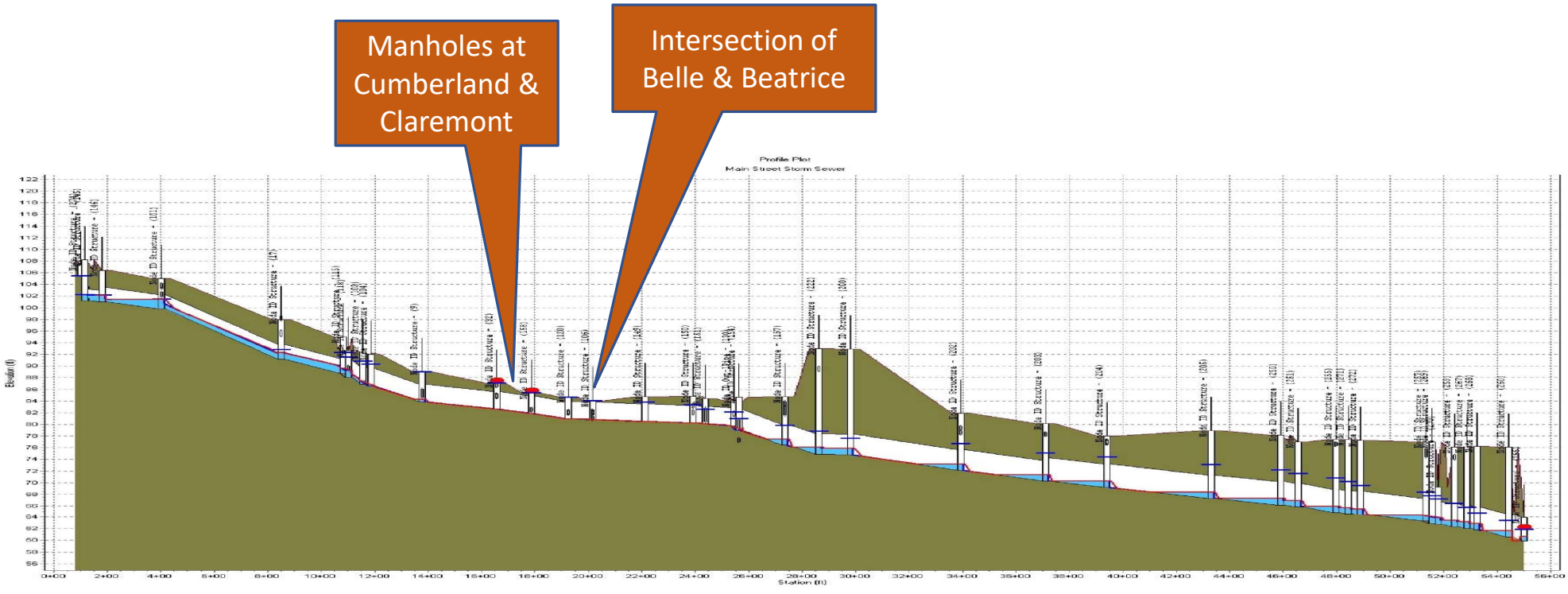
- Continuing on the same traffic flow analogy, slope adds velocity to the water flow…
  - If you happen to have a few large tractor trailers on a highway moving very slowly, traffic flow along the highway will be severely impeded, leading to backups
  - Due to very flat placement of the main drainage pipe, the conveyance velocity slows down as water volume increases. It means water level is forced to rise in upstream structures, which can lead to stormwater surcharging above the rim of an inlet or manhole, and lead to flooding.

Hydraulic Issues – Challenging Topology

- Belle Avenue and Beatrice Street is a low laying area and the topology is like a bowl with the bottom of the bowl at the intersection. In case of excessive rain in a short time, all surcharged water rushes towards this intersection causing immediate flooding.



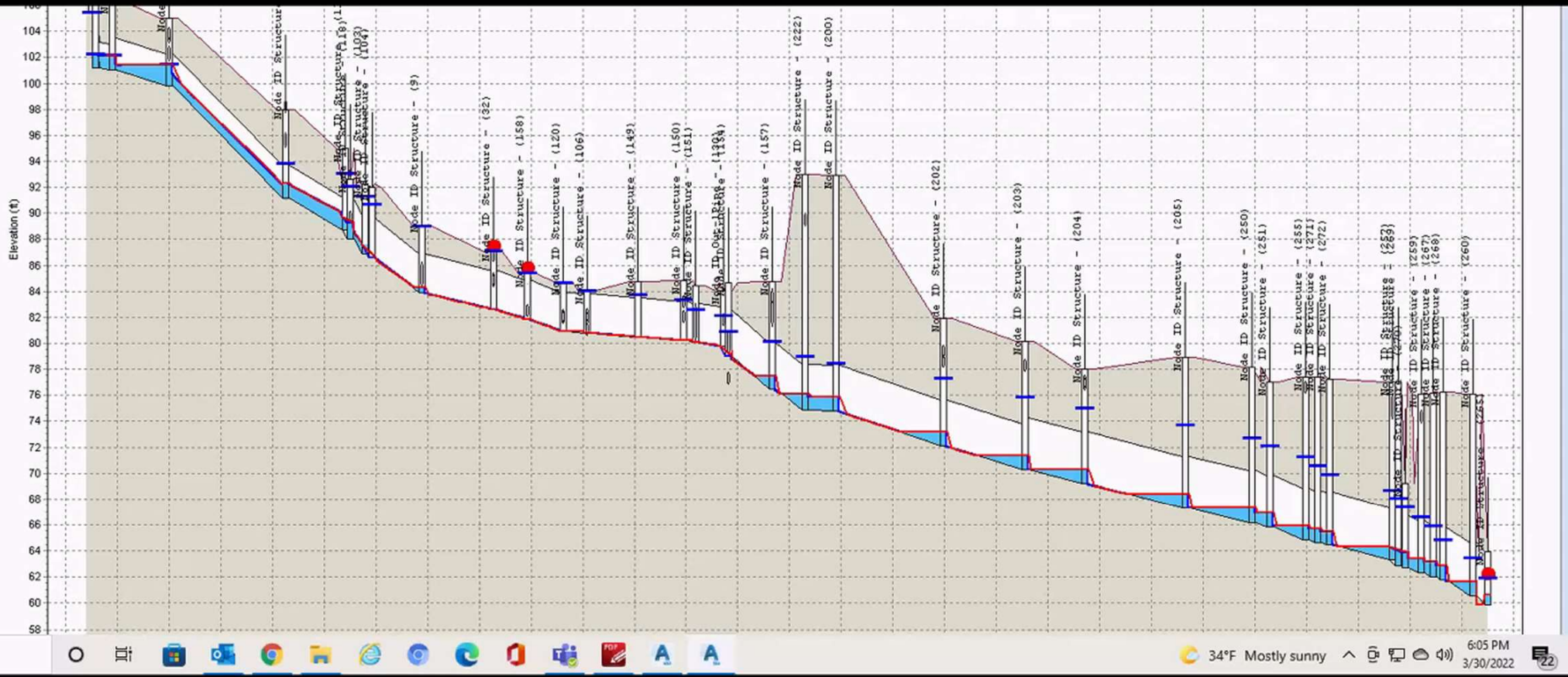
Resident's Feedback



Existing Condition - Analysis

Autodesk Storm and Sanitary Analysis

Existing Condition Simulation



Storm Events – Design Consideration

- Storm frequency for design consideration relates to a probability of a given design storm being met or exceeded in a given time period:
  - A 100-year storm has a 1/100 (1%) chance of occurring once per year.
  - A 25-year storm has a 4% chance of occurring once per year
  - It's possible to have (3) 100-year storms in 1 year or no 1-year storms for 5 years; these are probabilities, not predictions…
- For example, on September 4, 2021, 2.72 inches of rain fell in Teaneck, NJ (duration unknown):
  - If the storm's duration was:
    - 0.5 hours →200-year storm
    - 1.0 hours → ~25-year storm
    - 2.0 hours →> 10-year storm
    - 3.0 hours → ~10-year storm
    - 24 hours → ~1-year storm
- Storm systems are not designed for flash flooding events (i.e. high-intensity, short duration storms).
- Storm systems are typically designed for a 10-25-year design storm per RSIS. However, topography and existing downstream conditions may cause some limitations.
- In tropical storm Ida, Teaneck had 6.92 inches of rain in 8 hours. This was a 200 years storm event

Finding the Solution

- The purpose of this study was to develop conceptual-level improvements to address the drainage issues.
- Using the baseline model prepared for the existing conditions, problem areas were identified based on hydraulic modeling and proposed remedies for these areas in order to alleviate drainage issues. AutoDesk Storm and Sanitary Analysis 2022 SW for hydraulic modeling was utilized.
- Proposed drainage improvements were introduced in the model and prepared iterations of hydraulic models to analyze the effect of the proposed improvements on the drainage systems. Subsequently, when reviewing the various iterations, some were not viable when considering existing topographic and infrastructure conditions, and the process was repeated.
- Conceptual-level improvements are not ready for construction at this time. The surveying and mapping used for the project thus far were only performed for concept planning.
- In order to develop final, construction-level plans, the next phase of the project must be undertaken. This would include a significant expansion of the topographic surveying, as well as a full inventory of the existing utilities within the roadway.

