

NEEDHAM PLANNING BOARD
Tuesday June 17, 2025
7:00 p.m.

Charles River Room
Public Services Administration Building, 500 Dedham Avenue

AND
Virtual Meeting using Zoom
Meeting ID: **880 4672 5264**
(Instructions for accessing below)

To view and participate in this virtual meeting on your phone, download the “Zoom Cloud Meetings” app in any app store or at www.zoom.us. At the above date and time, click on “Join a Meeting” and enter the following Meeting ID: **880 4672 5264**

To view and participate in this virtual meeting on your computer, at the above date and time, go to www.zoom.us click “Join a Meeting” and enter the following ID: **880 4672 5264**

Or to Listen by Telephone: Dial (for higher quality, dial a number based on your current location):
US: +1 312 626 6799 or +1 646 558 8656 or +1 301 715 8592 or +1 346 248 7799 or +1 669 900 9128 or +1 253 215 8782 Then enter ID: **880 4672 5264**

Direct Link to meeting: <https://us02web.zoom.us/j/88046725264>

1. Decision: Amendment to Major Project Site Plan Special Permit No. 93-3: Wingate Development, LLC, 63 Kendrick Street, Needham, MA 02494, Petitioner. (Property located at 589 Highland Avenue, Needham, Massachusetts). Regarding certain plan modifications, including the addition of 2 EV changers, a Bocce court, Dog Run, and extended sidewalk and 3 parking spaces.
2. Public Hearing:

7:15 p.m. Amendment to Major Project Site Plan Special Permit No. 2012-07: The Children’s Hospital Corporation c/o Boston Children’s Hospital, 300 Longwood Avenue, Boston, MA, Petitioner. (Property located at 66 B Street, 360 First Avenue, 410 First Avenue, and 37 A Street, Needham, MA, Needham, Massachusetts). Regarding request for certain modifications to the conditions in the 2021 Amendment.
3. Public Hearing:

7:45 p.m. Amendment to Major Project Site Plan Review No. 2013-02: Town of Needham, 1471 Highland Avenue, Needham, Massachusetts, Petitioner, (Property located at 1407 Central Avenue, Needham, Massachusetts). Regarding proposal for a new building addition of approximately 12,400 square feet, as well as the renovation of roughly 1,800 square feet within the existing storage garage to create a dedicated tire maintenance bay. *Please note: this has been continued from the May 20, 2025 Planning Board meeting.*
4. Informal Presentation: Charles River Proposed 40B project.
5. Discussion: Beth Israel Deaconess Hospital-Needham (BIDN) to discuss the possibility of a revision to the Hospital’s approved parking plan through the addition of a valet-only parking lot on property located at 14 and 20 Oak Street.
6. Discussion of Planning Board Goals.
7. Minutes.
8. Report from Planning Director and Board members.
9. Correspondence.

(Items for which a specific time has not been assigned may be taken out of order.)



PLANNING DIVISION
Planning & Community Development

**MAJOR PROJECT SITE PLAN SPECIAL PERMIT
Amendment
June 17, 2025**

**Wingate Development, LLC
Application No. 93-3
(Original Decision dated July 27, 1993, as amended August 9, 1994, August 8, 1995,
November 21, 1995, June 3, 1997, and March 15, 2011,
Insignificant Change on April 18, 2013,
and further amended on December 17, 2013, and March 15, 2022, and May 16, 2023)**

DECISION of the Planning Board (hereinafter referred to as the Board) on the petition of Wingate Development, LLC, 57 Wells Ave, Suite 20, Newton, MA 02459, (hereinafter referred to as the Petitioner), for property located at 589 Highland Avenue, Needham, Massachusetts. The property is shown on Assessor's Map 77 as Parcel 1 containing 110,490 square feet in the Elder Services Zoning District.

This Decision is in response to an application submitted to the Board on May 9, 2025, by the Petitioner for an Amendment to Major Project Site Plan Review Special Permit issued by the Needham Planning Board on July 27, 1993, under Section 7.4 of the Needham Zoning By-Law and Section 4.2 of Major Project Special Permit No. 1993-03, dated July 27, 1993. The July 27, 1993, decision was further amended on August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013, and further amended on December 17, 2013, March 15, 2022, and May 16, 2023.

By Decision dated March 15, 2022, the Planning Board approved an application for an amendment to permit the conversion of the then-current Nursing Home to 50 Independent Living (IL) Units. The Nursing Home was officially closed on or about April 21, 2022. The Petitioner intends to proceed with the work and the change of use authorized by that permit. By Decision dated May 16, 2023, the Planning Board approved the expansion of that project by adding a third floor to the building, adding an additional 22 IL units, for a total of 72 IL units, of which 12.5%, or 9 units, will be affordable, as defined in the Elder Services district By-Law. The requested Major Project Site Plan Review Special Permit Amendment would permit the modification of the approved site plan to add 2 EV changers, a Bocce court, Dog Run, extended sidewalk and 3 parking spaces. There is no change proposed to the building square footage or elevations, nor to any other conditions in the earlier Decisions.

In accordance with the By-Law, Section 7.4, a Major Project Site Plan Review Amendment is required.

After causing notice of the time and place of the public hearing and of the subject matter hereof to be published, posted and mailed to the Petitioner, abutters and other parties-in-interest as required by law, the hearing was called to order by the Chairperson, Artie Crocker on Tuesday, June 3, 2025 at 7:00 PM in

the Charles River Room, Needham Public Services Administration Building, 500 Dedham Avenue, Needham, MA, as well as by Zoom Web ID Number 880 4672 5264. Board members Artie Crocker, Justin McCullen, Adam Block and Natasha Espada were present throughout the proceedings. The record of the proceedings and the submission upon which this decision is based may be referred to in the office of the Town Clerk or the office of the Board.

EVIDENCE

Submitted for the Board's review were the following exhibits:

- Exhibit 1 - Application for an Amendment to the Major Project Special Permit No. 93-3, dated May 9, 2025.
- Exhibit 2 - Cover Letter from David Feldman, Wingate Development LLC, dated April 24, 2025.
- Exhibit 3 - Plans entitled "Site Development Plans for Wingate at Needham, inc., 589 Highland Avenue, Needham, MA," prepared by Kelly Engineering Group, Inc., 0 Campanelli Drive, Braintree, MA 02062, R.E. Cameron & Associates, Inc., 681 Washington Street, Norwood MA, consisting of 3 sheets: Sheet 1, C1, dated February 3, 2023; Sheet 2, entitled "Existing Conditions Plan," dated February 3, 2023; Sheet 3, entitled "Layout Plan," dated February 3, 2023, revised March 26, 2025.
- Exhibit 4 - Landscape Plans, entitled "Wingate at Needham Renovation / Expansion," prepared by Hawk Design Inc., Sagamore, MA, consisting of 3 sheets: Sheet 1, Sheet L1, entitled "Site Landscaping Plan," dated February 3, 2023, revised March 26, 2025; Sheet 2, Sheet L2, entitled "Entry Landscape Plan," dated February 3, 2023, revised March 26, 2025; Sheet 3, Sheet L3, entitled "Parking / Plan Landscape Plan," dated February 3, 2023, revised March 26, 2025.
- Exhibit 5 - Design Review Board memorandum and approval, dated May 19, 2025.
- Exhibit 6 - Email from David Feldman, replying to Health Department Comments, dated May 25, 2025.
- Exhibit 20 - Interdepartmental Communication (IDC) to the Board from Thomas Ryder, Town Engineer, dated May 29, 2025; IDC to the Board from Tara Gurge, Assistant Public Health Director, Health Department, dated May 28, 2025; IDC to the Board from Joe Prondak, Building Commissioner, dated May 13, 2025; IDC to the Board from Chief John Schlittler, Police Department, dated May 29, 2025; and IDC to the Board from Chief Tom Conroy, Fire Department, dated May 29, 2025.

Exhibits 1, 2, 3, 4 and 6 are referred to hereafter as the Plan.

FINDINGS AND CONCLUSIONS

The findings and conclusions made in Major Project Site Plan Special Permit No. 93-3, dated July 27, 1993, as amended August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013, and further amended on December 17, 2013, March 15, 2022, and May 16, 2023, were ratified and confirmed except as follows:

- 1.1 The subject property is located at 589 Highland Avenue, Needham, Massachusetts, at the corner of Highland Avenue and Gould Street in the Elder Services Zoning District. The property is

shown on Assessor's Map No. 77 as Parcel 1 containing a total of 110,490 square feet. The property is presently owned by Wingate Development, LLC, 57 Wells Ave, Suite 20, Newton, MA 02459.

- 1.2 The property has been the subject of several site plan special permit decisions and amendments thereto. The original decision was dated July 27, 1993, and was amended as follows: August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013, and further amended on December 17, 2013, March 15, 2022, and May 16, 2023.
- 1.3 By Decision dated March 15, 2022, the Planning Board approved an application for an amendment to permit the conversion of the then-current Nursing Home to 50 Independent Living (IL) Units. The Nursing Home was officially closed on or about April 21, 2022. The Petitioner intends to proceed with the work and the change of use authorized by that permit. By Decision dated May 16, 2023, the Planning Board approved the expansion of that project by adding a third floor to the building, adding an additional 22 IL units, for a total of 72 IL units, of which 12.5%, or 9 units, will be affordable, as defined in the Elder Services district By-Law. The requested Major Project Site Plan Review Special Permit Amendment would permit the modification of the approved site plan to add 2 EV changers, a Bocce court, Dog Run, extended sidewalk and 3 parking spaces. There is no change proposed to the building square footage or elevations, nor to any other conditions in the earlier Decisions.
- 1.4 The existing 2 story building will remain. The existing footprint of the building will not change, and a third story will be added to create another 22 IL units, above the 50 approved under the 2022 Amendment, for a total of 72 IL units. The building will contain approximately 81,995 square feet at completion.
- 1.5 As shown on the site layout and landscaping plans submitted, a total of 84 parking spaces are proposed to be on site. The Petitioner proposes adding 4 additional EV parking spaces to the most recently approved site plan.
- 1.6 A Dog Run is proposed along the westerly property line of the site at Putnam Street. There will also be a dog waste station located outside the fenced Dog Run area. The Dog Run area is currently shaded and will remain shaded, so the dogs have a place to cool off. The Petitioner has agreed to include in the resident's "house rules" for the property the following measures as relates the Dog Run facility: (1) residents shall pick up after their pets; and (2) potential noise produced on site, due to this new Dog Run area, shall be minimal, and not cause a potential public health nuisance concern to residents or to other neighboring properties. Maintenance staff at the facility will police the Dog Run area daily as part of their daily grounds check to pick up papers and debris and remove the bags from the waste station.
- 1.7 As indicated in the Zoning Table shown on the Plan, the lot conforms to zoning requirements as to area and frontage. As indicated in the Zoning Table shown on the Plan, the proposed building will comply with all applicable dimensional and density requirements of the Elder Services Zoning District namely, front, side and rear setback, maximum building height, maximum number of stories, and floor area ratio. As indicated in the Zoning Table shown on the Plan, the proposed parking lot currently already complies with all the Design Guidelines under Section 5.1.3 of the Zoning By-Law.
- 1.8 Pursuant to Section 3.12.9 of the By-Law, the parking requirement for independent living units is .5 spaces per unit, resulting in a required parking supply for this proposed redevelopment of 36 spaces. The Petitioner also anticipates 6 full-time employees which would require an additional 3

spaces (1 space per 2 employees). The additional parking requirement would bring the total required parking spaces to 39 spaces. As the proposed number of spaces on this site is 84, there is more than sufficient parking to satisfy the requirement.

- 1.9 The Petitioner appeared before the Design Review Board on May 19, 2025, and obtained approval of the project.
- 1.10 Adjoining premises will be protected against detrimental uses on the site by provision of surface water drainage, sound and site buffers and preservation of views, light and air. The site has been designed to ensure that there will be no off-site drainage impacts. A drainage system exists on site.
- 1.11 A landscape plan has been developed for screening and enhancing the proposed revisions to the site. The proposed EV parking spaces will be located next to already existing spaces. Noise and visual impacts have been minimized, and noise regulations will be part of the “house rules”. Abutting properties will be protected by means of the existing solid fence and mature trees. Shade trees already exist in the proposed new Dog Run area. There is no new lighting proposed.
- 1.12 Convenience and safety of vehicle and pedestrian movement within the site and on adjacent streets and the location of driveway openings in relation to traffic or to adjacent streets has been assured. The only changes proposed to the parking area are the 4 new EV spaces. No changes to circulation are proposed.
- 1.13 Adequate parking has been provided for staff, deliveries, visiting professionals, family and friends of residents.
- 1.14 Adequate methods of disposal of refuse and other waste resulting from the uses permitted on the site have been provided. There will be a dog waste station inside the Dog Run area.
- 1.15 The proposed project will not have any adverse impact on the Town’s resources, including the effect on the Town’s water supply and distribution system, sewer collection and treatment, fire protection and streets. No changes are proposed to the utilities and circulation.
- 1.16 Relationship of structures and open spaces to the natural landscape, existing buildings and other community assets in the area and compliance with other requirements of the By-Law has been met. No changes are proposed to the existing structures. The site is being revised to allow for amenities for residents; the existing stockade fence between properties will remain.
- 1.17 Under Section 7.4 of the By-Law and Section 4.2 of Major Project Site Plan Special Permit No. 93-3, dated July 27, 1993, as amended August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013 and further amended on December 17, 2013, March 15, 2022 and May 16, 2023, a Major Project Site Plan Special Permit Amendment may be granted in the Elder Services Zoning District, if the Board finds that the proposed project complies with the standards and criteria set forth in the provisions of the By-Law. Based on the above findings and criteria, the Board finds that the Approved Plan Set, as conditioned and limited herein for Site Plan Review, to be in harmony with the purposes and intent of the By-Law, to comply with all applicable By-Law requirements, to have minimal adverse impact and to have proposed a development which is harmonious with the surrounding area.

THEREFORE, the Board voted 4-0 to GRANT (1) a Major Project Site Plan Review Special Permit Amendment under Section 7.4 of the Zoning By-Law and Section 4.2 of Major Project Site Plan Special

Permit No. 93-3, dated July 27, 1993, as amended August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013 and further amended on December 17, 2013, March 15, 2022 and May 16, 2023; subject to the following plan modifications, conditions and limitations.

PLAN MODIFICATIONS

Prior to the issuance of a building permit or the start of any construction pertaining to this Decision, the Petitioner shall cause the Plan to be revised to show the following additional, corrected, or modified information. The Building Commissioner shall not issue any building permit for the work proposed in this Decision nor shall he permit any construction activity pertaining to this Decision to begin on the site until and unless he finds that the Plan is revised to include the following additional corrected or modified information. Except where otherwise provided, all such information shall be subject to the approval of the Building Commissioner. Where approvals are required from persons other than the Building Commissioner, the Petitioner shall be responsible for providing a written copy of such approvals to the Building Commissioner before the Commissioner shall issue any building permit or permit for any construction on the site. The Petitioner shall submit four copies of the final Plans as approved for construction by the Building Commissioner to the Board prior to the issuance of a Building Permit.

- 2.0 The Plans shall be modified to include the requirements and recommendations of the Board as set forth below. The modified plans shall be submitted to the Board for approval and endorsement.
- a) No Plan Modifications required.

CONDITIONS AND LIMITATIONS

The plan modifications, conditions and limitations contained in Major Project Site Plan Special Permit No. 93-3, dated July 27, 1993, as amended August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013, and further amended on December 17, 2013, March 15, 2022 and May 16, 2023, are ratified and confirmed except as modified herein.

- 3.0 The following conditions of this approval shall be strictly adhered to. Failure to adhere to these conditions or to comply with all applicable laws and permit conditions shall give the Board the rights and remedies set forth in Section 3.20 hereof.
- 3.1 The plan modifications, conditions and limitations contained in Major Project Site Plan Special Permit No. 93-3, dated July 27, 1993, as amended August 9, 1994, August 8, 1995, November 21, 1995, June 3, 1997, March 15, 2011, Insignificant Change on April 18, 2013, and further amended on December 17, 2013, March 15, 2022 and May 16, 2023, are ratified and confirmed, except as follows:
- 3.2 At least 84 paved parking spaces, including 48 full sized spaces, 33 compact spaces, and 4 EV spaces shall be provided on-site.
- 3.3 The Petitioner's maintenance staff shall police the Dog Run area daily as part of their daily grounds check to pick up paper and debris and remove the bags from the waste station.
- 3.4 The Petitioner shall include in the resident's "house rules" the following conditions as relates the Dog Run facility: (1) residents shall pick up after their pets; and (2) potential noise produced on site, due to the new Dog Run area, shall be minimal, and shall not cause a potential public health nuisance concern to residents or to other neighboring properties.