Possible Solutions

- Some of the possible solutions to mitigate flooding could be:

Solution	Challenge
Abrupt bends should be eliminated	There are too many utility conflicts and the cost can easily sky rocket making this solution cost prohibitive
Replace undersized pipes with properly sized pipes	The current 36” pipe is the maximum size that could be put in that street.
Slope the pipes adequately to address conveyance issues	There is not enough slope in the ground due to extreme flatness

- The only viable approach that works in the proposed modeling consists of redirecting and storing the water surcharge to give the system enough time to recover. This is analogous to putting a portion of the traffic on a detour and another portion in a parking lot for some time.

Recommendations

- Construct a detention system in Sagamore Park. This will redirect the water at Cumberland Avenue towards the detention system and will reduce the water going towards Belle Ave and Beatrice Street intersection. The overflow of this system will be directed towards Windsor Road outfall
- Construct a bypass drainage pipe on Ester Avenue to prevent water going towards the main 36” drainage pipe on the intersection.
- Construct a detention system in Beverly Road Parking Lot to reduce the abrupt bend impact and store water surcharge to reduce flooding on that intersection
- Build Bioswales on select locations upstream between route 4 and Sagamore Avenue to reduce water flowing towards Belle Avenue

What is Bioswale?

- Bioswales are channels designed to concentrate and convey stormwater runoff while removing debris and pollution.
- Bioswales can also be beneficial in recharging groundwater.
- It is important to maintain bioswales to ensure the best possible efficiency and effectiveness in removal of pollutants from stormwater runoff.

Phase 1 – Detention System at Sagamore Park

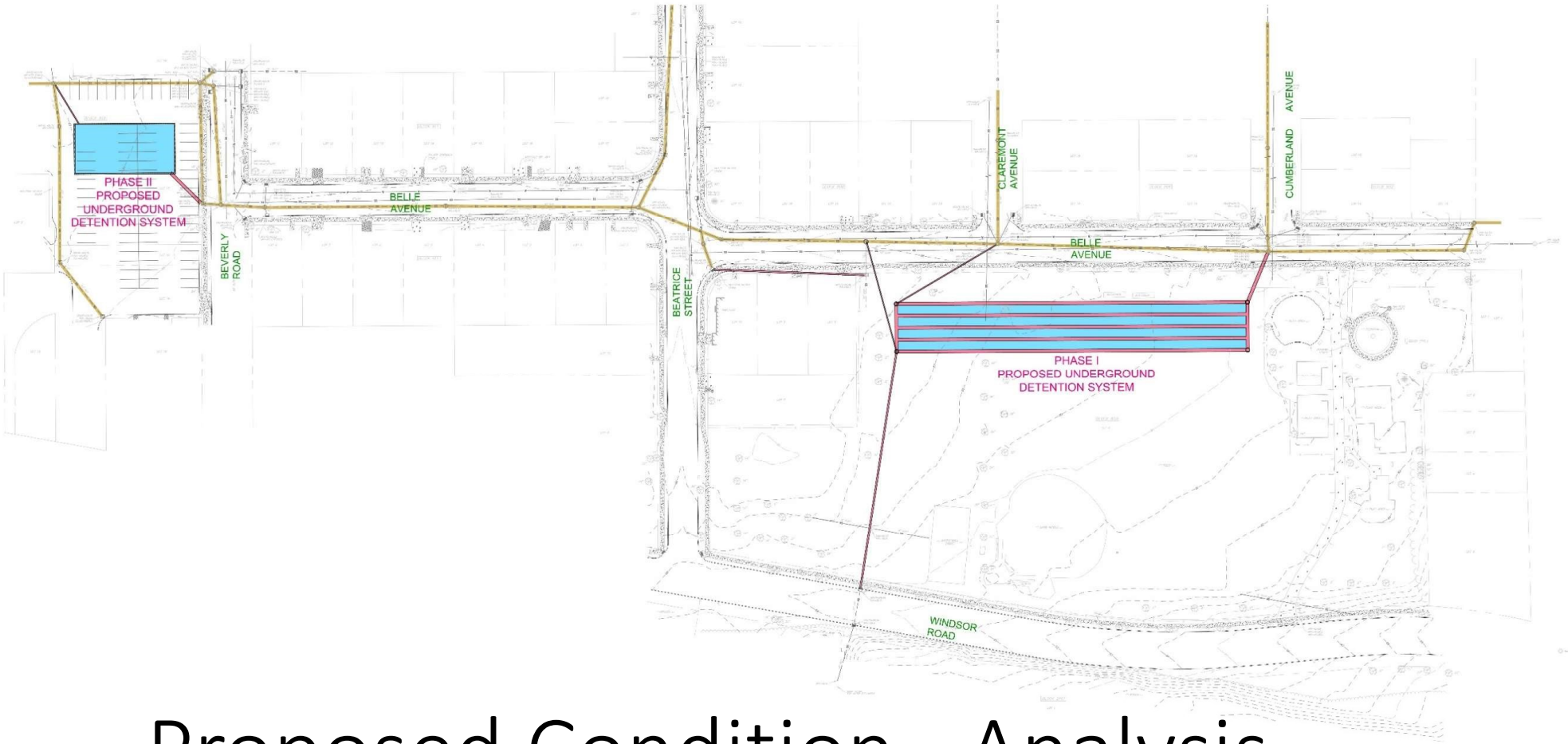
- A 90K gallons detention system is to be constructed in Sagamore Park
- It will connect to the main drainage pipe at Cumberland Avenue
- Additional inlets and culverts will be constructed to capture surface water flow and feed it into the system
- All feeding pipes will be connected to main culvert via doghouse manholes
- The overflow of the system will be connected to Windsor Road outfall
- The system will connect back to the main drainage pipe between Claremont and Beatrice
- A preliminary estimate of this work is $1.06M all costs included

Phase 2 – Detention System at Beverly Road Parking Lot

- A 100K gallons detention system is to be constructed in Beverly Road Parking Lot
- It will be connected to the bend at Beverly Road and Belle Avenue using a structure. This will reduce the negative impact of that bend.
- A couple of additional inlets will be constructed in the parking lot to capture surface water flow and feed it into the system
- The system will connect back to the main 42” drainage pipe at the other corner of the parking lot
- A preliminary estimate of this work in $1.3M all costs included

Phase 3 – Green Infrastructure (Bioswales)

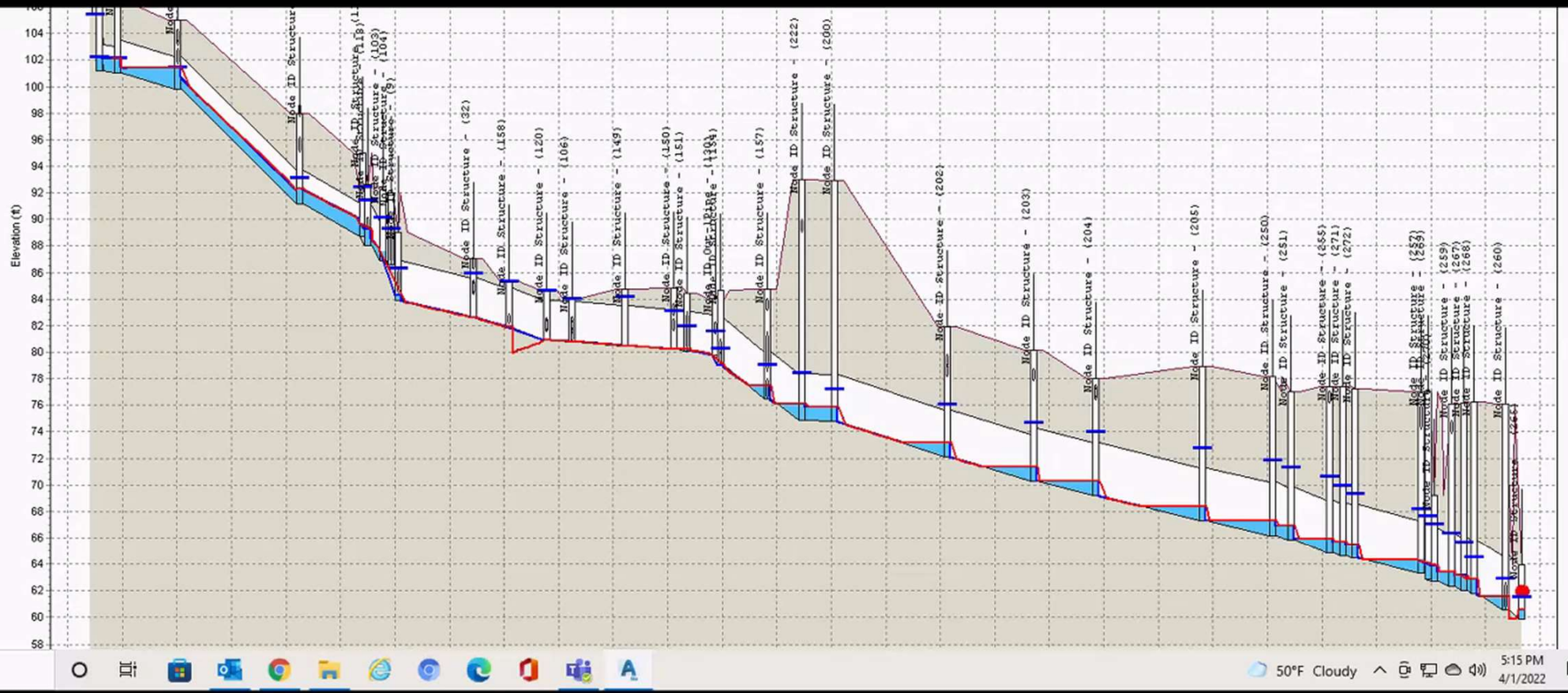
- Green Infrastructure (Bioswales) are being utilized throughout the tri-state area to address drainage issues and reduce cost of running combined sewer operations (CSO)
- Bioswales could be constructed at select locations between route 4 and Sagamore Avenue to capture storm water upstream relieving the impact on Belle Avenue and Beatrice intersection
- Soil testing needs to be done and ground water level needs to be determined before designing and constructing Bioswales
- A preliminary estimate of this work in $700k for 20 Bioswales each capable of storing 900-1,000 gallon of water



Proposed Condition - Analysis

Proposed Condition Simulation

(Includes Phase 1 and Phase 2 Improvements)



Next Steps

- Seasonal groundwater table at the proposed detention area needs to verified
- Final Report and supporting documentation will be prepared
- Funding for the proposed improvements
  - A NJDOT Infrastructure Improvements grant is already applied
  - A low to no interest loan could be obtained from NJ Infrastructure Bank, Water Bank Financing Program through NJ Environment Infrastructure Trust (NJEIT)

Contact Information

Township of Teaneck

Engineering Department

Farah Gilani

Township Engineer

201-837-1600 X1729

fgilani@teanecknj.gov

DRAINAGE STUDY; BELLE AVENUE, BEATRICE STREET & BEVERLY ROAD AREA, PREPARED BY FASTECH CONSULTING ENGINEERS

Fastech Consulting Engineers

DRAINAGE STUDY

Belle Avenue, Beatrice Street & Beverly Road Area,
Teaneck, New Jersey

David Garval P.E.

Fastech Consulting Engineers

Contents

1. Overview

Belle Avenue, located in the southwest quadrant of the Township of Teaneck, Bergen County, has a long-standing history of recurrent flooding that negatively affects the surrounding residential community. During storm events, the section of Belle Avenue between Beatrice Street and Beverly Road is frequently inundated with more than a foot of water, leading to roadway closures and significantly impacting the quality of life for residents.

This drainage study assesses the existing conditions of the Belle Avenue drainage basin, investigates the likely causes of flash flooding, and proposes a mitigation strategy to reduce the frequency and severity of future flood events.

The primary issue is that large, intense storms rapidly overwhelm the undersized drainage system on Belle Avenue, resulting in flash flooding within minutes. The existing stormwater pipes must manage runoff from a large contributing drainage area north of Belle Avenue, often reaching capacity before they can adequately drain the immediate area. Once these pipes are full, excess stormwater overflows from inlets onto the street. Belle Avenue's flat topography and position as a local low point further exacerbate flooding, allowing surface water to collect with little opportunity for drainage.

To address these issues, this study proposes increasing the capacity of the drainage system. A new subsurface detention system would temporarily store large volumes of stormwater diverted from the main drainage line and release it back into the system at a controlled rate. By slowing the flow into the existing system, this approach would allow the infrastructure to function more effectively, relieve the bottleneck, and reduce flooding along Belle Avenue.

2. Existing Site Conditions

Study Area

The focus area—Belle Avenue between Beatrice Street and Beverly Road—lies within a 178-acre suburban drainage basin spanning approximately 1.4 miles from Reis Avenue (north) to Terhune Street (south). The area is mostly comprised of Residential Single family homes, with a recreational park nearby.

Drainage Infrastructure

For this study, the basin is divided into two sub-areas:

- **Northern Sub-Basin:** Located north of NJ Route 4
- **Southern Sub-Basin:** Located south of NJ Route 4, where the area of concern is situated

The existing drainage infrastructure includes curb and gutter systems to direct surface flow, inlets to channel water underground, and a network of pipes and manholes to convey stormwater from

north to south. Drainage from the Northern Sub-Basin enters the Southern Sub-Basin through two 24-inch parallel pipes that pass beneath Route 4, merging into a single 30-inch stormwater main aligned with Belle Avenue.

This main pipe acts as a critical conduit for the entire basin, receiving combined flow from the north and collecting additional runoff from lateral pipes in the south. As the main runs along Belle Avenue between Route 4 and Beverly Road, it increases from a 30-inch to a 36-inch reinforced concrete pipe (RCP). It then transitions into a 42-inch pipe beneath the municipal parking lot, continues through Cedar Lane, and eventually discharges near Terhune Street.

Topography

The basin's topography generally slopes southeast, with higher elevations near Reis Avenue and lower elevations beyond Belle Avenue toward Terhune Street. Belle Avenue itself is a local low point, surrounded by higher ground. The terrain in the immediate area is relatively flat, with some sections exhibiting grade differences of less than 1%. A notable grade change occurs between Beverly Road and Cedar Lane, creating a bowl-like condition where Belle Avenue serves as a collection point for runoff flowing from all directions.

Climate Considerations

The drainage infrastructure in this area is over 50 years old and was not designed to accommodate the intensity of modern storm events. Recent weather patterns, driven by climate change, have become more extreme, highlighting the inadequacy of the existing system. As storms are projected to grow in frequency and intensity, increasing the system's capacity is essential to effectively manage future flood risks.

3. Stormwater Runoff Methodologies

To determine the stormwater runoff in this drainage basin, the USDA Natural Resources Conservation Service (NRCS) method was used. This method is perhaps the most widely used approach to hydrology in the United States and provides several techniques that are useful for modeling small urban watersheds. It utilizes the SCS runoff equation to predict the peak rate of runoff as well as the total volume. The runoff calculation equation and parameters are described in the following sections:

3.1 Rainfall Data

Intensity frequency-duration (IDF) data is one of the most common means of defining the rainfall characteristics at any given location. Each IDF curve defines the rainfall intensity (i) that will occur for a specified duration (d) at a certain rainfall frequency or return period (T).

Precipitation data of Teaneck, New Jersey, USA, from NOAA Atlas 14, volume 2, version 3 were used for the development of the IDF of the area. Rainfall intensity was used from 2-, 10-, 25-, and

100-year storms for rain storms up to 24 hours in duration (Table 1). The 24-hour storm of a 25-year return period has been used to evaluate the existing drainage network.

Table 1 Rainfall Intensities (inches)

Duration	Reoccurrence of Storm (Years)			
	2	10	25	100
5-min	0.404	0.54	0.613	0.719
10-min	0.64	0.849	0.96	1.12
15-min	0.795	1.06	1.2	1.4
30-min	1.09	1.51	1.74	2.09
60-min	1.35	1.95	2.3	2.84
2-hr	1.66	2.43	2.9	3.67
3-hr	1.85	2.72	3.25	4.14
6-hr	2.39	3.49	4.18	5.35
12-hr	2.95	4.35	5.25	6.83
24-hr	3.3	4.97	6.12	8.18

3.2 Stormwater Runoff Equation

The Natural Resource Conservation Service (NRCS) derived a relationship between accumulated rainfall and runoff from experimental plots for numerous soils and vegetative cover conditions. The following NRCS runoff equation was used to estimate direct runoff from 24-hour or 1-day storm rainfall:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

Where:

Q = volume of accumulated runoff (in)

P = accumulated rainfall (potential maximum runoff) (in)

S = potential maximum retention of rainfall on the watershed at the beginning of the storm (in),

$$S = \frac{1000}{CN}$$

Ia = initial abstraction, including surface storage, interception, and evaporation,

$$I_a = 0.2(S)$$

After adding the values of the initial abstraction, Modified NRCS Runoff Equation:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

3.3 Hydrologic Soil Group

Soil properties influence the relationship between runoff and rainfall since soils have differing rates of infiltration. Based on infiltration rates, the NRCS has divided soils into four hydrologic soil groups: A, B, C, and D. Below is a list of these classifications with their definitions as provided in Urban Hydrology for Small Watersheds (TR55) from NRCS.

Group A- Soils with low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively-drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B- Soils with moderate infiltration rates when thoroughly wetted consist chiefly of moderately deep to deep, moderately well to well-drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15- 0.30 in/hr).

Group C- Soils with low infiltration rates when thoroughly wetted consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr)

Group D- Soils with high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high-water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

The study area is mostly Hydrologic Soil Group C with a moderate slope.

3.4 Runoff Factor – Curve Number (CN)

The principal physical watershed characteristics affecting the relationship between rainfall and runoff are land use, land treatment, soil types, and land slope. The NRCS method uses a combination of soil conditions and land uses (ground cover) to assign a runoff factor to an area. These runoff factors, called runoff curve numbers (CN), indicate the runoff potential of an area. The higher the CN, the higher the runoff potential.