- 3.5 The Dog Run area is currently shaded and shall remain shaded, so the dogs have a place to cool off.
- 3.6 The building, parking areas, driveways, walkways, landscape areas, and other site and off-site features shall be constructed in accordance with the Plan, as modified by this Decision. Any changes, revisions or modifications to the Plan, as modified by this Decision, shall require approval by the Board.
- 3.7 The proposed building and support services shall contain the dimensions and shall be located on that portion of the locus exactly as shown on the Plan, and in accordance with the applicable dimensional requirements of the By-Law.
- 3.8 All buildings and land constituting the premises shall remain under a single ownership.
- 3.9 In addition to the provisions of this approval, the Petitioner must comply with all requirements of all state, federal, and local boards, commissions or other agencies, including, but not limited to, the Board of Selectmen, Building Commissioner, Fire Department, Department of Public Works, Conservation Commission, Police Department, and Board of Health.
- 3.10 All construction staging shall be on-site. No construction parking shall be on public streets. Construction parking shall be all on site or a combination of on-site and off-site parking at locations in which the Petitioner can make suitable arrangements. Construction staging plans shall be included in the final construction documents prior to the filing of a Building Permit and shall be subject to the review and approval of the Building Commissioner.
- 3.11 This Special Permit Amendment as described in this Decision is issued to Wingate Development, LLC, 57 Wells Ave, Suite 20, Newton, MA 02459. Prior to any change in the entity operating the facility (other than a change to an affiliated entity under common control with Wingate Development, LLC), Petitioner shall provide written notice of the anticipated change to the Board, and the new operating entity shall provide a written statement to the Board, signed by a person who will be responsible for the operations of the facility, that they have read this Decision and acknowledge that the terms hereof are binding on the new entity.
- 3.12 The final set of plans for the project site are as follows (**sheets revised by this decision are in bold**):
- 1) Architectural Plans, entitled “Wingate at Needham Renovation / Expansion,” prepared by The Architectural Team, Inc., 50 Commander’s Way at Admiral’s Hill, Chelsea, MA 02150, consisting of 10 sheets: Sheet 1, Sheet T0.01, entitled “Project Cover,” dated February 3, 2023; Sheet 2, Sheet D1.00, entitled “Existing/Demolition overall Plan – Basement,” dated February 3, 2023; Sheet 3, Sheet D1.01, entitled “Existing/Demolition Overall Plans (Schematic),” dated February 3, 2023; Sheet 4, Sheet A1.00, entitled “Proposed Overall Plan – Basement,” dated February 3, 2023, revised April 4, 2023; Sheet 5, Sheet A1.01, entitled “Proposed Overall Plans (Schematic),” dated February 3, 2023, revised April 4, 2023; Sheet 6, Sheet A1.02, entitled “Proposed Overall Plan Level 3 & Roof (Schematic),” dated February 3, 2023, revised April 4, 2023; Sheet 7, Sheet A4.01, “Exterior Elevations,” dated February 3, 2023; Sheet 8, Sheet A4.02, entitled “Exterior Elevations,” dated February 3, 2023; Sheet 9, Sheet A4.03, entitled “Exterior Elevations,” dated February 3, 2023; Sheet 10, Sheet A5.01, entitled “Wall Sections,” dated February 3, 2023.
 - 2) Landscape Plans, entitled “Wingate at Needham Renovation / Expansion,” prepared by Hawk Design Inc., Sagamore, MA, consisting of 7 sheets: Sheet 1, Cover Sheet, dated February 3, 2023;

Sheet 2, Sheet L1, entitled “Site Landscaping Plan,” dated February 3, 2023, revised March 26, 2025; Sheet 3, Sheet L1.1, entitled “Illustrative Site Plan Rendering,” dated February 3, 2023; Sheet 4, Sheet L2, entitled “Entry Landscape Plan,” dated February 3, 2023, revised March 26, 2025; Sheet 5, Sheet L3, entitled “Parking / Plan Landscape Plan,” dated February 3, 2023, revised March 26, 2025; Sheet 6, Sheet D1, entitled “Planting Details,” dated February 3, 2023; Sheet 7, Sheet D2, entitled “Planting Notes,” dated February 3, 2023.

- 3) Plans entitled “Site Development Plans for Wingate at Needham, inc., 589 Highland Avenue, Needham, MA,” prepared by Kelly Engineering Group, Inc., 0 Campanelli Drive, Braintree, MA 02062, R.E. Cameron & Associates, Inc., 681 Washington Street, Norwood MA, consisting of 3 sheets: **Sheet 1, Cover 1, dated February 3, 2023, revised March 26, 2025; Sheet 2, entitled “Existing Conditions Plan,” dated February 3, 2023; Sheet 3, entitled “Layout Plan,” dated February 3, 2023, revised March 26, 2025.**
 - 4) Renderings, entitled “Wingate at Needham Renovation / Expansion,” prepared by The Architectural Team, Inc., 50 Commander’s Way at Admiral’s Hill, Chelsea, MA 02150, consisting of 4 sheets: Sheet 1 entitled “Rendered View from Intersection of Gould Street and Highland Avenue,” dated March 30, 2023; Sheet 2, entitled “Rendered View from Gould Street Looking South,” dated March 30, 2023; Sheet 3, entitled “Rendered View from Rear parking,” dated March 30, 2023; Sheet 4, entitled “Rendered View from Side Entrance,” dated March 30, 2023.
- 3.13 All utilities, including telephone and electrical service, shall be installed underground from the street line.
 - 3.14 The maintenance of site and parking lot landscaping shall be the responsibility of the Petitioner, and the site and parking lot landscaping shall be maintained in good condition.
 - 3.15 The following interim safeguards shall be implemented during construction:
 - a. The hours of construction shall be 7:00 a.m. to 5:00 p.m. Monday through Saturday not at all on Sundays and holidays.
 - b. The Petitioner’s contractor shall provide temporary security chain-link or similar type fencing around the portions of the project site, which require excavation or otherwise pose a danger to public safety.
 - c. The Petitioner’s contractor shall designate a person who shall be responsible for the construction process. That person shall be identified to the Police Department, the Department of Public Works, the Building Commissioner, and the abutters and shall be contacted if problems arise during the construction process. The designee shall also be responsible for assuring that truck traffic and the delivery of construction material does not interfere with or endanger traffic flow on Highland Avenue, Gould Street or surrounding streets.
 - 3.16 No building permit shall be issued for the proposed project in pursuance of the Special Permit and Site Plan Approval until:
 - a. The final plans shall be in conformity with those approved by the Board, and a statement certifying such approval shall have been filed by this Board with the Building Commissioner.
 - b. The Petitioner shall have recorded with the Norfolk County Registry of Deeds a certified copy of this Decision granting this Special Permit and Site Plan Approval with the

appropriate reference to the book and page number of the recording of the Petitioner's title deed or notice endorsed thereon.

- 3.17 No building or structure, or portion thereof, subject to this Special Permit and Site Plan Approval shall be occupied until:
- a. An as-built plan, supplied by the engineer of record certifying that the on-site and off-site project improvements were built according to the approved documents, has been submitted to the Board and Department of Public Works. The as-built plan shall show the building, all finished grades and final construction details of the driveways, parking areas, drainage systems, utility installations, and sidewalk and curbing improvements on-site and off-site, in their true relationship to the lot lines. In addition to the engineer of record, said plan shall be certified by a Massachusetts Registered Land Surveyor.
 - b. There shall be filed with the Building Commissioner and Board a statement by the Department of Public Works certifying that the finished grades and final construction details of the driveways, parking areas, drainage systems, utility installations, and sidewalks and curbing improvements on-site and off-site, have been constructed to the standards of the Town of Needham Department of Public Works and in accordance with the approved Plan.
 - c. There shall be filed with the Board and Building Commissioner a Final Construction Control Document signed by a registered architect upon completion of construction.
 - d. There shall be filed with the Board and Building Commissioner an as-built Landscaping Plan showing the final location, number and type of plant material, final landscape features, parking areas, and lighting installations. Said plan shall be prepared by the landscape architect of record and shall include a certification that such improvements were completed according to the approved documents.
 - e. Notwithstanding the provisions of Sections a, b, and d hereof, the Building Commissioner may issue one or more certificates for temporary occupancy of all or portions of the buildings prior to the installation of final landscaping and other site features, provided that the Petitioner shall have first filed with the Board in an amount not less than 135% of the value of the aforementioned remaining landscaping or other work to secure installation of such landscaping and other site and construction features.
- 3.18 The building or structure authorized for construction by this permit shall not be occupied or used, and no activity except the construction activity authorized by this permit shall be conducted within said area until a Certificate of Occupancy and Use or a Certificate of Temporary Occupancy and Use has been issued by the Building Commissioner.
- 3.19 The Petitioner, by accepting this permit Decision, warrants that the Petitioner has included all relevant documentation, reports, and information available to the Petitioner in the application submitted, that this information is true and valid to the best of the Petitioner's knowledge.
- 3.20 Violation of any of the conditions of this Approval shall be grounds for revocation of any building permit or certificate of occupancy granted hereunder as follows: In the case of violation of any conditions of this Approval, the Town will notify the owner of such violation and give the owner reasonable time, not to exceed thirty (30) days, to cure the violation. If, at the end of said thirty (30) day period, the Petitioner has not cured the violation, or in the case of violations requiring more than thirty (30) days to cure, has not commenced the cure and prosecuted the cure continuously, the permit granting authority may, after notice to the Petitioner, conduct a hearing

in order to determine whether the failure to abide by the conditions contained herein should result in a recommendation to the Building Commissioner to revoke any building permit or certificate of occupancy granted hereunder. This provision is not intended to limit or curtail the Town's other remedies to enforce compliance with the conditions of this Approval including, without limitation, by an action for injunctive relief before any court of competent jurisdiction. The Petitioner agrees to reimburse the Town for its reasonable costs in connection with the enforcement of the conditions of this Approval if the Town prevails in such enforcement action.

LIMITATIONS

- 4.0 The authority granted to the Petitioner by this permit is limited as follows:
- 4.1 This permit applies only to the site and off-site improvements, which are the subject of this petition. All construction to be conducted on-site and off-site shall be conducted in accordance with the terms of this permit and shall be limited to the improvements on the Plan, as modified by this Decision.
- 4.2 There shall be no further development of this site without further site plan approval as required under Section 7.4 of the By-Law. The Board, in accordance with M.G.L., Ch. 40A, S.9 and said Section 7.4, hereby retains jurisdiction to (after hearing) modify and/or amend the conditions to, or otherwise modify, amend or supplement, this Decision and to take other action necessary to determine and ensure compliance with the Decision.
- 4.3 This Decision applies only to the requested Special Permits and Site Plan Review. Other permits or approvals required by the By-Law, other government boards, agencies or bodies having jurisdiction shall not be assumed or implied by this Decision.
- 4.4 No approval of any indicated signs or advertising devices is implied by this Decision.
- 4.5 The foregoing restrictions are stated for the purpose of emphasizing their importance but are not intended to be all-inclusive or to negate the remainder of the By-Law.
- 4.6 This Site Plan Special Permit Amendment shall lapse on June 17, 2027, if substantial use thereof has not sooner commenced, except for good cause. Any requests for an extension of the time limits set forth herein must be in writing to the Board at least 30 days prior to June 17, 2027. The Board herein reserves its rights and powers to grant or deny such extension without a public hearing. The Board, however, shall not grant an extension as herein provided unless it finds that the use of the property in question or the construction of the site has not begun, except for good cause.

This approval shall be recorded in the Norfolk District Registry of Deeds. This Special Permit Amendment shall not take effect until a copy of this decision bearing the certification of the Town Clerk that twenty (20) days have elapsed after the decision has been filed in the Town Clerk's office or that if such appeal has been filed, that it has been dismissed or denied is recorded with Norfolk District Registry Deeds and until the Petitioner has delivered a certified copy of the recorded document to the Board.

The provisions of this Special Permit Amendment shall be binding upon every owner or owner of the lots and the executors, administrators, heirs, successors and assigns of such owners, and the obligations and restrictions herein set forth shall run with the land, as shown on the Plan, in full force and effect for the benefit of and enforceable by the Town of Needham.

Any person aggrieved by this decision may appeal pursuant to the General Laws, Chapter 40A, Section 17 within twenty (20) days after filing of this decision with the Needham Town Clerk.

Witness our hands this 17th day of June, 2025.

NEEDHAM PLANNING BOARD

Artie Crocker, Chairperson

Justin McCullen

Adam Block

Natasha Espada

COMMONWEALTH OF MASSACHUSETTS

Norfolk, ss _____, 2025

On this ____ day of _____, 2025, before me, the undersigned notary public, personally appeared _____, one of the members of the Planning Board of the Town of Needham, Massachusetts, proved to me through satisfactory evidence of identification, which was _____, to be the person whose name is signed on the preceding or attached document, and acknowledged the foregoing to be the free act and deed of said Board before me.

Notary Public:

My Commission Expires: _____

TO WHOM IT MAY CONCERN: This is to certify that the 20-day appeal period on the Amendment to Decision of the project proposed by Wingate Development, LLC, 57 Wells Ave, Suite 20, Newton, MA 02459, for property located at the 589 Highland Avenue, Needham, Massachusetts, has passed,

____ and there have been no appeals filed in the Office of the Town Clerk or
____ there has been an appeal filed.

Date

Louise Miller, Town Clerk

Copy sent to:

Petitioner-Certified Mail # _____
Design Review Board
Building Commissioner
Conservation Commission
David Feldman, Wingate

Select Board
Engineering
Fire Department
Police Department

Board of Health
Town Clerk
Director, PWD
Parties in Interest

LEGAL NOTICE
Planning Board
TOWN OF NEEDHAM
NOTICE OF HEARING

In accordance with the provisions of M.G.L., Chapter 40A, S. 11, and the Needham Zoning By-Laws, Sections 7.4, and Section 4.2 of Major Site Plan Special Permit No. 2012-07 dated October 16, 2012, amended and restated April 2, 2013, and amended on September 17, 2013, January 6, 2015, April 28, 2015, November 10, 2015 and April 25, 2016 and June 4, 2021, the Needham Planning Board will hold a public hearing on Tuesday, June 17, 2025 at 7:15 PM in the Charles River Room, Needham Public Services Administration Building, 500 Dedham Avenue, Needham, MA, as well as by Zoom Web ID Number 880 4672 5264 (further instructions for accessing are below), regarding the application of The Children's Hospital, 300 Longwood Avenue, Boston, MA for an amendment to Major Project Special Permit No. 2012-07, dated October 16, 2012, amended and restated April 2, 2013, and amended on September 17, 2013, January 6, 2015, April 28, 2015, November 10, 2015 and April 25, 2016 and June 4, 2021.

The subject property is located at 66 B Street, 360 First Avenue, 410 First Avenue, 2 B and 37 A Street, Needham, MA, shown on Assessor's Map No. 300 as Parcel 28 containing 13.68 acres in the New England Business Center Zoning District.

The requested Major Project Site Plan Review Special Permit Amendment would permit certain modifications to the conditions in the 2021 Amendment as follows: (1) Amend Section 1.11 and Condition 3.3 to allow the Town to utilize \$30,000 (currently held by the Town of Needham) on traffic operations improvements at a Town intersection other than the intersection of 3rd Avenue and Kendrick Street as is currently written. (2) Amend Condition 3.4 so that the traffic monitoring program commences three years following receipt of the final Certificate of Occupancy for the Pediatric Medical Facility building located at 360 First Avenue, rather than one year as is currently written. (3) Amend Section 1.8 and Condition 3.5 to clarify that the Applicant will fulfill its obligations thereunder by providing the Town with \$25,000 to fund the Traffic Signal Warranty Analysis and Roadway Safety Audit of the Kendrick Street and 4th Avenue intersection. There is no change proposed to the building square footage or elevations, nor to any other conditions in the earlier Decisions.

In accordance with the Zoning By-Law, Section 7.4 and Major Project Site Plan Special Permit No. 2012-07, a Major Project Site Plan Special Permit Amendment is required.

To view and participate in this virtual meeting on your phone, download the "Zoom Cloud Meetings" app in any app store or at www.zoom.us. At the above date and time, click on "Join a Meeting" and enter the following Meeting ID: 880 4672 5264

To view and participate in this virtual meeting on your computer, at the above date and time, go to www.zoom.us click "Join a Meeting" and enter the following ID: 880 4672 5264

Or to Listen by Telephone: Dial (for higher quality, dial a number based on your current location): US: +1 312 626 6799 or +1 646 558 8656 or +1 301 715 8592 or +1 346 248 7799 or +1 669 900 9128 or +1 253 215 8782 Then enter ID: 880 4672 5264

Direct Link to meeting: <https://us02web.zoom.us/j/88046725264>

The application may be viewed at this link:

<https://www.needhamma.gov/Archive.aspx?AMID=146&Type=&ADID=> . Interested persons are encouraged to attend the public hearing and make their views known to the Planning Board. This legal notice is also posted on the Massachusetts Newspaper Publishers Association's (MNPA) website at (<http://masspublicnotices.org/>).

NEEDHAM PLANNING BOARD

Needham Hometown Weekly, May 29, 2025 and June 5, 2025

RECEIVED TOWN CLERK
NEEDHAM, MA 02492

2025 MAY 19 PM 2:17

TOWN OF NEEDHAM
MASSACHUSETTS



500 Dedham Avenue
Needham, MA 02492
781-455-7550

PLANNING BOARD

APPLICATION FOR SITE PLAN REVIEW

Project Determination: (circle one)

Major Project

Amendment
Minor Project

This application must be completed, signed, and submitted with the filing fee by the applicant or his representative in accordance with the Planning Board's Rules as adopted under its jurisdiction as a Special Permit Granting Authority. Section 7.4 of the By-Laws.

Location of Property Center 128 West - 66 B Street, 360 First Avenue, 410 First Avenue, 2B Street and 37A street
Name of Applicant The Children's Hospital Corporation
Applicant's Address 300 Longwood Avenue, Boston, MA 02215
Phone Number (857) 218-5073

Applicant is: Owner _____ Tenant _____
Agent/Attorney X _____ Purchaser _____

Property Owner's Name CHB Properties, Inc.
Property Owner's Address 300 Longwood Avenue, Boston, MA 02215
Telephone Number (857) 218-5073

Characteristics of Property: Lot Area 13.68 acres Present Use Pediatric Medical Facility
Map # 300 Parcel # 28 Zoning District New England Business Center

Description of Project for Site Plan Review under Section 7.4 of the Zoning By-Law:

Amendment of Special Permit No. 2012-07, as amended on April 2, 2013, Sept. 17, 2013, Jan. 6, 2015, April 28, 2015, Nov. 10, 2015, April 25, 2016, and Jan. 4, 2021, to update certain conditions contained in the 2021 Amendment.

Signature of Applicant (or representative) *Timothy Sullivan, as attorney for Owner and Applicant*
Address if not applicant One Post Office Square, 25th Floor, Boston, MA 02109
Telephone # (617) 574-0515
Owner's permission if other than applicant _____

SUMMARY OF PLANNING BOARD ACTION

Received by Planning Board *[Signature]* Date 5/15/25
Hearing Date _____ Parties of Interest Notified of Public Hearing _____
Decision Required by _____ Decision/Notices of Decision sent _____
Granted _____
Denied _____ Fee Paid _____ Fee Waived _____
Withdrawn _____

NOTE: Reports on Minor Projects must be issued within 35 days of filing date.

May 12, 2025

BY OVERNIGHT DELIVERY & ELECTRONIC MAIL

Town of Needham Planning Board Members
Public Service Administration Building
500 Dedham Avenue
Needham, MA 02492
Attn: Ms. Lee Newman

Re: Center 128 West - 66B Street, 360 First Avenue, 410 First Avenue, 2B Street and 37A Street (collectively, the "Property")

Dear Planning Board Members:

We are counsel to The Children's Hospital Corporation (the "Applicant"), 300 Longwood Avenue, Boston, Massachusetts 02115, an affiliate of Boston Children's Hospital, in connection with the Property, which is subject to the terms of that certain Major Project Site Plan Special Permit issued on October 16, 2012 (the "Original Decision") by the Planning Board (the "Board"), as amended by subsequent decisions issued by the Board on April 2, 2013, September 17, 2013, January 6, 2015, April 28, 2015, November 10, 2015, April 25, 2016, and January 4, 2021 (collectively, the "Amendments" and, together with the Original Decision, the "Existing Special Permit").

Pursuant to Chapter 40A of the Massachusetts General Laws, the Needham Zoning By-Law, the Board Rules and Section 4.2 of the Original Decision, the Applicant is proposing minor amendments to the Existing Special Permit to implement the following adjustments discussed with the Town:

1. Amend Section 1.11 and Condition 3.3 to allow the Town to utilize \$30,000 (currently held by the Town of Needham (the "Town")) on traffic operations improvements at a Town intersection other than the intersection of 3rd Avenue and Kendrick Street as is currently written. This update is necessary because the Commonwealth of Massachusetts is not permitting work to be done at 3rd Avenue and Kendrick Street as originally contemplated by the Existing Special Permit.
2. Amend Condition 3.4 so that the monitoring program commences three (3) years following receipt of the final Certificate of Occupancy for the

Pediatric Medical Facility building located at 360 First Avenue; rather than one (1) year as is currently written. The three (3) year time frame will allow for more accurate monitoring results because the Applicant will not start welcoming patients until at least six (6) months after the Certificate of Occupancy is issued, and, following the initial patient visits there is a "ramp-up" period before the facility is fully operational.

3. Amend Section 1.8 and Condition 3.5 to clarify that the Applicant will fulfill its obligations thereunder by providing the Town with \$25,000 to fund the Traffic Signal Warranty Analysis and Roadway Safety Audit of the Kendrick Street and 4th Avenue intersection.

In support of the Application, enclosed are the following materials and information:

1. Application for a minor modification to the Special Permit; and
2. Check payable to the Town in the amount of \$1,000, representing the filing fee for the Application.

We appreciate your attention to this matter. Thank you for your cooperation.

Very truly yours,

Timothy Sullivan

Timothy W. Sullivan
Attorney for The Children's
Hospital Corporation

Enclosures

Alexandra Clee

From: John Schlittler
Sent: Thursday, May 22, 2025 1:23 PM
To: Alexandra Clee
Subject: RE: Request for comment - Children's amendment

Police is fine

From: Alexandra Clee <aclee@needhamma.gov>
Sent: Thursday, May 22, 2025 12:07 PM
To: Joseph Prondak <jprondak@needhamma.gov>; Thomas Ryder <tryder@needhamma.gov>; John Schlittler <JSchlittler@needhamma.gov>; Tara Gurge <TGurge@needhamma.gov>; Timothy McDonald <tmcDonald@needhamma.gov>; Tom Conroy <TConroy@needhamma.gov>; Carys Lustig <clustig@needhamma.gov>
Cc: Elisa Litchman <elitchman@needhamma.gov>; Lee Newman <LNewman@needhamma.gov>; Justin Savignano <jsavignano@needhamma.gov>; Donald Anastasi <DAnastasi@needhamma.gov>; Jay Steeves <steevesj@needhamma.gov>; Ronnie Gavel <rgavel@needhamma.gov>
Subject: Request for comment - Children's amendment

Dear all, << File: DATE STAMPED application and Letter_Children's amend. 2025.pdf >>

We have received the attached application materials for the proposal by the Petitioner for an amendment to the existing Boston Children's permit. More information can be found in the attached application.

The Planning Board has scheduled this matter for June 17, 2025. Please send your comments **by Wednesday June 11, 2025**, at the latest.

The documents attached for your review are detailed below:

1. Application for Amendment.
2. Cover Letter from Timothy W. Sullivan, Goulston Storrs, dated May 12, 2025.

Thank you, alex.

Alexandra Clee
Assistant Town Planner
Needham, MA
781-455-7550 ext. 271
www.needhamma.gov/planning

Alexandra Clee

From: Joseph Prondak
Sent: Tuesday, May 27, 2025 1:17 PM
To: Alexandra Clee
Subject: RE: Request for comment - Children's amendment

Hi Alex,

The Building Department has no objections nor other concerns for these amendments.

Sincerely,

Joe Prondak
Needham Building Commissioner
781-455-7550 x72308

From: Alexandra Clee <aclee@needhamma.gov>
Sent: Thursday, May 22, 2025 12:07 PM
To: Joseph Prondak <jprondak@needhamma.gov>; Thomas Ryder <tryder@needhamma.gov>; John Schlittler <JSchlittler@needhamma.gov>; Tara Gurge <TGurge@needhamma.gov>; Timothy McDonald <tmcDonald@needhamma.gov>; Tom Conroy <TConroy@needhamma.gov>; Carys Lustig <clustig@needhamma.gov>
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Alexandra Clee
Assistant Town Planner
Needham, MA
781-455-7550 ext. 271
www.needhamma.gov/planning

Alexandra Clee

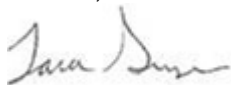
From: Tara Gurge
Sent: Monday, June 9, 2025 3:04 PM
To: Alexandra Clee
Subject: RE: Request for comment - Children's amendment - Public Health comments

Follow Up Flag: Flag for follow up
Flag Status: Flagged

Alex –

The Public Health Division conducted the review of the Boston Children's Amendment, and we have no additional comments to share at this time.

Thanks,



TARA E. GURGE, R.S., C.E.H.T., M.S. (she/her/hers)
ASSISTANT PUBLIC HEALTH DIRECTOR
Needham Public Health Division
Health and Human Services Department
178 Rosemary Street
Needham, MA 02494
Ph- (781) 455-7940; Ext. 211/Fax- (781) 455-7922
Mobile- (781) 883-0127
Email - tgurge@needhamma.gov
Web- www.needhamma.gov/health



 please consider the environment before printing this email

STATEMENT OF CONFIDENTIALITY

This e-mail, including any attached files, may contain confidential and privileged information for the sole use of the intended recipient(s). Any review, use, distribution or disclosure by others is strictly prohibited. If you are not the intended recipient (or authorized to receive information for the recipient), please contact the sender by reply e-mail and delete all copies of this message. Thank you.

From: Alexandra Clee <aclee@needhamma.gov>
Sent: Thursday, May 22, 2025 12:07 PM
To: Joseph Prondak <jprondak@needhamma.gov>; Thomas Ryder <tryder@needhamma.gov>; John Schlittler <JSchlittler@needhamma.gov>; Tara Gurge <TGurge@needhamma.gov>; Timothy McDonald <tmcDonald@needhamma.gov>; Tom Conroy <TConroy@needhamma.gov>; Carys Lustig <clustig@needhamma.gov>
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2. Cover Letter from Timothy W. Sullivan, Goulston Storrs, dated May 12, 2025.

Thank you, alex.

Alexandra Clee
Assistant Town Planner
Needham, MA
781-455-7550 ext. 271
www.needhamma.gov/planning

From: [Tom Conroy](#)
To: [Alexandra Clee](#)
Subject: RE: Request for comment - Children's amendment
Date: Thursday, June 12, 2025 2:18:42 PM

Sorry Alex! No issues with the Fire department.

Thanks,

Tom

Thomas M. Conroy

Fire Chief - Needham Fire Department

tconroy@needhamma.gov

Ph (781) 455-7580

From: Alexandra Clee <aclee@needhamma.gov>
Sent: Thursday, June 12, 2025 1:18 PM
To: Tom Conroy <TConroy@needhamma.gov>
Cc: Lee Newman <LNewman@needhamma.gov>
Subject: FW: Request for comment - Children's amendment

Hi Chief,

Any comments?

THanks!

Alexandra Clee

Assistant Town Planner

Needham, MA

781-455-7550 ext. 72271

www.needhamma.gov

From: Alexandra Clee

Sent: Thursday, May 22, 2025 12:07 PM

To: Joseph Prondak <jprondak@needhamma.gov>; Thomas Ryder <tryder@needhamma.gov>; John Schlittler <JSchlittler@needhamma.gov>; Tara Gurge <TGurge@needhamma.gov>; Timothy McDonald <tmcdonald@needhamma.gov>; Tom Conroy <TConroy@needhamma.gov>; Carys Lustig <clustig@needhamma.gov>
Cc: Elisa Litchman <elitchman@needhamma.gov>; Lee Newman <LNewman@needhamma.gov>; Justin Savignano <jsavignano@needhamma.gov>; Donald Anastasi <DAnastasi@needhamma.gov>; Jay Steeves <steevesj@needhamma.gov>; Ronnie Gavel <rgavel@needhamma.gov>

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The Planning Board has scheduled this matter for June 17, 2025. Please send your comments **by Wednesday June 11, 2025**, at the latest.

The documents attached for your review are detailed below:

1. Application for Amendment.
2. Cover Letter from Timothy W. Sullivan, Goulston Storrs, dated May 12, 2025.

Thank you, alex.

Alexandra Clee

Assistant Town Planner

Needham, MA

781-455-7550 ext. 271

www.needhamma.gov/planning



**Department of Public Works
Engineering Division**
500 Dedham Avenue
Needham, MA 02492
781-455-7550
www.needhamma.gov

June 11, 2025

Needham Planning Board
Public Service Administration Building
Needham, MA 02492

RE: Amendment Major Project Special Permit No. 2012-07
360 & 41 First Ave & 66 B Street- Children's Hospital

Dear Members of the Board:

The Department of Public Works has completed its review of the request from the applicant to amend the Boston Children's Hospital decision. The proposed amendment will allow Children's Hospital ramp-up period before monitoring traffic flow. The town may utilize \$30,000 currently held to be used for traffic mitigation not contemplated during the original application submittal. An additional \$25,000 will be provided to the town to fund traffic analysis at Kendrick and 4th Avenue.

The additional documents submitted for review are as follows:

1. Application for Amendment.
2. Cover Letter from Timothy W. Sullivan, Goulston Storrs, dated May 12, 2025.

Our comments and recommendations are as follows:

- We have no comments or objections to the proposed amendment

If you have any questions regarding the above, please contact our office at 781-455-7550.

Truly yours,

Thomas A Ryder
Town Engineer

June 3, 2025

55 Walkers Brook Drive, Suite 100, Reading, MA 01867
Tel: 978.532.1900

Needham Planning Board
Public Services Administration Building
500 Dedham Avenue
Needham, MA 02492

Re: **DPW Complex Phase I Fleet Maintenance Facility: 1407 Central Avenue (Jack Cogswell Building)**
Response to Planning Board Comments

Dear Members of the Needham Planning Board:

Weston & Sampson, on behalf of the Town of Needham's (Town) Department of Public Works (the Applicant), is pleased to present a response to comments package pertaining to the Planning Board feedback we received on May 20th relative to the above-referenced project.

The attachments associated with this response letter include new material for the Planning Board's review. Attachments A and B are new documents, Attachment C is the revised Traffic Report, and Attachment D is the stormwater report associated with our Conservation Commission approval, which was not submitted in our first Planning Board filing and has been provided per the Planning Board's request.

We have attached the following digital materials in support of this application (e-mailed to aclee@needhamma.gov):

- The response to comments narrative
- Attachment A: Photometric Plan
- Attachment B: Proposed Automotive Fluid Storage and Spill Prevention Measures
- Attachment C: Updated Traffic Report
- Attachment D: Stormwater Management Report

If you have any questions or would like to discuss this further, please do not hesitate to contact us at (603) 263-9498.

Sincerely,

WESTON & SAMPSON ENGINEERS, INC.



Jesse O'Donnell
Project Manager I



Tyler J. Cofelice, P.E.
Project Manager II

June 03, 2025

55 Walkers Brook Drive, Suite 100, Reading, MA 01867
Tel: 978.532.1900

Needham Planning Board
Town of Needham
500 Dedham Avenue
Needham, MA 02492

Re: **Response to Comments—1407 Central Ave. Jack Cogswell Building Addition – Fleet Maintenance**

Dear Members of the Planning Board:

As part of the Town of Needham's Planning Board Site Plan Review process for the proposed Jack Cogswell Building Addition at 1407 Central Avenue, Weston & Sampson has received comments from the Health and Human Services Department (dated May 14, 2025), the Engineering Department (dated May 19, 2025) as well as comments received during the May 20th Planning Board public hearing. We have included each comment below in *italics*, with our corresponding responses in **bold** text.

Health & Human Services Department Comments

- 1. Please install sufficient and approved mechanism(s) to prevent the discharge of oil, gasoline, grease, sand, and other substances that are harmful or hazardous to building drainage systems and/or the public sewer system, to this garage addition, per 248 CMR, § 10.09 - Interceptors, Separators and Holding Tanks. Per MA Dept. of Environmental Protection (MassDEP) and MA Wellhead Protection regulation guidance, no floor drain shall be allowed to discharge without pretreatment, such as an oil/water separator, etc. All floor drains added to this new garage addition need to have a mechanism installed prior to the direct connection to the municipal sewer line. (**Please Note:** Connection of a separation system to a sewer shall adhere to Massachusetts Department of Environmental Protection rules located at 314 CMR 7.00: Sewer System Connection and Extension Permit Program).*

An oil water separator is proposed in the paved area outside of the new building addition to offer pretreatment prior to discharge into the sanitary sewer, in accordance with the governing regulations.

- 2. If new exterior lighting is installed, the lights shall not cause a public health nuisance and should be directed down towards the ground in order to prevent the risk of bright light migrating into other neighboring residential properties.*

Lighting is proposed to be mounted on the building walls; no pole-mounted site lighting is planned. Since Weston & Sampson's Site Plan Review submission on April 15, Arora Engineers has prepared a photometric plan demonstrating that the proposed lighting will not increase illumination levels on abutting properties, in compliance with local regulations. The photometric plan is included with this letter as Attachment A.

- 3. Due to the installation of the new generator, please ensure that the noise produced will be minimal, and muffled if necessary, and not cause a public health nuisance noise concern for the abutting neighbors.*

To mitigate the noise produced by the proposed generator, a comprehensive Environmental Sound Study has been prepared by Cavanaugh Tocci Associates, Inc. and is included as Appendix B in Weston & Sampson's Site Plan Review filing with the Planning Board. A sound barrier wall is proposed on the site plans (Appendix D of the Site Plan Review filing) to mitigate noise produced by the generator in a manner that is consistent with the relevant MassDEP regulations and the Environmental Sound Study.