Several factors, such as the percentage of impervious areas and the means of conveying runoff from impervious areas to the drainage system, should be considered in computing CN for developed areas. The NRCS runoff curve number (CN) for different urban land uses is shown in Figure 1. The characteristics of the study area can be described as having ½-acre avg. lot size,

residential zoning, with a 25% impervious area. The associated curve number for the study area has been adopted to be (CN=80).

Figure 1 *– Runoff Curve Numbers for hydrologic soil groups in Urban Areas*

(d) Urban Areas [1]

Cover Description Cover Type and Hydrologic Condition	Average Percent Impervious Area [2]	Runoff Curve Numbers for Hydrologic Soil Group A	B	C	D
Fully developed urban areas (vegetation established):					
Open space (lawns, parks, golf courses, cemeteries, etc.): [3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2- inch sand or gravel mulch and basin borders)		96	96	96	96
Urban district:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas:					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94

[1] Average runoff condition and I_a=0.2S

[2] The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.

[3] CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

[4] Composite CNs for natural desert landscaping should be computed based on the impervious area (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CNs to use for the design of temporary measures during grading and construction should be computed using the degree of development (impervious area percentage) and the CNs for the newly graded pervious areas

3.5 Antecedent Soil Moisture Conditions (AMC)

The antecedent soil moisture conditions (AMC) specify the moisture level in the ground before the storm. The four AMC conditions are:

Table 2 AMC Conditions

AMC -I	DRY
AMC-II	Normal
AMC-III	Wet
AMC-IV	Saturated or frozen

It is common practice to use the AMC-II condition for most design work. Therefore, the AMC-II condition has been used in the current analysis.

3.6 Time of Concentration

The time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. TC influences the shape and peak of the runoff hydrograph. Urbanization usually decreases Tc, thereby increasing the peak discharge. The factors affecting the time of concentration are surface roughness, channel length, and slope. The Kirpich Method has been used to estimate the time of concentration for each sub-basin. For a channel-flow component of runoff, the Kirpich equation is:

$$Travel\ Time = K * L^{0.77} * S^{-0.385}$$

3.7 Hydrograph

The US Department of Agriculture Soil Conservation Service has developed several techniques for analyzing stormwater runoff. One of the most widely used is the runoff Hydrograph method. The runoff hydrograph consists of a series of ordinates (ft3/sec or m3/sec) at evenly spaced intervals “dt”. Each ordinate specifies the average flow during the interval.

3.8 Drainage Pipe Capacity

Pipe capacity and stormwater flow through pipes can be calculated using Manning’s Energy Equation.

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{\frac{2}{3}}\sqrt{S}$$

Where:
Q = Flow (cubic feet per second)
V = Velocity (feet per second)

A = Flow Area (square feet)
n = Manning's Roughness Coefficient (unitless)
R = Hydraulic Radius (feet)
S = Channel Slope (feet in height/feet in length)

4. Stormwater Drainage Model - HYDROCAD

To analyze stormwater runoff using the principles listed above, a drainage model was developed in HYDROCAD software. The available information included the tax map (for the property boundaries and streetscape), Google Earth elevation data, two surveys (for the topography of the surface in the basin), and the use of drainage maps (that show the larger stormwater pipe network that spans the basin). All these items, in conjunction with one another, were used to create a model of the existing conditions of the drainage network. Through the modeling and analysis of the existing network, the cause of flooding on the span of Belle Avenue from Beatrice Street to Beverly Road can be identified.

For this study, the behavior of stormwater in the northern sub-basin was not a concern. Flooding occurs along Belle Avenue in the southern sub-basin; as such, only the volume of water runoff carried from the northern sub-basin to the southern sub-basin needed to be accounted for. To calculate the volume of runoff, an "imaginary headwall" was included in the model where the twin 24" pipes cross beneath Route 4. This allows for the volume of surface runoff to be properly "collected" and calculated, without creating a pipe network. After, the calculated volume of stormwater runoff was added to the northmost point of the southern sub-basin (at the exit of the twin pipes underneath route 4). The surface topography and tax map were still used when creating the model of the northern sub-basin, in addition to graphical representations of the stormwater pipe network.

The model of the southern sub-basin needed to be analyzed more closely to identify the causes of flooding along the span of the flood area. As such, the model includes all above-ground and underground drainage infrastructure. The southern sub-basin includes functioning Inlets, manholes, storm pipes, and outfalls.

The HydroCAD is an integrated solution for the analysis, design, and documentation of complete drainage systems using standard hydrograph techniques. Compared to other programs requiring several separate modules, HydroCAD is faster, easier to use, costs less, and does much more. It provides a wide range of commonly used hydrology and hydraulics capabilities, including SCS, NRCS, and SBUH runoff hydrology, Hydrograph routing through ponds & reaches, Automatic Pond storage calculations, including embedded storage chambers, and Easy management and reporting of multiple rainfall events, etc.

5. Existing Drainage Network

The existing drainage network based on the above-mentioned methodology has been modeled on HYDROCAD.

After completing the model development, a stormwater analysis was conducted for 10-year and 25-year storms. The analysis indicates that during a 10-year storm, 45% of the pipes are unable to handle the volume of stormwater runoff. This percentage increases to 54.5% during a 25-year storm. Notably, this includes segments of the 36" and 42" reinforced concrete pipes (RCP), which serve as the primary stormwater conduits from Belle Avenue beneath Cedar Lane. Additionally, several contributing pipes and inlet structures along the main storm sewer line were found to be over-capacity.

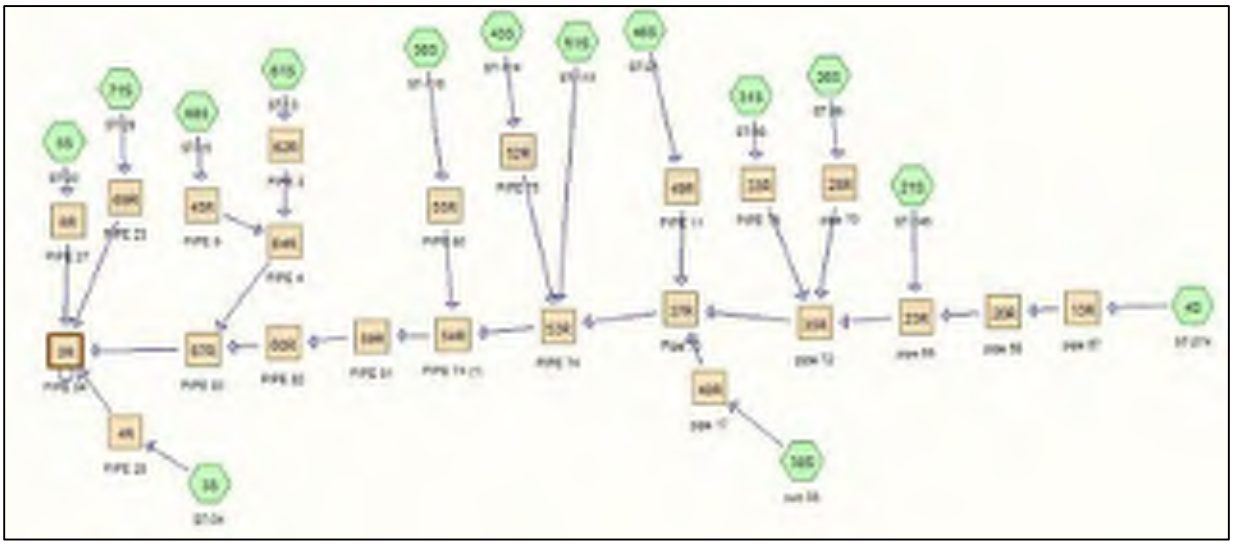


Figure 2 Existing HYDROCAD Layout

6. Proposed Drainage Network

The analysis focused on evaluating several design alternatives within the drainage network to address flooding in the area. Different configurations were simulated using HYDROCAD to determine their effectiveness in managing stormwater runoff on Belle Ave. Among the options considered, an underground stormwater detention system was determined to be most successful in mitigating excess flow and providing relief to the existing drainage system. Subsurface detention systems are widely recognized for their ability to temporarily store runoff and reduce peak discharge rates.

To manage flooding at Belle Avenue, a subsurface detention system with a storage capacity of 0.583 acre-feet (consisting of twelve 42-inch diameter pipes, each 220 feet in length) is proposed to be installed at Sagamore Park. This system includes controlled inflow and outflow mechanisms using orifice and weir structures to regulate discharge. After evaluating all alternatives, the

proposed infrastructure layout outlined below was identified as the most effective and has been adopted as the final design solution.

6.1 Proposed Layout

In the proposed layout, Pipe 82 has been converted into a detention pipe storage system equipped with an outlet control device featuring an orifice. This modification allows for controlled discharge toward the main sewer line, as well as diversion to the detention system. A 36-inch orifice is designated for the secondary outflow directed to the detention facility, while a 15-inch orifice regulates the primary outflow to Pipe 83.

Once water enters the detention system, the design includes a primary discharge to Pipe 84 through a broad-crested rectangular weir combined with an orifice. Additionally, a secondary outflow is facilitated by a 12-inch orifice to manage excess flow. The summary of the design and flow conditions for the 10-year and 25-year storms is briefed in the following sections.