4. *Please have the applicant apply for a dumpster permit through the Public Health Division. See direct link to this online permit application -- <https://needhamma.portal.opengov.com/categories/1073/record-types/1006346>.*

Acknowledged.

5. *Ensure that the applicant has on-going dust control due to the potential dust that could be produced from the drilling of the ledge. Please control any potential nuisance dust and/or noise created.*

The project specifications will provide a dust control specification (Section 01 14 19.16), which will require the General Contractor to implement site-specific dust control measures.

6. *On-going pest control must be conducted before construction starts, and also throughout the construction project, to prevent the risk of pests.*

The project specifications will include pest control measures (Section 01 57 16) for the General Contractor throughout construction.

7. *Please ensure that the applicant completes the final approval requirements and obtain an approved Geothermal Well permit through the Public Health Division. Application has been applied for and is in the plan review process.*

Acknowledged.

Engineering Department

1. *As part of the NPDES requirements, the applicant has submitted a letter proposing Public Out Reach & Education and Public Participation & Involvement control measures to be incorporated into the Planning Board's Decision to be completed prior to Certificate of Occupancy.*

Acknowledged. This will be coordinated with the Building Design & Construction Department and the Town Engineering Department during construction.

Paraphrased Planning Board Comments

1. *Provide a summary of how the proposed design will protect the environment, including stormwater management measures and the handling and storage of hazardous materials such as motor oil to be used at the facility.*

A copy of the stormwater report, submitted as part of the Conservation Commission's Notice of Intent (NOI) application, is included as Attachment D. This report provides a detailed explanation of how the proposed stormwater management system complies with all ten Massachusetts Stormwater Standards, which are intended to protect water quality and the environment.

A summary of the types and quantities of automotive fluids proposed to be stored and used on site, along with the measures that will be implemented to ensure their proper management and environmental protection, is included as Attachment B.

2. *Provide clarification on the following items related to the traffic study: how vehicles will be dropped off and picked up; how vehicles will be routed through town to access the fleet maintenance facility; proposed site ingress and egress; confirmation that traffic counts include third-party vendor trips; documentation of stopping sight distances; and a response to concerns from the 2014 traffic study regarding entrance and exit visibility and stopping distances.*

Weston & Sampson has prepared an updated traffic report addressing these comments, included as Attachment C.

3. *Clarify when construction of the sewer line extension will occur and provide an estimate of how long the work is expected to take.*

The proposed low-pressure sewer extension along Central Avenue is approximately 630 feet in length. Based on anticipated rock removal and full pavement restoration, including milling and overlay, construction is expected to take approximately 4 to 5 weeks. This estimate accounts for trench excavation through areas of ledge, pipe installation, and full-width roadway resurfacing.

To minimize traffic impacts, the work can be scheduled during the summer months when school is not in session, avoiding the heaviest traffic periods along Central Avenue.

Sincerely,

WESTON & SAMPSON ENGINEERS, INC.



Tyler J. Cofelice, P.E.

Project Manager II

ATTACHMENT A
PHOTOMETRIC PLAN



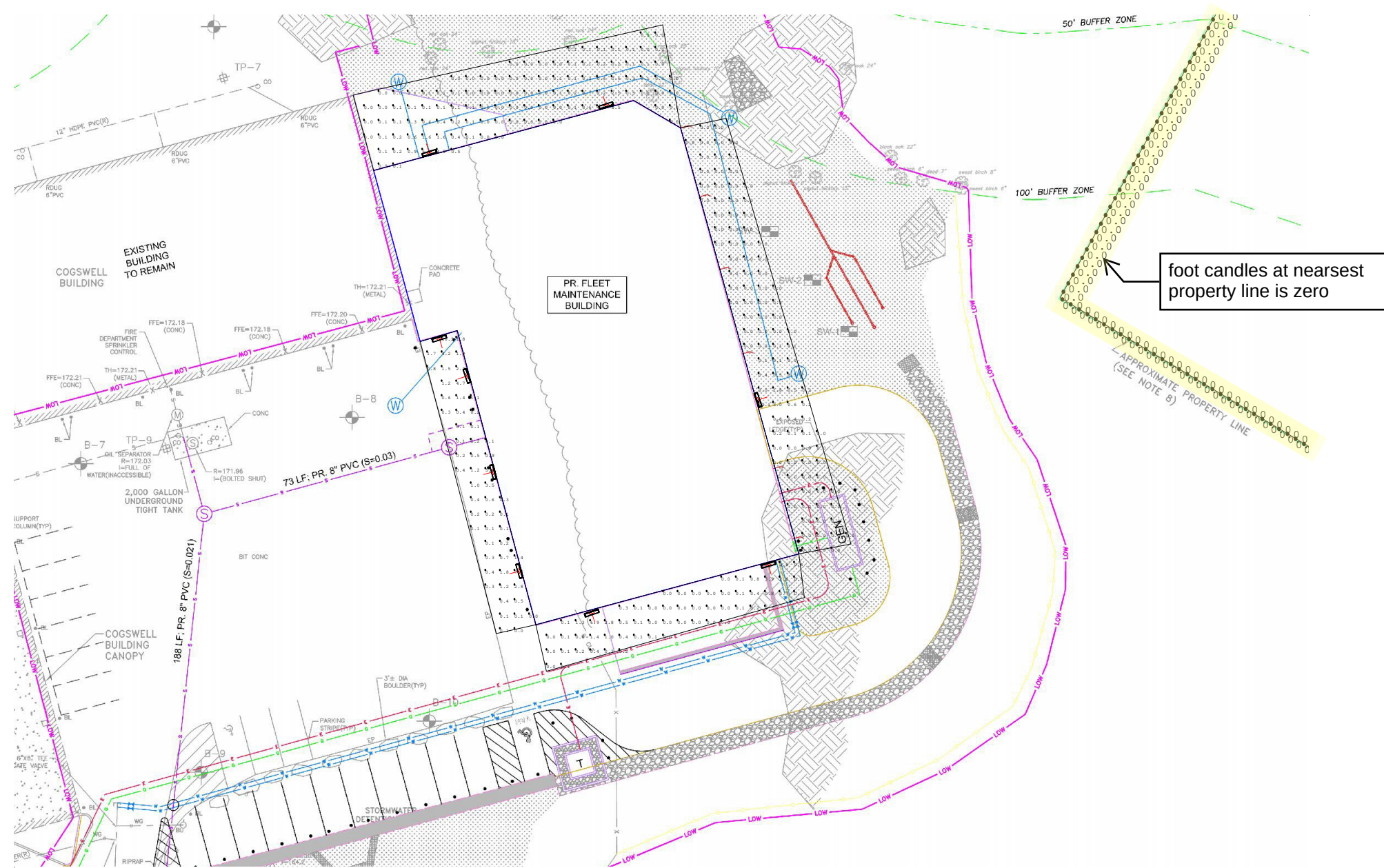
Summary

Project Name: 161824.001 - Town of Needham - DPW
Facility Expansion Lighting Photometric

Firm: Arora Engineers, LLC

Date: 5/20/2025

Viewpoint - Cont.



VIEWPOINT: Viewpoint_5

ATTACHMENT B
PROPOSED AUTOMOTIVE FLUID STORAGE
AND SPILL PREVENTION MEASURES

Proposed Automotive Fluid Storage and Spill Prevention Measures Needham Fleet Maintenance Facility – 1407 Central Avenue

As part of the proposed improvements to the Town of Needham's Fleet Maintenance Facility, a dedicated fluid storage room and associated infrastructure will be constructed to safely store and manage the automotive fluids used in municipal fleet operations. The proposed design is focused on regulatory compliance, environmental protection, and the prevention of accidental spills or releases.

Proposed Fluids and Storage Volumes

The following fluids are proposed to be stored on-site:

Bulk Storage Tanks (UL-142 rated, double-walled steel):

- 200 gallons – 15W-40 Motor Oil
- 200 gallons – Hydraulic Oil
- 100 gallons – 5W-20 Motor Oil
- 100 gallons – 5W-30 Motor Oil
- 600 gallons – Waste Oil

55-Gallon Drums:

- (2) Waste Antifreeze
- (2) 0W-20 Motor Oil
- (2) Heavy Duty Automatic Transmission Fluid
- (2) Standard Automatic Transmission Fluid
- (2) Heavy Duty Antifreeze
- (2) Standard Antifreeze

Small Containers:

- Various quart- and gallon-sized containers stored on shelving within the fluid storage room

The proposed fluid storage room will be constructed of 2-hour fire-rated CMU walls and feature a sealed concrete floor designed to act as secondary containment. All 55-gallon drums will be placed on spill pallets that can contain the full volume of a leaking drum, helping to isolate any localized leaks.

Bulk fluids will be stored in UL-142-rated double-walled steel tanks, each incorporating multiple spill prevention and safety features. These tanks consist of a primary inner tank and a secondary outer tank, which together provide built-in secondary containment. In the event of a failure of the primary tank wall, the outer shell will contain the released fluid, preventing it from entering the environment. An interstitial space between the two tank walls is continuously monitored using a leak detection gauge, which provides early warning of a breach in the primary tank. Each tank will also be equipped with an overfill prevention valve, which automatically shuts off fluid delivery when the tank nears capacity—reducing the risk of accidental overflow during refilling operations. A visual level gauge on each tank provides staff with real-time fluid levels and further ensures tanks are never inadvertently overfilled.

Additional spill prevention measures will include readily accessible spill response supplies such as Speedi-Dri absorbent, spill pads, and booms stored within the fluid room. In the unlikely event of a system failure or unnoticed leak, the sealed floor of the storage room provides a final containment layer. If fluid were to reach a

floor drain, it would be directed to the on-site oil-water separator, which is specifically designed to capture and remove petroleum-based contaminants before any water is discharged from the facility.

Fluids will be distributed to overhead reel banks in the maintenance bays via stainless steel piping supplied by pneumatic pumps. The system will be controlled by a motorized valve on a timeclock, which will shut off the compressed air supply after hours to prevent unattended operation. Additionally, a heat-actuated shutoff valve will disable the air supply in the event of a fire. Should a leak occur in the distribution lines, the spilled fluid would be captured by the sealed floor and directed to a floor drain leading to the oil-water separator.

An emergency eyewash and shower station will be installed within the fleet maintenance bays to allow for immediate response in the event of accidental exposure.

These proposed measures are intended to ensure safe, compliant, and environmentally responsible fluid management as part of the Town's upgraded fleet maintenance operations.

ATTACHMENT C
UPDATED TRAFFIC REPORT

MEMORANDUM

TO: Town of Needham Planning Board

FROM: Doug Ostler, PE, PTOE, Weston & Sampson

DATE: April 11, 2025
Revised June 2, 2025

SUBJECT: Needham Fleet Maintenance Facility – Traffic Impact Assessment



 Digitally Signed
2025.06.02
18:17:01-04'00'

Introduction

Weston & Sampson has prepared this traffic impact assessment for a proposed fleet maintenance facility addition to the Town of Needham's Department of Public Works (DPW) complex on the north side of Central Avenue west of Marked Tree Road. Based on the size and expected use of the proposed fleet maintenance facility, this report will review existing traffic volumes on the adjacent street, approximate trip generation of the facility, and discuss traffic impacts, if any, that are expected with the proposed facility.

The traffic impact assessment was revised following the Planning Board public hearing on May 20, 2025, to address specific questions raised during the meeting. In particular, the Planning Board requested clarification on several aspects of the original study, including: the process for vehicle drop-off and pick-up; how vehicles will be routed through town to access the site; proposed ingress and egress points; confirmation that traffic counts include trips by third-party vendors; documentation of stopping sight distances; and a response to concerns from a 2014 traffic study regarding visibility and sight distances at the site entrances.

Proposed Fleet Maintenance Facility

Site Modifications

The proposed Fleet Maintenance Facility will be on the east side of the existing Cogswell Building. The existing Cogswell Building is used for equipment storage for the town. A portion of the Cogswell building is being considered for an extra vehicle bay for servicing tires/wheels while the remainder will continue to be used for storage. The proposed facility will provide four vehicle bays to facilitate maintenance and repairs of Town of Needham vehicles. The proposed project will modify the adjacent pavement and parking area and a portion of the internal road connection to support vehicular movement to/from the facility.

Proposed Access

The proposed fleet maintenance garage will utilize the existing driveways currently used to access the Cogswell Storage Garage and the Recycling Transfer Station (RTS). No changes are proposed to the directional flow or restrictions of any of the four existing driveways.

Ingress to the fleet maintenance garage will occur at the easternmost driveway, which currently serves the Cogswell Storage Garage. This driveway is restricted to DPW staff and fleet vehicles only and is not open to the public. Egress from the facility will occur at either the third driveway from the east, or the driveway furthest west. The third driveway from the east currently serves as the primary public exit from the site and includes two outbound lanes. The driveway furthest west allows both ingress and egress movements to the RTS but is not available for the proposed Fleet Maintenance Facility on Mondays due to a closed gate at the RTS. Drivers of heavy vehicles at the RTS are asked to use the westernmost driveway when possible as its intersection with Central Avenue provides increased visibility. Driveway Visibility is discussed in the next section. Figure 1 illustrates the designated ingress and egress routes for the proposed facility.

Driver Visibility Exiting Existing Driveways

During the Planning Board hearing, there was concerns raised regarding the adequacy of sight distance at the third from the east driveway on Central Avenue, which is one of the two driveways the new fleet maintenance facility will use to exit onto Central Avenue. Sight distance methodology is established within the *Policy on Geometric Design of Highways and Streets* manual published by the American Association of State Highway and Transportation Officials (AASHTO)¹. Stopping sight distance is considered the minimum required visibility to safely stop before an obstruction. Intersection sight distance is the recommended sight distance which is based on the visible distance needed to allow an entering vehicle from the driveway to not cause an approaching vehicle on Central Avenue to reduce its travel speed to less than 70% of the roadway design speed. The calculations are based on the posted speed, design speed (if different), or 85th percentile speed (if measured). The posted speed limit on Central Avenue is 30 miles per hour and the 85th percentile speed was measured as 38-39 miles per hour over the 2 days recorded.

A 2014 traffic study conducted by Pare Corporation² documented sight distance requirements and driveway visibility at the RTS. The Pare traffic study refers to this driveway as the center driveway (the RTS facility provided 3 driveways—what is now the public entrance driveway was not constructed at that time). Visibility measured at the driveway was 310 feet to the right (viewing eastbound approaching traffic) and over 500 feet to the left (viewing westbound approaching traffic). The Pare traffic study noted the stopping sight distance required based on a 40 miles per hour evaluation speed is 305 feet which sufficient visibility is provided in both directions. The Pare traffic study noted the intersection sight triangle distance at 40 miles per hour is 385 feet for passenger vehicles and 445 feet for single-unit trucks. Visibility at the driveway is greater than this distance looking to the left and is less than this distance looking to the right. The Pare traffic study notes that according to AASHTO's *Policy on Geometric Design of Highways and Streets*, if the available ISD is at least equal to the required stopping sight distance (SSD), the intersection can be considered safe for operation.

On Tuesday through Sunday, the RTS gate is open, exiting vehicles from the fleet maintenance facility are to use the westernmost driveway to enter Central Avenue. The Pare traffic study measured visibility

¹ "Policy on Geometric Design of Highways and Streets, 7th Edition", American Association of State Highway Transportation Officials, Washington, DC, 2018.

² John Shevlin, "Needham Facilities Master Plan Traffic Engineering Services DPW and Fire/Police Buildings Needham, Massachusetts", Pare Corporation,

at this driveway to be 475 feet to the right (viewing eastbound approaching traffic) and over 500 feet to the left (viewing westbound approaching traffic). Thus, the primary driveway exiting to Central Avenue provides visibility beyond stopping sight distance and intersection sight distance in both directions.

While it is acceptable for heavy vehicles to exit the site at the driveways, it is recommended to prioritize repair and servicing of heavy vehicles on days when the westernmost driveway is open for the facility for improved driver visibility of Central Avenue traffic.

Existing Roadway Description and Traffic Volumes

Central Avenue is functionally classified as an urban minor arterial, and it connects Elliot Street in Newton to Centre Avenue in Dover. Adjacent to the site, Central Avenue is approximately twenty-five feet wide and provides one eleven-foot-wide lane in each direction with a center double yellow stripe and white shoulder stripes. The posted speed limit within the vicinity of the site is 40 miles per hour (MPH).

Traffic volume counts with vehicular classification and speed data on Central Avenue were collected for forty-eight hours on Tuesday, February 25, through Wednesday, February 26, 2025. Based on the month of the traffic counts and functional classification, the traffic count data does not require a seasonal adjustment factor per Massachusetts Department of Transportation published correction factors. The traffic counts show an average of 13,953 daily traffic on Central Avenue. The AM peak hour began at 7:30 AM and was comprised of 1,302 vehicles, which was 9.3 percent of daily traffic. The PM peak hour began at 4:15 PM and was comprised of 1,249 vehicles, which was 9.0 percent of daily traffic. Truck traffic on Central Avenue averaged 2.0 percent of all vehicular traffic throughout the day. During the peak hours, truck percentage of total vehicular traffic was 2.4 percent during the AM peak hour and 0.6 percent during the PM peak hour. The 85th percentile speeds on Central Avenue on both days was 38 MPH eastbound and 39 MPH westbound.

Traffic impact assessments typically consider not only project-generated trips but also background growth in traffic volumes unrelated to the proposed development. Weston & Sampson reviewed historical traffic data for Central Avenue east of the Recycling Transfer Station, using MassDOT counts from 2016, 2019, and 2025. The 2025 daily volume of 13,953 vehicles reflects an average annual growth rate of 1.3% from 2016 (12,453 vehicles/day), but a 0.6% average annual decrease from 2019 (14,438 vehicles/day). This decline may be partially attributable to lasting effects of the COVID-19 pandemic on commuting patterns and local travel behavior.

It is acknowledged that future developments—such as a daycare facility, pickleball courts, and a skate park across the street—are expected to contribute to increased traffic in the future. The daycare entered construction in 2023 and is expected to open in the future. Funding for the Claxon Field Renovation Project was appropriated in 2024. However, no traffic impact assessments or trip generation data for those projects were provided to Weston & Sampson at the time of this report. Future impacts from area developments should be addressed individually through their respective permitting processes.

Given the most recent decline in background traffic recorded on Central Avenue and an expectation of additional background trips from other developments, this assessment applies a 1.0% annual growth rate over 2 years for analysis purposes. Thus, the projected background traffic volumes on Central Avenue if the proposed facility open in 2027 is 14,233 vehicles per day of which 283 are heavy vehicles.

Trip Generation of Proposed Development

Trip generation estimates for the proposed Fleet Maintenance Facility are based on three categories.

Service and Repair Trips

These are trips related to vehicles being dropped off and picked up for maintenance. Weston & Sampson reviewed recent maintenance records provided by the Town of Needham Department of Public Works (DPW), which documented 774 vehicle repairs between 2023 and 2024. To account for some repairs for which are not documented, this evaluation increases the repair totals by 10%, for a total number of annual service visits of approximately 851. This equates to an average of 3.3 vehicle repair visits per workday, aligning with the DPW's typical range of 2 to 5 repairs per day. Vehicles to be repaired or serviced may arrive from a variety of locations and delivery methods. The following is considered in the evaluation of the proposed facility's projected trip generation:

- Some of the annual service visits included in the total account for inspections may performed off-site, which would not result in trips to the facility. Thus, some of the vehicle servicing accounted for in this assessment will not result in generated trips to/from the proposed facility.
- Approximately 20–25% of current repairs originate at the adjacent Recycling Transfer Station (RTS), which currently require vehicles to travel across town to 470 Dedham Avenue. Under the proposed plan, these trips will travel between the RTS and the proposed facility on site, reducing public road usage. Due to access conditions, these trips to the maintenance facility will travel a short distance on Central Street adjacent to the overall RTS facility; these trips are not projected to add trips east or west of the RTS facility. Trips exiting the maintenance facility will return to their stored bays in the RTS facility without using Central Avenue.
- Similar to the DPW vehicles stored at the RTS facility, several DPW vehicles are already stored at the adjacent Cogswell Storage Garage that will no longer need to be serviced at another location and will result in reducing public road usage.
- Some vehicle service trips require a secondary vehicle to follow the vehicle to be serviced in order to pick up the driver. This can generate up to 6 trips if 3 trips are generated in delivery of the vehicle to be serviced and 3 trips are generated in retrieval of the serviced vehicle.
- Some vehicle service trips occur as an employee delivers a vehicle to be repaired and leaves with another vehicle that has finished servicing. This can generate 2 trips shared with at least 1 other serviced vehicle, potentially generating 1 trip per serviced vehicle.

To remain conservative in the traffic assessment, a total of 6 service vehicle arrivals and 6 departures per weekday (12 trips total) is assumed. This estimate is intentionally cautious based on the variety of storage locations and trip generation characteristics described above.

Staff Commute Trips

The facility will have six employees working typical shifts from 6:30 AM to 3:00 PM. Staff commuting trips based on the shift start and end times occur outside of the AM and PM peak periods recorded on Central Avenue. A total of 12 weekday staff trips (6 arrivals and 6 departures) is assumed.

Vendor and Other Delivery Trips

Additional incidental trips from vendors and parts deliveries are also expected. Based on input from the Fleet Maintenance Department, vendor traffic averages between 1–2 trips per day. For analysis purposes, a conservative estimate of 8 incidental trips per day (4 in, 4 out) is used to capture these deliveries and any operational needs.

Total Project Trip Generation Estimate

A detailed breakdown of projected weekday trip generation is presented in Table 1. Of the 32 total weekday trips, approximately 26 (over 80%) are expected to occur during non-peak hours, with only 6 trips projected on Central Avenue external to the RTS facility during traditional AM and PM peak hours.

Table 1 - Trip Generation Estimates

Trip Type	Peak Hour	In	Out	Total
Repair Trips (approximately 20% of trips are heavy vehicles)	Weekday, AM Peak Hour	2	2	4
	Weekday, PM Peak Hour	0	0	0
	Weekday, Total of Non-Peak Hours	4	4	8
	Weekday, Total	6	6	12
Staff Commute Trips	Weekday, AM Peak Hour	0	0	0
	Weekday, PM Peak Hour	0	0	0
	Weekday, Total of Non-Peak Hours	6	6	12
	Weekday, Total	6	6	12
3 rd Party Vender Supply, Parts Delivery, and Other Trips	Weekday, AM Peak Hour	1	1	2
	Weekday, PM Peak Hour	0	0	0
	Weekday, Total of Non-Peak Hours	3	3	6
	Weekday, Total	4	4	8
Total Trips	Weekday, AM Peak Hour	3	3	6
	Weekday, PM Peak Hour	0	0	0
	Weekday, Total of Non-Peak Hours	13	13	26
	Weekday, Total	16	16	32

Trip Distribution Through Town

External repair-related trips are expected to primarily originate from or return to the existing fleet facility at 470 Dedham Avenue, where many Town vehicles are currently stored. Staff commute patterns will vary based on individual residences. However, the DPW has indicated that most staff driving or ferrying vehicles to the Recycling Transfer Station (RTS) prefer routes to the west of the facility—specifically South Street to Charles River Street—over eastern routes through Dedham Street to Great Plain Avenue. This preference is especially common when operating heavy vehicles due to lighter traffic, wider, more navigable turns, and easier turns onto Central Avenue.

The western route often provides equal or better travel times during periods of congestion on Great Plain Avenue. For the purposes of this study, up to 75% of external trips will approach from or depart on Central Avenue towards High Rock Street, of which none are heavy vehicles. The remainder will approach from or depart on Central Avenue towards Charles River Street, of which include all heavy vehicle trips.

Overall, the project is anticipated to generate approximately 32 total daily trips of which 4 daily trips are heavy vehicles. To the east of the facility, 24 new daily trips on Central Avenue are expected including no new heavy vehicle trips—equating to a 0.2% increase in total traffic volumes. To the west of the facility, 8 new daily trips on Central Avenue are expected including 4 new heavy vehicle trips—equating to a 0.1% increase in total traffic volumes and 1.4% increase in heavy vehicle traffic volumes.

To minimize neighborhood impacts, the DPW has proposed a Standard Operating Procedure prohibiting the use of Marked Tree Lane for vehicle drop-offs and pickups related to the Fleet Maintenance Facility. Figure 2 provides for a visual representation of service trips through town.

Conclusions

The proposed fleet maintenance facility is expected to generate a total of 32 weekday trips, including vehicle repairs, staff commuting, and incidental vendor deliveries. This projection is deliberately conservative—it intentionally underestimates the expected likelihood of staff consolidating trips by efficiency dropping off and picking up vehicles, the occurrence of trips staying within the greater Recycling Transfer Station, vehicle inspections that do not occur at the Fleet Maintenance Facility, and likely overestimation of vendor activity that does not occur daily. Furthermore, the projected trip generation does not deduct existing trips that would no longer occur by vehicles stored at the Recycle Transfer Station that currently need to be serviced offsite.

To the east of the facility, 24 new daily trips on Central Avenue are expected including no new heavy vehicle trips—equating to a 0.2% increase in total traffic volumes. To the west of the facility, 8 new daily trips on Central Avenue are expected including 4 new heavy vehicle trips—equating to a 0.1% increase in total traffic volumes and 1.4% increase in heavy vehicle traffic volumes.

Of the 32 total trips, approximately 26 will occur outside of Central Avenue's AM and PM peak hours. Only six trips (3 in, 3 out) are estimated during the morning peak hour, and no trips are expected during the PM peak hour based on staff work schedules.

Projected increase in traffic on Central Avenue to the east and west represents just 0.1% of daily traffic volumes, and up to four heavy vehicle trips per day (1.4% of existing heavy vehicle traffic)—well within the normal day-to-day variability of traffic patterns recorded in the traffic counts.

The projected trips generated by the project will not have a meaningful impact to traffic on Central Avenue. Many of the vehicles served by this facility are already operating on-site or adjacent at the Recycling Transfer Station, meaning a portion of traffic is internalized and will not contribute to public road volumes. Additionally, the Town has committed to prohibiting use of Marked Tree Lane through a formal Standard Operating Procedure to avoid neighborhood cut-through traffic.

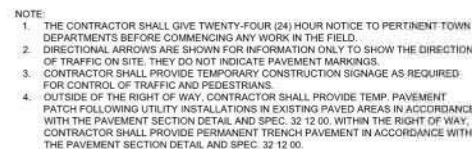
While it is acceptable for heavy vehicles to exit the site at the driveways, it is recommended to prioritize repair and servicing of heavy vehicles on days when the westernmost driveway is open for the facility for improved driver visibility of Central Avenue traffic.

In sum, the fleet maintenance facility is designed to improve operational efficiency for the DPW without generating meaningful new demand on the surrounding roadway network. The low number of daily trips, the off-peak distribution, and the operational characteristics in place all support the conclusion that this project will not create an adverse impact on traffic.

List of Attachments

Attachment A	Site Plan
Attachment B	Figure 1 – Proposed Entrance and Exit Diagram
Attachment C	Figure 2 – Trip Distribution
Attachment D	Traffic Projections
Attachment E	Selected Excerpts from 2014 Pare Traffic Study
Attachment F	Traffic Counts

Attachment A Site Plan



	PR. BITUMINOUS PAVEMENT
	PR. CONCRETE
	LIMIT OF PROPOSED WORK
	PR. LOAM & SEED
	PR. CRUSHED ROCK (REPURPOSED BLASTED/REMOVED LEDGE)
	PR. BUILDING ADDITION

<u>ZONING BY-LAW SECTION</u>	<u>DESCRIPTION [1]</u>
5.1.3(a) [2]	PARKING ILLUMINATION, AVERAGE OF 1 FOOTCANDLE
5.1.3(n) [2]	BICYCLE RACKS
5.1.3(k) & 5.1.3(n)	PARKING AREA LANDSCAPING

[1] REFER TO THE NARRATIVE SUBMITTED WITH THE MAJOR PROJECT SITE PLAN SPECIAL PERMIT APPLICATION FOR FURTHER INFORMATION PERTAINING TO EACH WAIVER REQUEST.

[2] WAIVER REQUESTED IS A CONTINUANCE OF THE SAME WAIVER REQUEST THAT WAS GRANTED AS PART OF THE PLANNING BOARD'S NOVEMBER 20, 2018 AMENDMENT DECISION.

TOWN OF NEEDHAM ZONING BY-LAW

OVERLAY DISTRICT(S): **11.** WIRELESS COMMUNICATIONS FACILITIES TOWERS, ADULT USE, LARGE SCALE GROUND-MOUNTED SOLAR PV INSTALLATIONS, TEMPORARY METEOROLOGICAL TOWERS.

<u>DIMENSIONAL CONSTRAINT</u>	<u>ZONE: SRA REQUIREMENTS</u>	<u>EXISTING</u>	<u>PROPOSED</u>
MIN. LOT AREA (AC)	1	76±	NO CHANGE
MIN. FRONTAGE (FL)	150	1260±	NO CHANGE
MIN. FRONT YARD SETBACK (FL) [2]	35	4.9 [3]	186.9
MINIMUM SIDE YARD SETBACK (FL) [2]	25	53.2	96.7
MINIMUM REAR YARD SETBACK (FL) [2]	25	1640	2062
MAX. FLOOR AREA RATIO	0.30	<= 0.30	<= 0.30
MAX.% LOT COVERAGE	15%	<= 15%	<= 15%
MAX. STORY HEIGHT (FL)	2.5	1	1.5
MAXIMUM BUILDING HEIGHT (FL)	35	22±	33.8
PARKING SPACES	SEE [4]	3	12
MIN. TRANSITION AREA (FL)	25	4.9 [3]	1604

N/A = NOT APPLICABLE
 >> = SUBSTANTIALLY GREATER THAN
 << = SUBSTANTIALLY LESS THAN

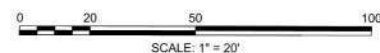
☐ THE REQUIREMENTS OF THE LISTED OVERLAY DISTRICTS DO NOT DIRECTLY APPLY TO OR IMPACT THE PROJECT

1) THE REQUIREMENTS OF THE LISTED OVERLAY DISTRICTS DO NOT DIRECTLY APPLY TO OR IMPACT THE PROJECT.

2) EXISTING BACKSAP DATA WAS OBTAINED FROM SHEET C0.01 OF THE STAMPED SITE PLANS ASSOCIATED WITH THE NOVEMBER 20, 2018 AMENDMENT DECISION APPROVING A MAJOR PROJECT SITE PLAN, SPECIAL PERMIT FOR THE FLEET FACILITY.

3) THE EXISTING GUARD SHED IS A STRUCTURE (LESS THAN 100 SQ. FT.) LOCATED 4.8 FT FROM THE FRONT PROPERTY LINE. IT IS ASSUMED THE STRUCTURE WILL REMAIN AS AN EXISTING, NONCONFORMING STRUCTURE.

14 [4] PER THE NOVEMBER 2018 AMENDMENT DECISION ISSUED BY THE PLANNING BOARD, THE EXISTING FLEET FACILITY CONTAINS 3 OUTDOOR PARKING SPACES. 9 ADDITIONAL SPACES ARE PROPOSED TO ACHIEVE A TOTAL PARKING COUNT OF 12 SPACES, BASED ON PARKING NEEDS PROJECTED BY OPWV STAFF. THE SPACES LISTED IN THE PARKING TABLE (5.1.2 OF THE NEEDHAM ZONING BY-LAW) DO NOT APPEAR TO DIRECTLY RELATE TO THE USE OF THE PROJECT. PER 5.1.2, IN THIS CIRCUMSTANCE, THE PLANNING BOARD SHALL RECOMMEND A REASONABLE NUMBER OF SPACES TO ACCOMMODATE THE PROJECT. THE APPLICANT HAS REQUESTED 12 SPACES TO MEET THE PROJECT STAKEHOLDERS. THE APPLICANT BELIEVES THE 12 PROPOSED SPACES WILL ADEQUATELY SERVE THE PARKING NEEDS OF THE BUILDING ADDITION TO THE FACILITY.