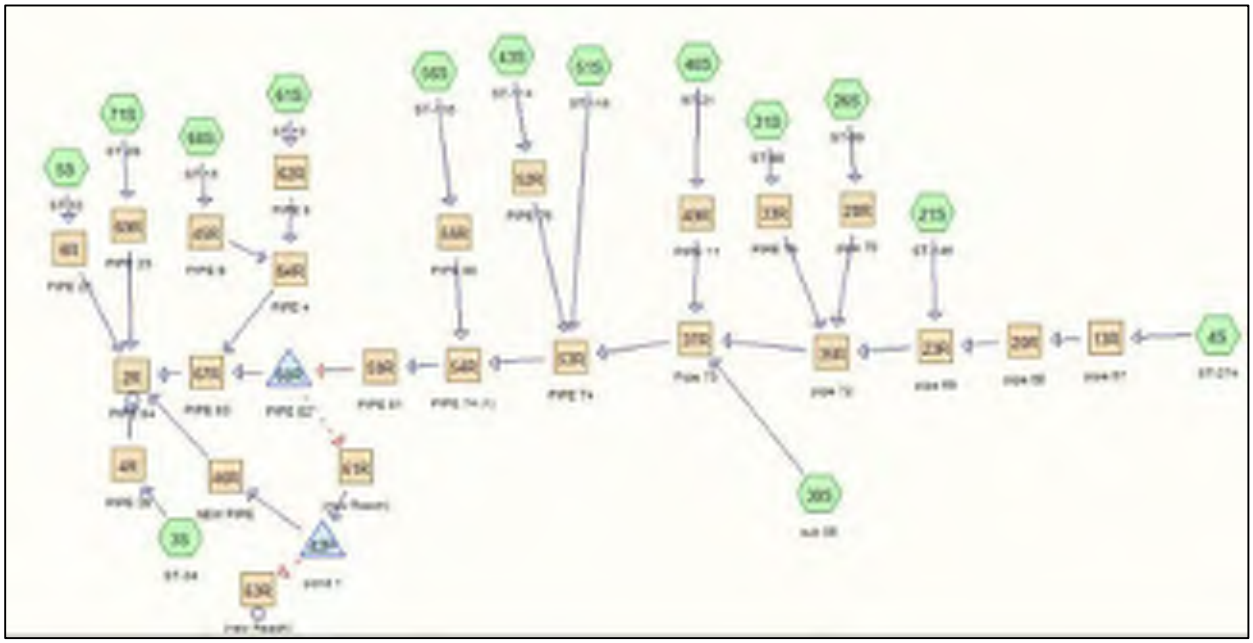


Figure 3 Proposed HYDROCAD Layout

6.2 Design and Flow Conditions for 10-Year Storm

1. **Pipe 82 Modification**:
    - Converted to 36” pipe storage pond.
    - Primary outflow: 9.25 ft³/s to Pipe 83.
    - Secondary outflow: 42.75 ft³/s to the detention system.

2. **Detention System**:
    - Capacity: 0.583 acre-ft (42” diameter, 12 pipes, 220 ft length).
    - Inflow: 42.75 ft^3/s.
    - Outflow: 36.35 ft^3/s primary, 2.83 ft^3/s secondary.
    - Attenuation: 7.9-minute lag.
3. **Pipe 84**:
    - Inflow: 57.0 ft^3/s.
    - Capacity: 50.15 ft^3/s, resulting in a 6.85 ft^3/s overflow.

Hydrographs of pipe 82, the detention system, and pipe 84 are shown in Table 3 of APPENDIX 1.

6.3 Design and Flow Conditions for 25-Year Storm

1. **Pipe 82 Modification**:
    - Converted to a 36” pipe storage pond.
    - Primary outflow: 10.07 ft^3/s to Pipe 83.
    - Secondary outflow: 48.49 ft^3/s to the detention system.
2. **Detention System**:
    - Capacity: 0.583 acre-ft (42” diameter, 12 pipes, 220 ft length).
    - Inflow: 48.49 ft^3/s from Pipe 82.
    - Outflow: 41.1 ft^3/s primary, 3.85 ft^3/s secondary.
    - Attenuation: 6.4-minute lag.
3. **Pipe 84**:
    - Inflow: 63.7 ft^3/s (41 ft^3/s from detention, remainder from sub-catchments).
    - Capacity: 50 ft^3/s, resulting in a 13 ft^3/s overflow.

Hydrographs of pipe 82, the detention system, and pipe 84 are shown in Table 4 of APPENDIX 1.

7. Findings

Following the analysis and modeling of the drainage network in HYDROCAD, it is concluded that the implementation of a detention system at Sagamore Park leads to a complete (100%) elimination of flooding at Pipe 83 for both the 10-year and 25-year storm events. In contrast, Pipe 84 continues to experience a flood volume of 4.5 cfs during a 10-year storm. For the 25-year storm, an overflow

of 12 cfs still occurs at Pipe 84 in the proposed layout. Notably, the detention system achieves a substantial reduction of approximately 19 cfs in flood volume at the location of Pipe 83. To address the remaining flooding at Pipe 84, further improvements could include expanding the storage capacity of the detention system or increasing the rate of secondary outflow.

To address the residual overflow at Pipe 84, consider increasing the detention volume at Sagamore Park or optimizing the outlet configuration to allow for greater secondary discharge.

Pipes 105 and 106 should be evaluated for replacement with larger diameter and steeper gradient pipes to accommodate the 17 cfs runoff from Structures 185 and 186 and reduce flooding at Pipe 85.

8. Analysis at Belle Avenue and Beatrice Road Intersection

It was observed that, in both the existing and proposed layouts, there is no significant reduction in flooding at Pipe 85, located at the intersection of Belle Avenue and Beatrice Road. This is primarily due to storm runoff from two contributing sub-catchments (Structures 185 and 186), which generate a combined flow of approximately 17 cfs. The associated connection pipes (Pipe 105 and Pipe 106) are undersized and have insufficient slope, limiting their capacity to convey the runoff effectively.