Weston & Sampson

Weston & Sampson Engineers, Inc.
100 Foxborough Boulevard, Suite 250
Foxborough, MA 02035
978.532.1900 800.SAMPSON
www.westonandsampson.com

Consultants

[illegible]

COA

Rest

Issued For:

DESIGN
DEVELOPMENT
REVIEW

Scale: AS NOTED

Date:	MARCH 7, 2025
Drawn By:	JLO
Reviewed By:	JP
Approved By:	TJC

W&S Project No.: ENG24-0773
W&S File No:

Drawing Title

SITE LAYOUT AND MATERIALS PLAN

Sheet Number

C300

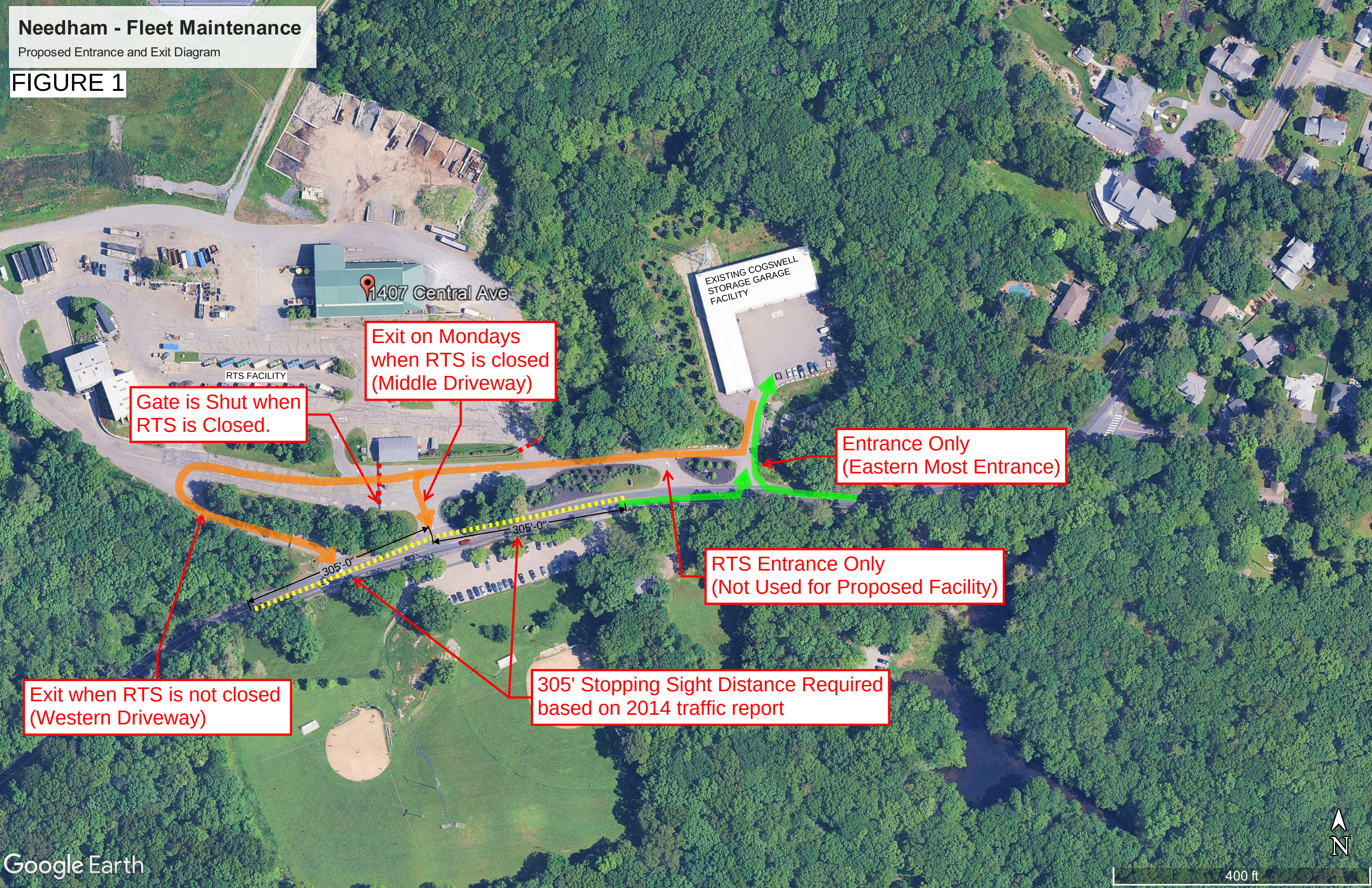
COPYRIGHT © 2025 WESTON & SAMPSON, INC.

Attachment B Figure 1 – Proposed Entrance and Exit Diagram

Needham - Fleet Maintenance

Proposed Entrance and Exit Diagram

FIGURE 1



Attachment C Figure 2 – Trip Distribution

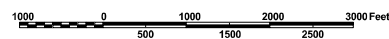
FIGURE 2- TRIP DISTRIBUTION



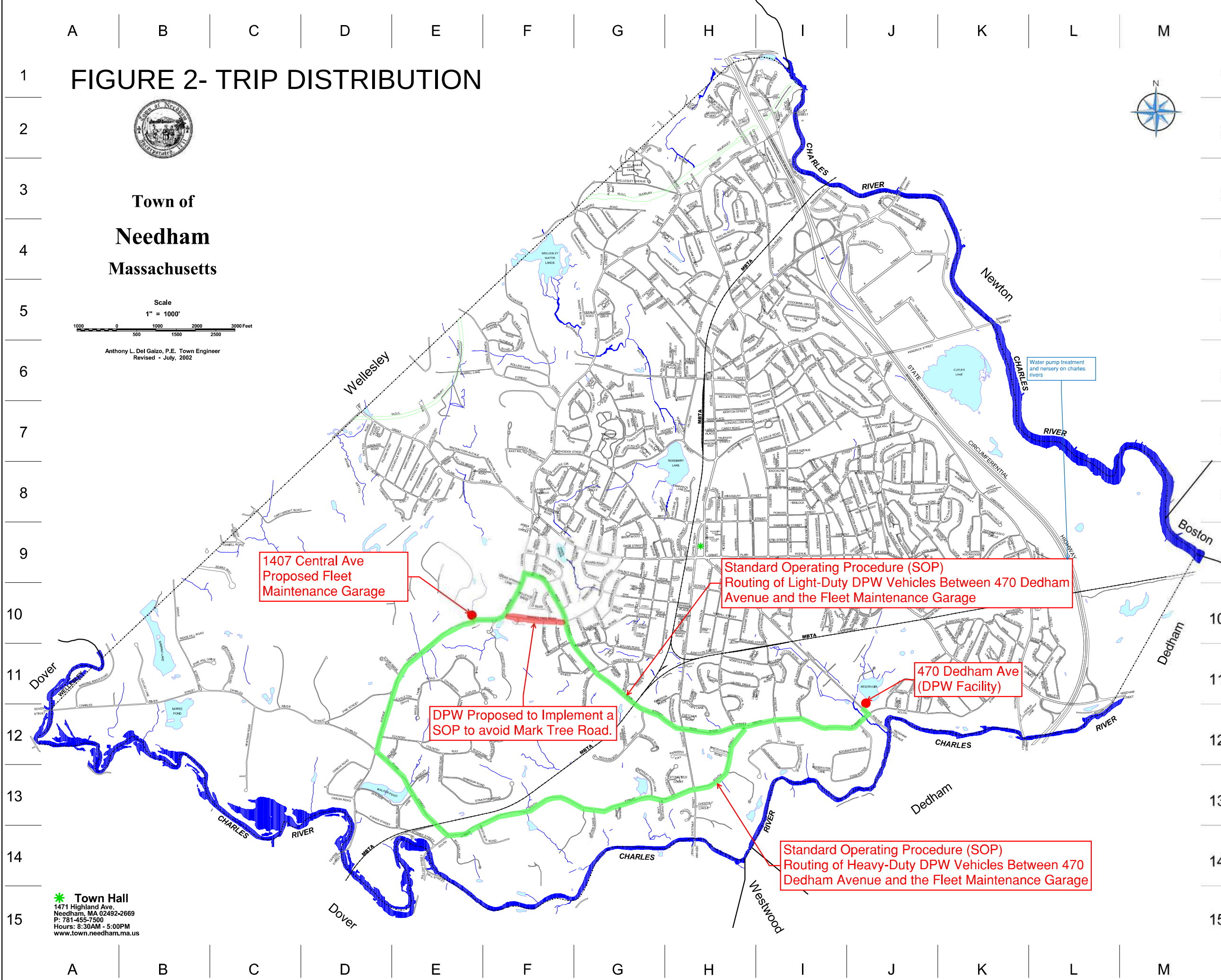
**Town of
Needham
Massachusetts**

Scale

1" = 1000'



Anthony L. Del Gaizo, P.E. Town Engineer
Revised - July, 2002



1407 Central Ave
Proposed Fleet
Maintenance Garage

Standard Operating Procedure (SOP) Routing of Light-Duty DPW Vehicles Between 470 Dedham Avenue and the Fleet Maintenance Garage

470 Dedham Ave
(DPW Facility)

DPW Proposed to Implement a SOP to avoid Mark Tree Road.

Standard Operating Procedure (SOP) Routing of Heavy-Duty DPW Vehicles Between 470 Dedham Avenue and the Fleet Maintenance Garage

*** Town Hall**
1471 Highland Ave.
Needham, MA 02492-2669
P: 781-455-7500
Hours: 8:30AM - 5:00PM
www.town.needham.ma.us

[illegible]

Attachment D Traffic Projections

Traffic Projections

2-day Averages from 48-hour counts

Day Total		Non Heavy	Heavy	Total
	Both Directions	13,676	278	13,953
	% Trucks			2.0%

AM Peak Hour		Non Heavy	Heavy	Total
7:30 AM	EB	649	20	669
	WB	621	12	633
	Both Directions	1,270	32	1,302
	% Trucks			2.5%
	K-Value			9.3%
	D-Value			51.4%

PM Peak Hour		Non Heavy	Heavy	Total
4:15 PM	EB	629	4	633
	WB	612	5	617
	Both Directions	1,241	8	1,249
	% Trucks			0.6%
	K-Value			9.0%
	D-Value			50.6%

ADT Comparison with Older Traffic counts

Year	2016	2019	2025
EB	6,150	6,981	6,861
WB	6,303	7,457	7,093
Total	12,453	14,438	13,953
% Change	12.0%	-3.4%	
Annual % Change	1.3%	-0.6%	

Traffic Projections

Projected ADT for analysis purposes

Consider an annual background growth for 2 years: 1.0%

	All	Heavy
2025	13,953	278
2026	14,093	280
2027	14,233	283

Projected Site and Total Traffic

	All	Heavy
If site generates	32	4
And is split	75%	0% to the east
and	25%	100% to the west

To the east...

The site adds	24	0
To 2017 traffic	14,233	283
For a total of	14,257	283
which is an increase of	0.17%	0.00%

To the west...

The site adds	8	4
To 2017 traffic	14,233	283
For a total of	14,241	287
which is an increase of	0.06%	1.39%

Attachment E Selected Excerpts from 2014 Pare Traffic Study



Engineers | Scientists | Planners

PARECORP.COM



July 31, 2014

Mr. William R. Hammer, AIA
HKT Architects Inc.
35 Medford Street
Somerville, MA 02143

Re: **Needham Facilities Master Plan**
Traffic Engineering Services
DPW and Fire/Police Buildings
Needham, Massachusetts
PARE Project No. 14116.01

Dear Mr. Hammer:

Pare Corporation (PARE) has completed the requested traffic study to determine the potential impacts of two alternatives for the construction of a new Department of Public Works (DPW) facility at two locations in Needham, Massachusetts. The two new DPW locations under consideration include a shared location with the existing Recycling/Transfer Station (RTS) on Central Avenue and an undeveloped property, known as Parcel 74, on Greendale Avenue (between Cheney Street and Brookline Street). The existing DPW is located at 470 Dedham Avenue. The findings of this investigation are discussed below.

Site Descriptions

Existing DPW Facility

The existing Needham DPW facility is located at 470 Dedham Avenue (Massachusetts Route 135) just west of the Dedham Avenue/South Street signalized intersection. DeFazio Park is located just west of the DPW and the two sites share the western driveway. Dedham Avenue is classified as an Urban Principal Arterial and has a posted speed limit of 40 mile per hour in the vicinity of the site. Dedham Avenue consists of one 11-foot wide travel lane in each direction with 1-foot wide shoulders. Sidewalk is located on the north side of the roadway and is separated from traffic by a grass buffer.

The main entrance to the DPW is located approximately 450 feet north of South Street and operates as a two-way driveway. The second access point to the DPW is shared with DeFazio Park and is located approximately 1,000 feet to the west. Two-way access to the rear of the DPW facility is provided through the DeFazio Park parking lot and is frequently used by the DPW. Figure 1 shows the location of the existing DPW facility and surrounding area.

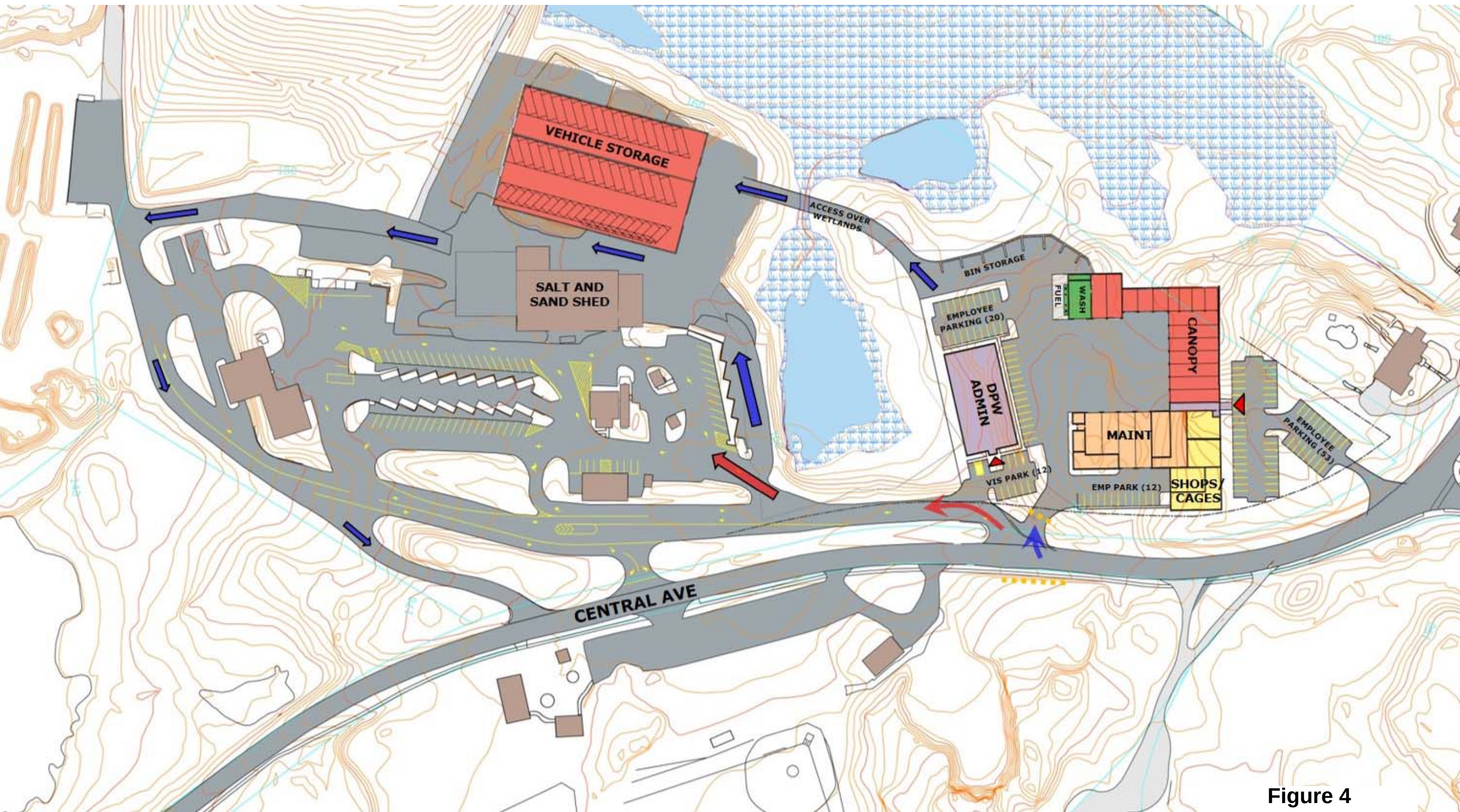


Figure 4
Alternative 1
Recycling/Transfer Station -
Central Avenue

**Table 4: Sight Distance Summary - Central Avenue**

Intersection/Sight Distance Measurement	Feet		
	Required Minimum ¹	Intersection Sight Distance ²	Measured
Central Avenue & RTS Southern Driveway			
<i>Stopping Sight Distance:</i>			
Dedham Avenue approaching from the north	305	--	>500
Dedham Avenue approaching from the south	305	--	475
<i>Intersection Sight Distance:</i>			
Looking north from Existing DPW Driveway(East Entrance)	305	385/445	>500
Looking south from Existing DPW Driveway(East Entrance)	305	385/445	475
Central Avenue & RTS Center Driveway			
<i>Stopping Sight Distance:</i>			
Dedham Avenue approaching from the north	305	--	>500
Dedham Avenue approaching from the south	305	--	310
<i>Intersection Sight Distance:</i>			
Looking north from DPW/DeFazio Park Driveway	305	385/445	>500
Looking south from DPW/DeFazio Park Driveway	305	385/445	310
Central Avenue & RTS Entrance Driveway			
<i>Stopping Sight Distance:</i>			
Dedham Avenue approaching from the north	305	--	335
Dedham Avenue approaching from the south	305	--	>500
<i>Intersection Sight Distance:</i>			
Looking north from DPW/DeFazio Park Driveway	305	385/445	335
Looking south from DPW/DeFazio Park Driveway	305	385/445	>500
Central Avenue & Employee Parking Lot			
<i>Stopping Sight Distance:</i>			
Dedham Avenue approaching from the north	305	--	125
Dedham Avenue approaching from the south	305	--	165
<i>Intersection Sight Distance:</i>			
Looking north from DPW/DeFazio Park Driveway	305	385/445	115
Looking south from DPW/DeFazio Park Driveway	305	385/445	145

1. Based on 40 mile per hour design speed.

2. ISD values shown are for right turn/left turn movements.

Several sight distance measurements taken at the RTS site fell short of those required by AASHTO. The ISD measurement at the Center Driveway did not meet AASHTO requirement from the driveway looking to the south. There is a vertical crest curve just south of the driveway that limits visibility from the driveway to the south. The ISD does however, exceed the required SSD.