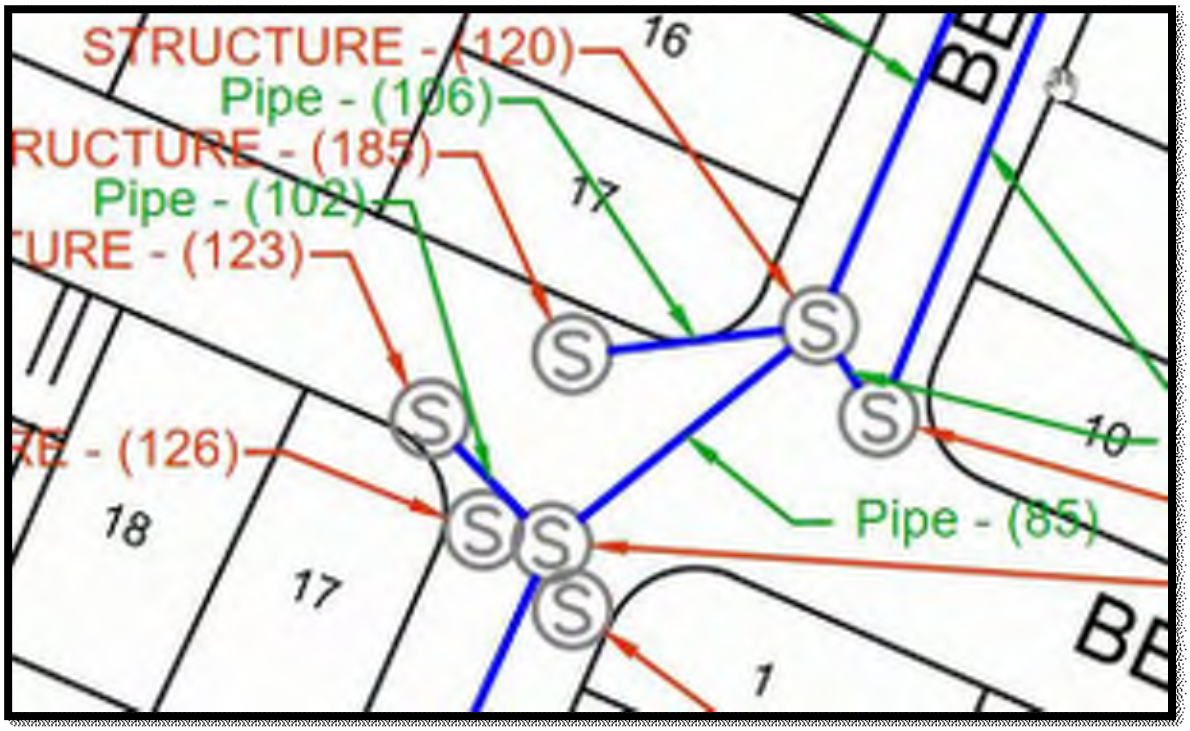


Figure 4 Pipe 85 location

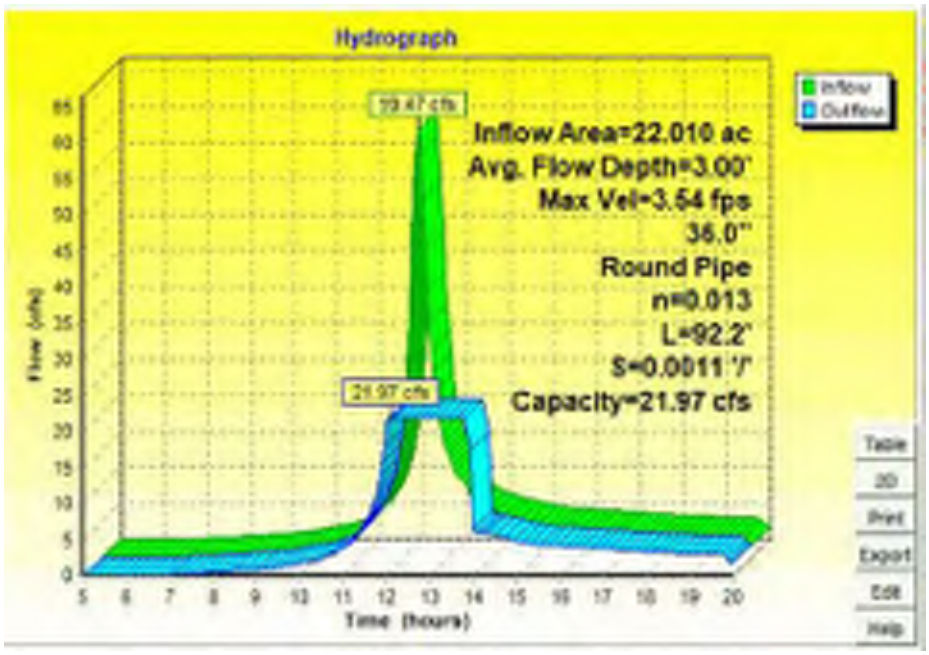


Figure 5 *Resulting Hydrograph of Pipe 85*

9. Conversion of Pipe 90 at Belle Avenue and Beverly Road Intersection

In the existing drainage network, Pipe 90, which receives inflow from Pipe 223 running along Belle Avenue, is operating at full capacity. To address this issue, Pipe 90 has been upgraded to a box culvert in the proposed design to evaluate its impact on flood reduction. This modification significantly increases the flow area, with the new box culvert measuring 4 feet by 9 feet. The location, along with the existing hydrographs and the updated HYDROCAD layout, is presented below.

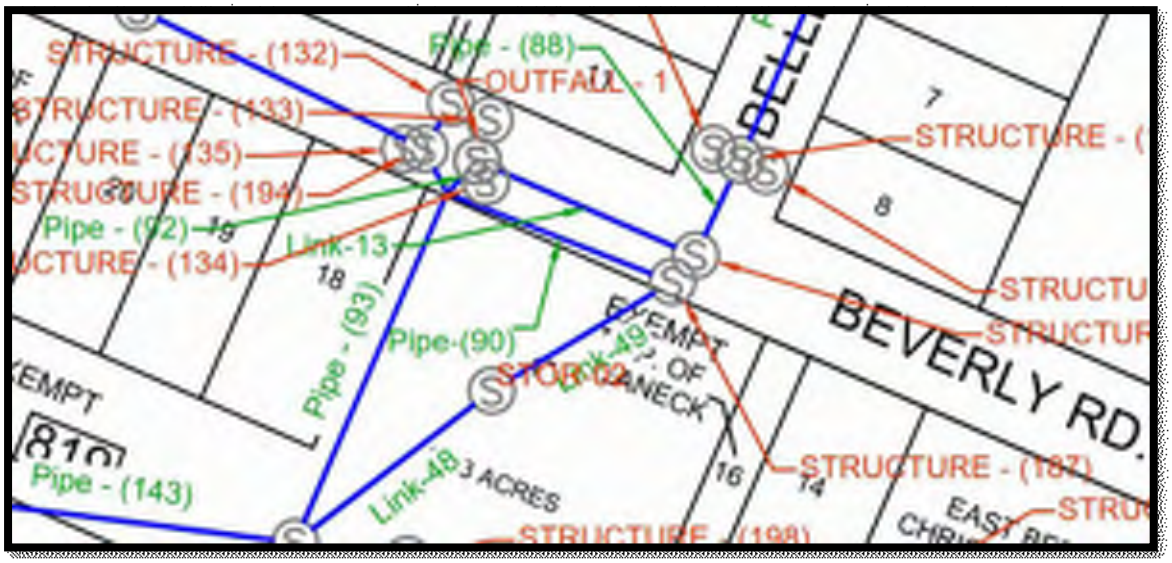


Figure 6 Existing pipe 90 location

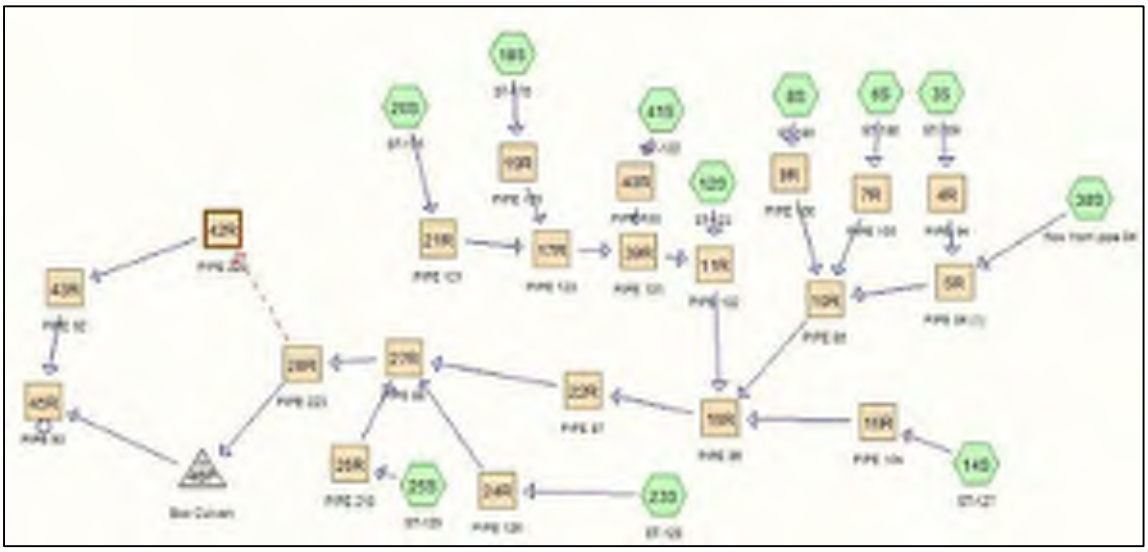


Figure 7 proposed HYDROCAD culvert layout

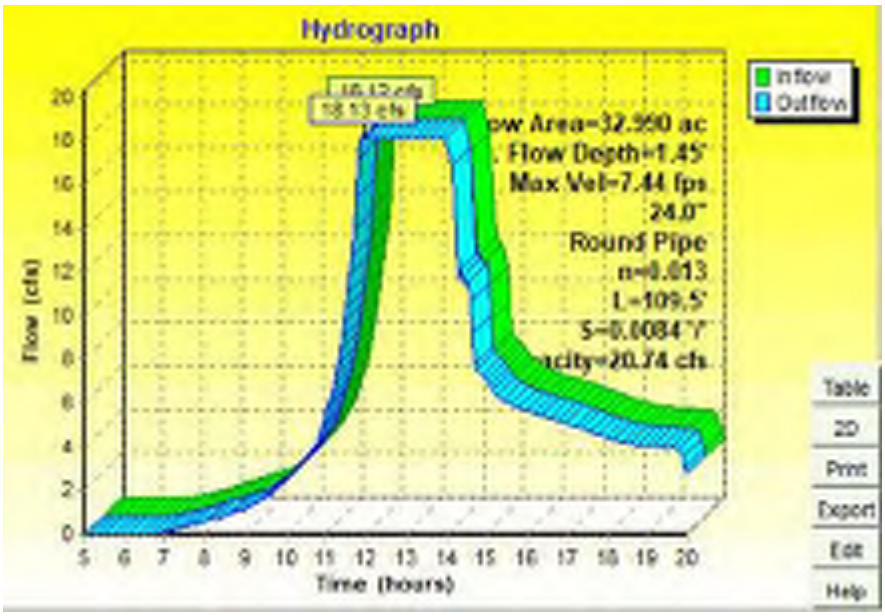


Figure 8 Existing Pipe 90 hydrograph for 25-year storm

10. Conclusion

The drainage analysis and modeling using HYDROCAD for the Belle Avenue watershed area have provided critical insights into the causes of flooding and the effectiveness of proposed mitigation measures. The introduction of an underground detention system at Sagamore Park has proven highly effective, eliminating flooding at Pipe 83 for both the 10-year and 25-year storm events. This system has also contributed to a significant flood volume reduction—approximately 19 cfs—at this location.

However, challenges remain in other parts of the network. Pipe 84 continues to experience flooding, with a persistent overflow of 4.5 cfs under the 10-year storm and 12 cfs under the 25-year storm. This indicates that the current storage volume and outlet configuration may be insufficient for fully managing the flow in this area.

Furthermore, Pipe 85, located at the intersection of Belle Avenue and Beatrice Road, shows only marginal improvement under the proposed layout. This is attributed to high runoff contributions from Structures 185 and 186, coupled with undersized and low-slope conveyance pipes (Pipes 105 and 106), which restrict flow capacity.