Sight distance measurements were taken at the existing RTS entrance driveway. This driveway currently operates as one-way, entry only. However, under Alternative 1, this driveway is planned to operate as a two-way driveway to serve the new DPW facility. ISD measurements from the existing driveway to the north were not met as the sight distance is restricted by the horizontal curvature of Central Avenue, and vegetation and exposed bedrock along the west side of Central Avenue. The ISD does however, exceed the required SSD.

Attachment F Traffic Counts



Location Map: 250468 Needham, MA

Precision Data Industries, LLC 157 Washington Street, Suite 2, Hudson, MA 01749 ph: 508-875-0100 email: datarequests@pdillc.com

(1) 48hr VCU-ATR (premium)
w/Radar for Speed

(1) VCU & (1) HR

Needham Recycling
and Transfer Station

Soolman Nutrition

Claxton Field

A

Client:
Weston & Sampson

Engineer:
D. Ostler

Site Code:
ENG24-0073

Date:
Tuesday 2/25/25-Wednesday 2/26/25

PDI Job #
250468

City, State:
Needham, MA

Central Avenue between
Marked Tree Road and DPW Driveway
City, State: Needham, MA
Client: Weston & Sampson/ D. Ostler
Site Code: ENG24-0073



PDI File #: 250468 ATR-A

Count Date: Tuesday, February 25, 2025
Direction: EB

AM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 AM	0	0	0	0	0	0	0
12:15 AM	0	0	1	0	0	0	1
12:30 AM	0	0	1	0	1	0	2
12:45 AM	0	0	0	0	0	0	0
1:00 AM	0	0	0	0	0	0	0
1:15 AM	0	0	2	0	0	0	2
1:30 AM	0	0	0	0	0	0	0
1:45 AM	0	0	0	0	0	0	0
2:00 AM	0	0	1	0	0	0	1
2:15 AM	0	0	1	0	0	0	1
2:30 AM	0	0	1	0	0	0	1
2:45 AM	0	0	1	0	0	0	1
3:00 AM	0	0	0	0	0	0	0
3:15 AM	0	0	1	0	0	0	1
3:30 AM	0	0	5	0	0	0	5
3:45 AM	0	0	5	0	0	0	5
4:00 AM	0	0	4	0	0	0	4
4:15 AM	0	0	13	0	0	0	13
4:30 AM	0	0	4	0	0	0	4
4:45 AM	0	0	11	0	0	0	11
5:00 AM	0	0	14	0	1	0	15
5:15 AM	0	0	26	0	0	0	26
5:30 AM	0	0	42	0	0	1	43
5:45 AM	0	0	63	0	0	0	63
6:00 AM	0	0	76	0	0	0	76
6:15 AM	0	0	135	0	0	0	135
6:30 AM	0	0	197	1	1	0	199
6:45 AM	0	0	204	1	5	0	210
7:00 AM	0	0	212	2	3	0	217
7:15 AM	0	0	237	1	2	0	240
7:30 AM	0	1	255	1	2	1	260
7:45 AM	0	0	234	1	6	2	243
8:00 AM	0	0	211	1	8	0	220
8:15 AM	0	0	223	2	11	0	236
8:30 AM	0	0	154	0	9	0	163
8:45 AM	0	0	193	0	4	1	198
9:00 AM	0	0	172	0	3	0	175
9:15 AM	0	0	147	0	1	0	148
9:30 AM	0	0	135	0	5	0	140
9:45 AM	0	0	147	0	5	1	153
10:00 AM	0	0	104	0	3	1	108
10:15 AM	0	0	113	1	3	0	117
10:30 AM	0	0	136	0	2	0	138
10:45 AM	0	0	120	0	5	1	126
11:00 AM	0	0	92	0	0	0	92
11:15 AM	0	0	118	0	1	1	120
11:30 AM	0	0	92	0	2	0	94
11:45 AM	0	0	112	0	1	1	114

AM Total	0	1	4015	11	84	10	4121
Percentage	0.00%	0.02%	97.43%	0.27%	2.04%	0.24%	
AM Peak	12:00 AM	6:45 AM	7:00 AM	6:30 AM	7:45 AM	7:00 AM	7:15 AM
Volume	0	1	938	5	34	3	963

PM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 PM	0	0	83	0	2	0	85
12:15 PM	0	0	113	0	1	1	115
12:30 PM	0	0	112	0	5	0	117
12:45 PM	0	0	102	0	4	0	106
1:00 PM	0	0	88	0	2	0	90
1:15 PM	0	0	88	0	4	0	92
1:30 PM	2	0	100	1	0	0	103
1:45 PM	0	0	99	0	4	1	104
2:00 PM	2	0	95	0	2	0	99
2:15 PM	0	0	87	0	2	0	89
2:30 PM	1	0	77	0	3	0	81
2:45 PM	0	0	100	0	0	0	100
3:00 PM	0	1	92	2	3	0	98
3:15 PM	0	0	89	1	0	0	90
3:30 PM	0	0	108	3	0	0	111
3:45 PM	0	1	97	1	1	0	100
4:00 PM	0	0	65	1	0	0	66
4:15 PM	0	0	73	0	0	0	73
4:30 PM	0	0	75	0	0	0	75
4:45 PM	0	0	96	0	0	0	96
5:00 PM	1	0	68	0	0	0	69
5:15 PM	0	0	91	0	1	0	92
5:30 PM	0	0	55	0	0	0	55
5:45 PM	0	0	54	0	1	0	55
6:00 PM	0	0	66	2	0	1	69
6:15 PM	0	0	45	0	1	0	46
6:30 PM	0	0	50	0	0	0	50
6:45 PM	0	0	43	0	0	0	43
7:00 PM	0	0	36	0	0	0	36
7:15 PM	0	0	23	0	0	0	23
7:30 PM	0	0	19	0	0	0	19
7:45 PM	0	0	40	0	0	0	40
8:00 PM	0	0	17	0	0	0	17
8:15 PM	0	0	24	0	0	0	24
8:30 PM	0	0	22	0	0	0	22
8:45 PM	0	0	23	0	0	0	23
9:00 PM	0	0	20	0	0	0	20
9:15 PM	0	0	13	0	0	0	13
9:30 PM	0	0	13	0	0	0	13
9:45 PM	0	0	13	0	0	0	13
10:00 PM	0	0	15	0	0	0	15
10:15 PM	0	0	19	0	0	0	19
10:30 PM	0	0	12	0	0	0	12
10:45 PM	0	0	6	0	0	0	6
11:00 PM	0	0	7	0	0	0	7
11:15 PM	0	0	4	0	0	0	4
11:30 PM	0	0	3	0	0	0	3
11:45 PM	0	0	1	0	0	0	1

PM Total	6	2	2641	11	36	3	2699
Percentage	0.22%	0.07%	97.85%	0.41%	1.33%	0.11%	
PM Peak	1:15 PM	3:00 PM	12:15 PM	3:00 PM	12:30 PM	12:00 PM	12:15 PM
Volume	4	2	415	7	15	1	428
Day Total	6	3	6656	22	120	13	6820
Percentage	0.09%	0.04%	97.60%	0.32%	1.76%	0.19%	

Central Avenue between
Marked Tree Road and DPW Driveway
City, State: Needham, MA
Client: Weston & Sampson/ D. Ostler
Site Code: ENG24-0073



PDI File #: 250468 ATR-A

Count Date: Wednesday, February 26, 2025
Direction: EB

AM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 AM	0	0	1	0	0	0	1
12:15 AM	0	0	2	0	0	0	2
12:30 AM	0	0	0	0	0	0	0
12:45 AM	0	0	0	0	0	0	0
1:00 AM	0	0	1	0	0	0	1
1:15 AM	0	0	1	0	0	0	1
1:30 AM	0	0	0	0	0	0	0
1:45 AM	0	0	1	0	0	0	1
2:00 AM	0	0	0	0	0	0	0
2:15 AM	0	0	1	0	1	0	2
2:30 AM	0	0	0	0	0	0	0
2:45 AM	0	0	0	0	0	0	0
3:00 AM	0	0	2	0	0	0	2
3:15 AM	0	0	1	0	0	0	1
3:30 AM	0	0	4	0	0	0	4
3:45 AM	0	0	2	0	0	0	2
4:00 AM	0	0	8	0	0	0	8
4:15 AM	0	0	8	0	0	0	8
4:30 AM	0	0	7	0	0	0	7
4:45 AM	0	0	5	0	0	0	5
5:00 AM	0	0	17	0	0	0	17
5:15 AM	0	0	29	0	0	0	29
5:30 AM	0	0	35	0	0	0	35
5:45 AM	0	0	43	0	0	0	43
6:00 AM	0	0	99	0	0	0	99
6:15 AM	0	0	115	0	1	0	116
6:30 AM	0	0	203	2	2	0	207
6:45 AM	0	0	229	0	2	0	231
7:00 AM	0	0	206	2	2	0	210
7:15 AM	0	0	223	1	2	0	226
7:30 AM	0	0	257	1	0	0	258
7:45 AM	0	0	222	2	2	1	227
8:00 AM	0	0	199	0	6	1	206
8:15 AM	0	0	233	2	4	0	239
8:30 AM	0	0	188	0	4	0	192
8:45 AM	0	0	199	0	3	0	202
9:00 AM	0	0	218	0	3	0	221
9:15 AM	0	0	147	0	2	0	149
9:30 AM	0	0	150	0	4	0	154
9:45 AM	0	0	115	0	4	0	119
10:00 AM	0	0	128	0	8	0	136
10:15 AM	0	0	94	1	7	0	102
10:30 AM	0	0	138	0	2	0	140
10:45 AM	0	0	99	0	3	0	102
11:00 AM	0	0	90	0	5	0	95
11:15 AM	0	0	102	0	1	0	103
11:30 AM	0	0	97	0	1	0	98
11:45 AM	0	0	109	0	2	0	111

AM Total	0	0	4028	11	71	2	4112
Percentage	0.00%	0.00%	97.96%	0.27%	1.73%	0.05%	
AM Peak	12:00 AM	12:00 AM	6:45 AM	7:00 AM	9:30 AM	7:15 AM	7:30 AM
Volume	0	0	915	6	23	2	930

PM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 PM	0	0	108	0	9	0	117
12:15 PM	0	0	99	0	0	0	99
12:30 PM	0	0	116	0	1	0	117
12:45 PM	2	0	108	0	1	0	111
1:00 PM	0	0	112	0	7	0	119
1:15 PM	0	0	105	0	2	0	107
1:30 PM	0	0	98	1	3	0	102
1:45 PM	0	0	93	0	3	0	96
2:00 PM	0	0	98	0	2	0	100
2:15 PM	0	0	106	0	4	0	110
2:30 PM	2	0	89	0	1	0	92
2:45 PM	0	0	100	0	3	1	104
3:00 PM	0	0	99	1	0	0	100
3:15 PM	1	0	91	2	2	0	96
3:30 PM	0	0	95	2	1	0	98
3:45 PM	0	0	98	2	1	0	101
4:00 PM	0	0	76	0	1	0	77
4:15 PM	0	0	78	1	0	0	79
4:30 PM	0	0	99	0	1	1	101
4:45 PM	0	0	76	0	0	0	76
5:00 PM	0	0	82	0	0	0	82
5:15 PM	0	0	69	0	0	0	69
5:30 PM	0	0	74	0	1	0	75
5:45 PM	0	0	73	1	0	0	74
6:00 PM	0	0	47	0	1	0	48
6:15 PM	0	0	64	0	1	0	65
6:30 PM	0	0	56	0	0	0	56
6:45 PM	0	0	36	0	0	0	36
7:00 PM	0	0	36	0	1	0	37
7:15 PM	0	0	44	0	0	0	44
7:30 PM	0	0	27	0	0	0	27
7:45 PM	0	0	36	0	0	0	36
8:00 PM	0	0	19	0	0	0	19
8:15 PM	0	0	21	0	0	0	21
8:30 PM	0	0	18	0	0	0	18
8:45 PM	0	0	9	0	0	0	9
9:00 PM	0	0	11	0	0	0	11
9:15 PM	0	0	8	0	0	0	8
9:30 PM	0	0	13	0	0	0	13
9:45 PM	0	0	7	0	0	0	7
10:00 PM	0	0	7	0	0	0	7
10:15 PM	0	0	6	0	1	0	7
10:30 PM	0	0	3	0	0	0	3
10:45 PM	0	0	5	0	0	0	5
11:00 PM	0	0	4	0	0	0	4
11:15 PM	0	0	2	0	0	0	2
11:30 PM	0	0	3	0	0	0	3
11:45 PM	0	0	1	0	0	0	1

PM Total	5	0	2725	10	47	2	2789
Percentage	0.18%	0.00%	97.71%	0.36%	1.69%	0.07%	
PM Peak	2:30 PM	12:00 PM	12:30 PM	3:00 PM	1:00 PM	2:00 PM	12:30 PM
Volume	3	0	441	7	15	1	454
Day Total	5	0	6753	21	118	4	6901
Percentage	0.07%	0.00%	97.86%	0.30%	1.71%	0.06%	

Central Avenue between
Marked Tree Road and DPW Driveway
City, State: Needham, MA
Client: Weston & Sampson/ D. Ostler
Site Code: ENG24-0073



PDI File #: 250468 ATR-A

Count Date: Tuesday, February 25, 2025
Direction: WB

AM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 AM	0	0	5	0	0	0	5
12:15 AM	0	0	6	0	0	0	6
12:30 AM	0	0	1	0	0	0	1
12:45 AM	0	0	1	0	0	0	1
1:00 AM	0	0	2	0	0	0	2
1:15 AM	0	0	0	0	0	0	0
1:30 AM	0	0	0	0	0	0	0
1:45 AM	0	0	0	0	0	0	0
2:00 AM	0	0	0	0	0	0	0
2:15 AM	0	0	0	0	0	0	0
2:30 AM	0	0	0	0	0	0	0
2:45 AM	0	0	0	0	0	0	0
3:00 AM	0	0	1	0	0	0	1
3:15 AM	0	0	0	0	0	0	0
3:30 AM	0	0	1	0	0	0	1
3:45 AM	0	0	1	0	0	0	1
4:00 AM	0	0	1	0	0	0	1
4:15 AM	0	0	1	0	0	0	1
4:30 AM	0	0	1	0	0	0	1
4:45 AM	0	0	2	0	0	0	2
5:00 AM	0	0	1	0	0	0	1
5:15 AM	1	0	2	0	1	0	4
5:30 AM	0	0	5	0	0	0	5
5:45 AM	0	0	11	0	1	0	12
6:00 AM	0	0	7	1	0	0	8
6:15 AM	0	0	20	0	0	0	20
6:30 AM	0	0	15	1	1	0	17
6:45 AM	0	0	36	0	0	0	36
7:00 AM	0	0	34	0	1	0	35
7:15 AM	0	0	69	0	1	0	70
7:30 AM	0	0	92	1	2	0	95
7:45 AM	0	0	98	1	1	0	100
8:00 AM	0	0	85	3	3	0	91
8:15 AM	0	0	89	0	4	0	93
8:30 AM	0	0	79	0	4	3	86
8:45 AM	0	0	91	0	4	1	96
9:00 AM	0	0	78	0	5	1	84
9:15 AM	0	0	72	0	4	0	76
9:30 AM	0	0	67	0	7	1	75
9:45 AM	0	0	82	0	5	0	87
10:00 AM	0	0	77	0	3	0	80
10:15 AM	0	0	78	0	4	0	82
10:30 AM	0	0	78	0	3	0	81
10:45 AM	1	0	91	0	9	0	101
11:00 AM	0	0	112	0	6	0	118
11:15 AM	0	0	99	0	2	0	101
11:30 AM	0	0	84	0	6	4	94
11:45 AM	0	0	112	0	2	0	114

AM Total	2	0	1787	7	79	10	1885
Percentage	0.11%	0.00%	94.80%	0.37%	4.19%	0.53%	
AM Peak	4:30 AM	12:00 AM	11:00 AM	7:15 AM	10:45 AM	8:15 AM	11:00 AM
Volume	1	0	407	5	23	5	427