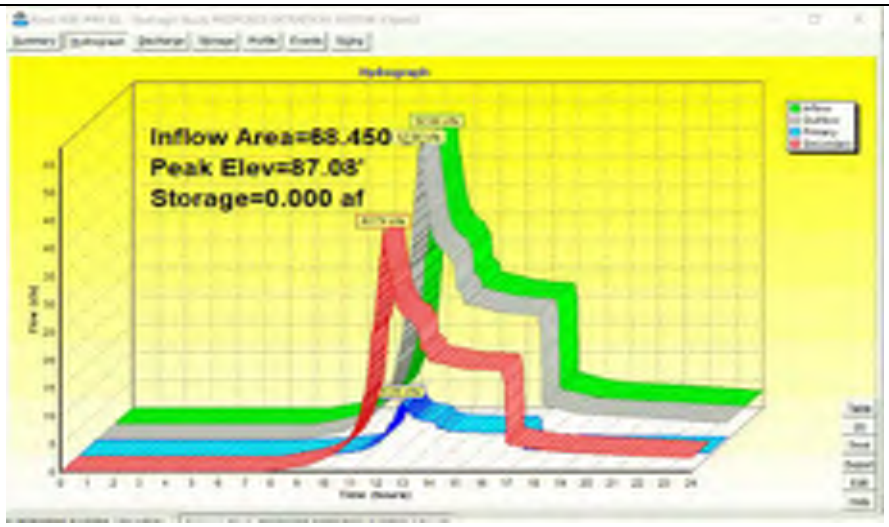
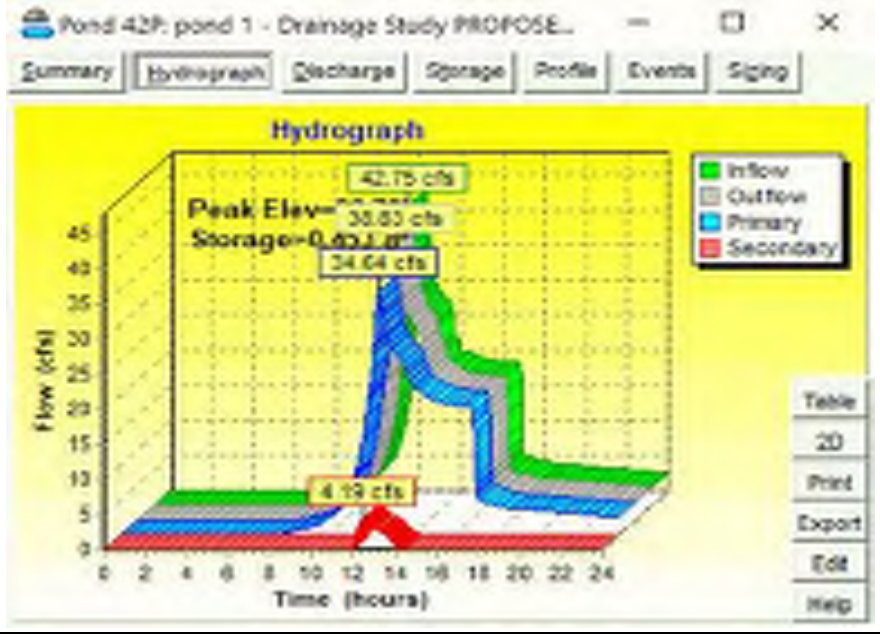
In the downstream network, Pipe 90 was originally at capacity under existing conditions due to inflow from Pipe 223. In response, it was upgraded to a 4' x 9' box culvert in the proposed design, significantly enhancing its flow capacity. This modification is expected to help alleviate localized flooding in that section of the network.

11. Recommendation

The findings of this study confirm that the existing drainage system on Belle Avenue is inadequate to handle major weather events. Key characteristics of the study area, such as flat topography, undersized pipes, and a large drainage area, make it a critical part of the overall drainage basin. Through hydraulic analysis, several potential solutions were explored to address flooding issues. The most effective option is the installation of an underground detention system at Sagamore Park, which will provide additional temporary storage and enhance the overall drainage system's performance – thereby eliminating flooding at Belle Avenue.

APPENDIX 1

Table 3 – Hydrographs for 10-Year Storm

Pipe Number	Hydrograph
Pipe 82	
Detention pond	

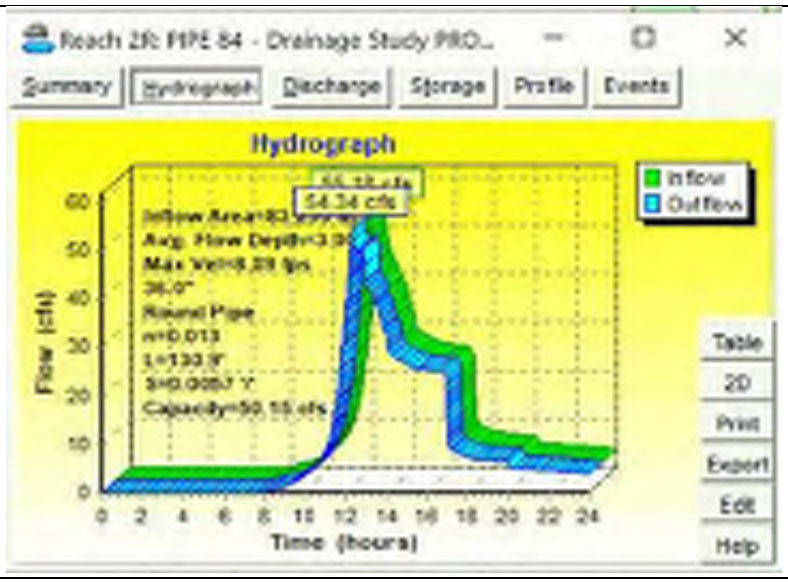
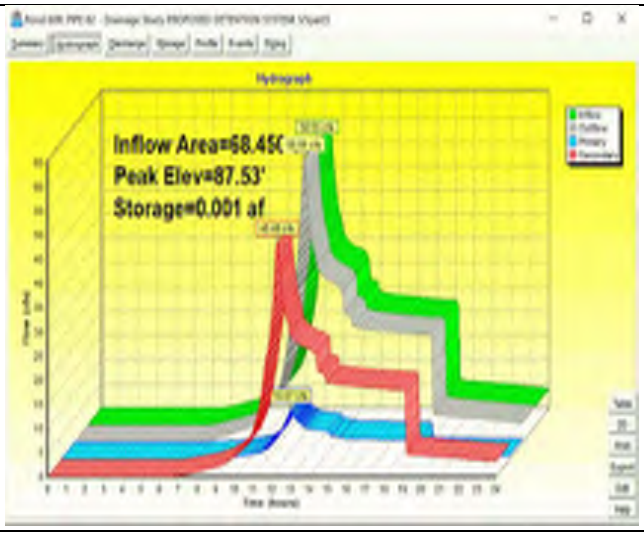
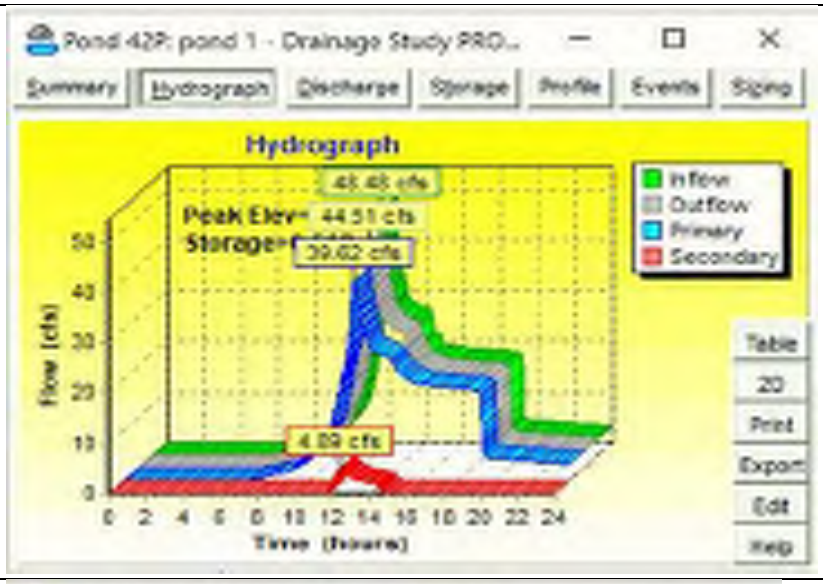
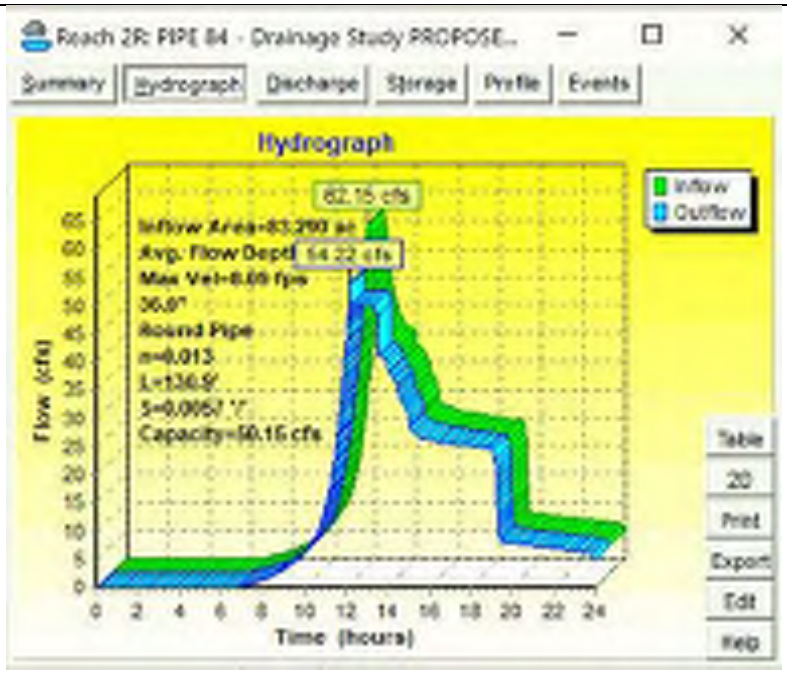
Pipe 84	

Table 4 – Hydrographs for 25-Year Storm

Pipe Number	Hydrograph
Pipe 82	

Detention pond	
Pipe 84	

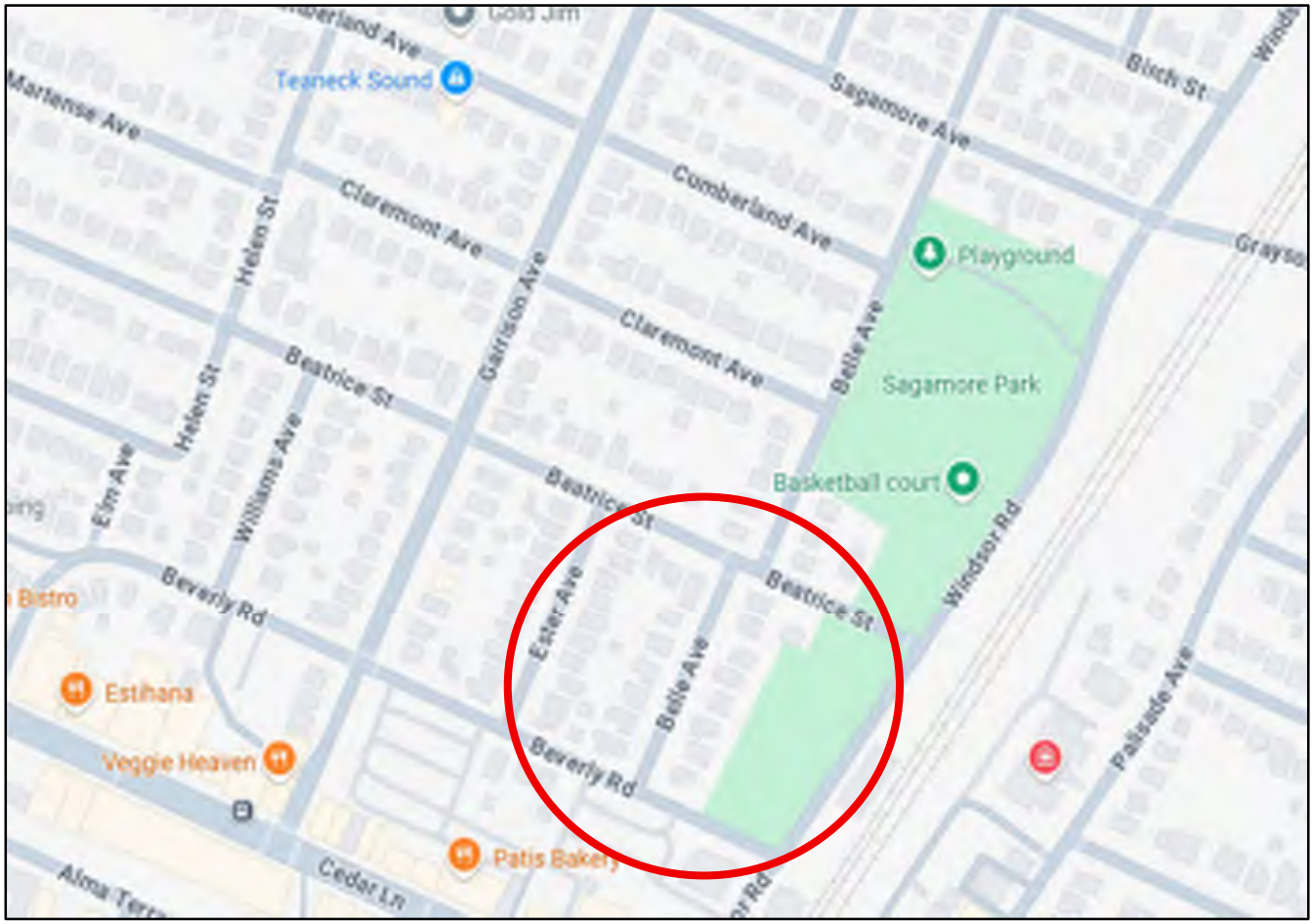
APPENDIX 2

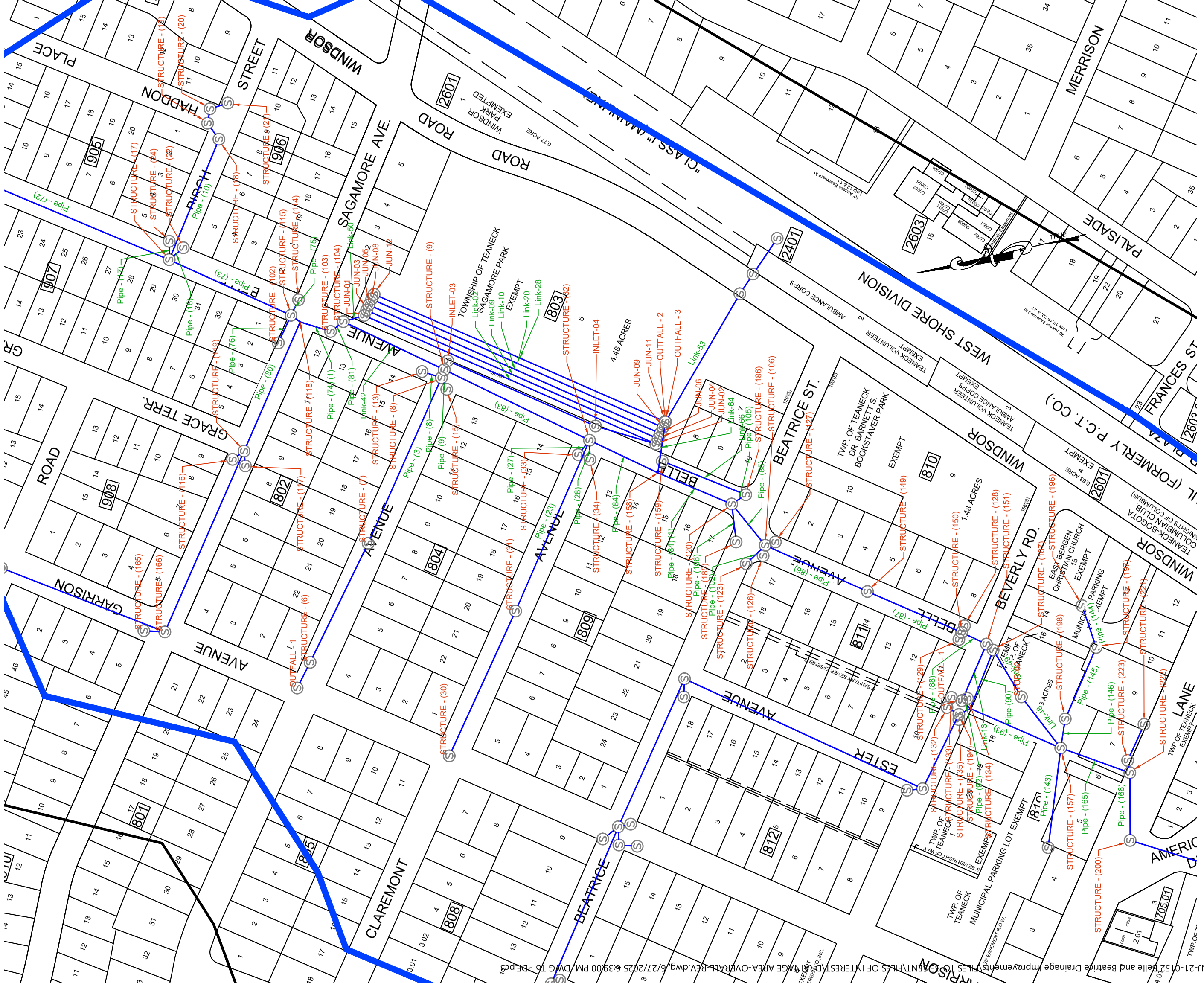
Schematic of Proposed Underground Detention System in Sagamore Park

The schematic has been provided for visual aid and is not intended to convey the actual engineering design for the proposed project.

APPENDIX 3

Location Map





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