PM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 PM	0	0	101	0	6	1	108
12:15 PM	0	0	99	0	6	0	105
12:30 PM	0	1	116	0	2	0	119
12:45 PM	0	0	88	0	2	0	90
1:00 PM	0	0	87	0	1	0	88
1:15 PM	0	0	105	0	1	0	106
1:30 PM	0	0	112	0	3	0	115
1:45 PM	0	0	111	1	6	1	119
2:00 PM	0	0	117	0	7	1	125
2:15 PM	0	0	154	0	5	0	159
2:30 PM	1	0	165	1	7	0	174
2:45 PM	1	0	169	1	1	1	173
3:00 PM	0	0	150	1	2	0	153
3:15 PM	0	0	184	2	1	0	187
3:30 PM	0	0	230	0	0	0	230
3:45 PM	0	0	186	0	6	0	192
4:00 PM	0	0	225	1	2	0	228
4:15 PM	0	0	244	0	2	0	246
4:30 PM	0	0	224	2	1	0	227
4:45 PM	0	0	240	0	1	0	241
5:00 PM	0	0	235	0	3	0	238
5:15 PM	0	0	220	0	1	0	221
5:30 PM	0	0	198	0	2	0	200
5:45 PM	1	0	167	0	2	0	170
6:00 PM	0	0	215	0	1	0	216
6:15 PM	0	0	145	0	0	0	145
6:30 PM	0	0	116	0	1	0	117
6:45 PM	0	0	90	0	0	0	90
7:00 PM	0	0	90	0	1	0	91
7:15 PM	0	0	76	0	0	0	76
7:30 PM	0	0	57	0	0	0	57
7:45 PM	0	0	51	0	0	0	51
8:00 PM	0	0	58	0	0	0	58
8:15 PM	0	0	38	0	0	0	38
8:30 PM	0	0	37	0	1	0	38
8:45 PM	0	0	34	0	0	0	34
9:00 PM	0	0	37	0	0	0	37
9:15 PM	0	0	24	0	1	0	25
9:30 PM	1	0	23	0	0	0	24
9:45 PM	0	0	27	0	0	0	27
10:00 PM	0	0	32	0	0	0	32
10:15 PM	0	0	19	0	0	0	19
10:30 PM	0	0	14	0	0	0	14
10:45 PM	0	0	10	0	0	0	10
11:00 PM	0	0	17	0	0	0	17
11:15 PM	0	0	14	0	0	0	14
11:30 PM	0	0	9	0	0	0	9
11:45 PM	0	0	3	0	0	0	3

PM Total	4	1	5163	9	75	4	5256
Percentage	0.08%	0.02%	98.23%	0.17%	1.43%	0.08%	
PM Peak	2:00 PM	12:00 PM	4:15 PM	2:30 PM	1:45 PM	1:15 PM	4:15 PM
Volume	2	1	943	5	25	2	952
Day Total	6	1	6950	16	154	14	7141
Percentage	0.08%	0.01%	97.33%	0.22%	2.16%	0.20%	

Central Avenue between
Marked Tree Road and DPW Driveway
City, State: Needham, MA
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Site Code: ENG24-0073



PDI File #: 250468 ATR-A

Count Date: Wednesday, February 26, 2025
Direction: WB

AM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 AM	0	0	4	0	0	0	4
12:15 AM	0	0	7	0	0	0	7
12:30 AM	0	0	2	0	0	0	2
12:45 AM	0	0	2	0	0	0	2
1:00 AM	0	0	0	0	0	0	0
1:15 AM	0	0	3	0	0	0	3
1:30 AM	0	0	3	0	0	0	3
1:45 AM	0	0	1	0	0	0	1
2:00 AM	0	0	2	0	0	0	2
2:15 AM	0	0	0	0	0	0	0
2:30 AM	0	0	0	0	0	0	0
2:45 AM	0	0	1	0	0	0	1
3:00 AM	0	0	1	0	0	0	1
3:15 AM	0	0	1	0	0	0	1
3:30 AM	0	0	0	0	0	0	0
3:45 AM	0	0	1	0	0	0	1
4:00 AM	0	0	2	0	0	0	2
4:15 AM	0	0	1	0	0	0	1
4:30 AM	0	0	0	0	0	0	0
4:45 AM	0	0	2	0	0	0	2
5:00 AM	0	0	2	0	0	0	2
5:15 AM	1	0	0	0	0	0	1
5:30 AM	0	0	8	0	0	0	8
5:45 AM	0	0	6	0	0	0	6
6:00 AM	0	0	7	1	1	0	9
6:15 AM	0	0	14	0	0	0	14
6:30 AM	0	0	22	1	3	0	26
6:45 AM	0	0	25	0	1	0	26
7:00 AM	0	0	44	0	0	0	44
7:15 AM	0	0	51	0	0	1	52
7:30 AM	0	0	64	2	3	0	69
7:45 AM	0	0	95	0	2	0	97
8:00 AM	0	0	84	3	2	0	89
8:15 AM	0	0	79	0	2	0	81
8:30 AM	0	0	100	0	5	0	105
8:45 AM	0	0	92	0	4	0	96
9:00 AM	0	0	72	0	2	0	74
9:15 AM	0	0	88	0	1	0	89
9:30 AM	0	0	80	1	1	0	82
9:45 AM	0	0	65	0	7	0	72
10:00 AM	0	0	87	0	10	0	97
10:15 AM	0	0	73	0	5	1	79
10:30 AM	0	1	83	0	6	0	90
10:45 AM	0	0	91	0	3	0	94
11:00 AM	0	0	104	0	2	0	106
11:15 AM	0	0	81	0	0	0	81
11:30 AM	0	0	109	0	2	0	111
11:45 AM	1	0	107	0	6	0	114

AM Total	2	1	1766	8	68	2	1847
Percentage	0.11%	0.05%	95.61%	0.43%	3.68%	0.11%	
AM Peak	4:30 AM	9:45 AM	11:00 AM	7:15 AM	9:45 AM	6:30 AM	11:00 AM
Volume	1	1	401	5	28	1	412

PM	Bicycles	Motorcycle	Cars & Light Goods	Buses	Single Unit Heavy	Multi Unit Heavy	Total
12:00 PM	0	0	100	0	1	0	101
12:15 PM	0	0	110	0	2	0	112
12:30 PM	2	0	110	0	5	0	117
12:45 PM	0	0	100	0	6	0	106
1:00 PM	0	0	111	1	1	0	113
1:15 PM	0	0	108	1	7	1	117
1:30 PM	0	0	127	0	3	0	130
1:45 PM	2	1	124	1	4	0	132
2:00 PM	0	0	96	1	2	0	99
2:15 PM	0	0	150	0	0	1	151
2:30 PM	0	0	146	0	2	0	148
2:45 PM	0	0	183	2	0	0	185
3:00 PM	0	0	153	1	3	0	157
3:15 PM	0	0	179	2	4	0	185
3:30 PM	0	0	204	1	2	0	207
3:45 PM	0	0	198	1	1	0	200
4:00 PM	0	0	175	1	0	0	176
4:15 PM	0	0	222	0	2	0	224
4:30 PM	0	0	215	1	2	0	218
4:45 PM	0	0	221	0	1	0	222
5:00 PM	0	0	229	0	2	0	231
5:15 PM	0	0	212	0	3	0	215
5:30 PM	0	0	223	0	2	0	225
5:45 PM	0	1	183	0	1	0	185
6:00 PM	0	0	189	0	1	0	190
6:15 PM	0	0	123	0	1	1	125
6:30 PM	0	0	123	0	0	0	123
6:45 PM	0	0	102	0	1	0	103
7:00 PM	0	0	80	0	0	0	80
7:15 PM	0	0	76	0	0	0	76
7:30 PM	0	0	50	0	0	0	50
7:45 PM	0	0	66	0	0	0	66
8:00 PM	0	0	60	0	0	0	60
8:15 PM	0	0	47	0	0	0	47
8:30 PM	0	0	49	0	0	0	49
8:45 PM	0	0	44	0	0	0	44
9:00 PM	0	0	35	0	0	0	35
9:15 PM	0	0	36	0	0	0	36
9:30 PM	0	0	32	0	0	0	32
9:45 PM	0	0	21	0	0	0	21
10:00 PM	0	0	26	0	0	0	26
10:15 PM	0	0	21	0	0	0	21
10:30 PM	0	0	18	0	0	0	18
10:45 PM	0	0	10	0	0	0	10
11:00 PM	0	0	12	0	0	0	12
11:15 PM	0	0	10	0	0	0	10
11:30 PM	0	0	4	0	0	0	4
11:45 PM	0	0	3	0	0	0	3

PM Total	4	2	5116	13	59	3	5197
Percentage	0.08%	0.04%	98.44%	0.25%	1.14%	0.06%	
PM Peak	12:00 PM	1:00 PM	4:15 PM	2:45 PM	12:30 PM	12:30 PM	4:15 PM
Volume	2	1	887	6	19	1	895
Day Total	6	3	6882	21	127	5	7044
Percentage	0.09%	0.04%	97.70%	0.30%	1.80%	0.07%	

**Central Avenue between
Marked Tree Road and DPW Driveway
City, State: Needham, MA
Client: Weston & Sampson/ D. Ostler
Site Code: ENG24-0073**



PDI File # 250468 ATR-A

Direction: EB

Weekly Report

Day	Tuesday		Wednesday												Week	
Date	02/25/25		02/26/25												Ave	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
12:00	0	85	1	117	0	0	0	0	0	0	0	0	0	0	1	101
12:15	1	115	2	99	0	0	0	0	0	0	0	0	0	0	2	107
12:30	2	117	0	117	0	0	0	0	0	0	0	0	0	0	1	117
12:45	0	106	0	111	0	0	0	0	0	0	0	0	0	0	0	109
1:00	0	90	1	119	0	0	0	0	0	0	0	0	0	0	1	105
1:15	2	92	1	107	0	0	0	0	0	0	0	0	0	0	2	100
1:30	0	103	0	102	0	0	0	0	0	0	0	0	0	0	0	103
1:45	0	104	1	96	0	0	0	0	0	0	0	0	0	0	1	100
2:00	1	99	0	100	0	0	0	0	0	0	0	0	0	0	1	100
2:15	1	89	2	110	0	0	0	0	0	0	0	0	0	0	2	100
2:30	1	81	0	92	0	0	0	0	0	0	0	0	0	0	1	87
2:45	1	100	0	104	0	0	0	0	0	0	0	0	0	0	1	102
3:00	0	98	2	100	0	0	0	0	0	0	0	0	0	0	1	99
3:15	1	90	1	96	0	0	0	0	0	0	0	0	0	0	1	93
3:30	5	111	4	98	0	0	0	0	0	0	0	0	0	0	5	105
3:45	5	100	2	101	0	0	0	0	0	0	0	0	0	0	4	101
4:00	4	66	8	77	0	0	0	0	0	0	0	0	0	0	6	72
4:15	13	73	8	79	0	0	0	0	0	0	0	0	0	0	11	76
4:30	4	75	7	101	0	0	0	0	0	0	0	0	0	0	6	88
4:45	11	96	5	76	0	0	0	0	0	0	0	0	0	0	8	86
5:00	15	69	17	82	0	0	0	0	0	0	0	0	0	0	16	76
5:15	26	92	29	69	0	0	0	0	0	0	0	0	0	0	28	81
5:30	43	55	35	75	0	0	0	0	0	0	0	0	0	0	39	65
5:45	63	55	43	74	0	0	0	0	0	0	0	0	0	0	53	65
6:00	76	69	99	48	0	0	0	0	0	0	0	0	0	0	88	59
6:15	135	46	116	65	0	0	0	0	0	0	0	0	0	0	126	56
6:30	199	50	207	56	0	0	0	0	0	0	0	0	0	0	203	53
6:45	210	43	231	36	0	0	0	0	0	0	0	0	0	0	221	40
7:00	217	36	210	37	0	0	0	0	0	0	0	0	0	0	214	37
7:15	240	23	226	44	0	0	0	0	0	0	0	0	0	0	233	34
7:30	260	19	258	27	0	0	0	0	0	0	0	0	0	0	259	23
7:45	243	40	227	36	0	0	0	0	0	0	0	0	0	0	235	38
8:00	220	17	206	19	0	0	0	0	0	0	0	0	0	0	213	18
8:15	236	24	239	21	0	0	0	0	0	0	0	0	0	0	238	23
8:30	163	22	192	18	0	0	0	0	0	0	0	0	0	0	178	20
8:45	198	23	202	9	0	0	0	0	0	0	0	0	0	0	200	16
9:00	175	20	221	11	0	0	0	0	0	0	0	0	0	0	198	16
9:15	148	13	149	8	0	0	0	0	0	0	0	0	0	0	149	11
9:30	140	13	154	13	0	0	0	0	0	0	0	0	0	0	147	13
9:45	153	13	119	7	0	0	0	0	0	0	0	0	0	0	136	10
10:00	108	15	136	7	0	0	0	0	0	0	0	0	0	0	122	11
10:15	117	19	102	7	0	0	0	0	0	0	0	0	0	0	110	13
10:30	138	12	140	3	0	0	0	0	0	0	0	0	0	0	139	8
10:45	126	6	102	5	0	0	0	0	0	0	0	0	0	0	114	6
11:00	92	7	95	4	0	0	0	0	0	0	0	0	0	0	94	6
11:15	120	4	103	2	0	0	0	0	0	0	0	0	0	0	112	3
11:30	94	3	98	3	0	0	0	0	0	0	0	0	0	0	96	3
11:45	114	1	111	1	0	0	0	0	0	0	0	0	0	0	113	1
Total	4121	2699	4112	2789	0	0	0	0	0	0	0	0	0	0	4117	2744
Day Total	6820		6901		0		0		0		0		0		6861	
Peak HR	7:15 AM	12:15 PM	7:30 AM	12:30 PM											7:30 AM	12:15 PM
Volume	963	428	930	454											945	437

**Central Avenue between
Marked Tree Road and DPW Driveway
City, State: Needham, MA
Client: Weston & Sampson/ D. Ostler
Site Code: ENG24-0073**



PDI File # 250468 ATR-A

Direction: WB

Weekly Report

Day	Tuesday		Wednesday												Week			
Date	02/25/25		02/26/25												Ave			
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM		
12:00	5	108	4	101	0	0	0	0	0	0	0	0	0	0	5	105		
12:15	6	105	7	112	0	0	0	0	0	0	0	0	0	0	7	109		
12:30	1	119	2	117	0	0	0	0	0	0	0	0	0	0	2	118		
12:45	1	90	2	106	0	0	0	0	0	0	0	0	0	0	2	98		
1:00	2	88	0	113	0	0	0	0	0	0	0	0	0	0	1	101		
1:15	0	106	3	117	0	0	0	0	0	0	0	0	0	0	2	112		
1:30	0	115	3	130	0	0	0	0	0	0	0	0	0	0	2	123		
1:45	0	119	1	132	0	0	0	0	0	0	0	0	0	0	1	126		
2:00	0	125	2	99	0	0	0	0	0	0	0	0	0	0	1	112		
2:15	0	159	0	151	0	0	0	0	0	0	0	0	0	0	0	155		
2:30	0	174	0	148	0	0	0	0	0	0	0	0	0	0	0	161		
2:45	0	173	1	185	0	0	0	0	0	0	0	0	0	0	1	179		
3:00	1	153	1	157	0	0	0	0	0	0	0	0	0	0	1	155		
3:15	0	187	1	185	0	0	0	0	0	0	0	0	0	0	1	186		
3:30	1	230	0	207	0	0	0	0	0	0	0	0	0	0	1	219		
3:45	1	192	1	200	0	0	0	0	0	0	0	0	0	0	1	196		
4:00	1	228	2	176	0	0	0	0	0	0	0	0	0	0	2	202		
4:15	1	246	1	224	0	0	0	0	0	0	0	0	0	0	1	235		
4:30	1	227	0	218	0	0	0	0	0	0	0	0	0	0	1	223		
4:45	2	241	2	222	0	0	0	0	0	0	0	0	0	0	2	232		
5:00	1	238	2	231	0	0	0	0	0	0	0	0	0	0	2	235		
5:15	4	221	1	215	0	0	0	0	0	0	0	0	0	0	3	218		
5:30	5	200	8	225	0	0	0	0	0	0	0	0	0	0	7	213		
5:45	12	170	6	185	0	0	0	0	0	0	0	0	0	0	9	178		
6:00	8	216	9	190	0	0	0	0	0	0	0	0	0	0	9	203		
6:15	20	145	14	125	0	0	0	0	0	0	0	0	0	0	17	135		
6:30	17	117	26	123	0	0	0	0	0	0	0	0	0	0	22	120		
6:45	36	90	26	103	0	0	0	0	0	0	0	0	0	0	31	97		
7:00	35	91	44	80	0	0	0	0	0	0	0	0	0	0	40	86		
7:15	70	76	52	76	0	0	0	0	0	0	0	0	0	0	61	76		
7:30	95	57	69	50	0	0	0	0	0	0	0	0	0	0	82	54		
7:45	100	51	97	66	0	0	0	0	0	0	0	0	0	0	99	59		
8:00	91	58	89	60	0	0	0	0	0	0	0	0	0	0	90	59		
8:15	93	38	81	47	0	0	0	0	0	0	0	0	0	0	87	43		
8:30	86	38	105	49	0	0	0	0	0	0	0	0	0	0	96	44		
8:45	96	34	96	44	0	0	0	0	0	0	0	0	0	0	96	39		
9:00	84	37	74	35	0	0	0	0	0	0	0	0	0	0	79	36		
9:15	76	25	89	36	0	0	0	0	0	0	0	0	0	0	83	31		
9:30	75	24	82	32	0	0	0	0	0	0	0	0	0	0	79	28		
9:45	87	27	72	21	0	0	0	0	0	0	0	0	0	0	80	24		
10:00	80	32	97	26	0	0	0	0	0	0	0	0	0	0	89	29		
10:15	82	19	79	21	0	0	0	0	0	0	0	0	0	0	81	20		
10:30	81	14	90	18	0	0	0	0	0	0	0	0	0	0	86	16		
10:45	101	10	94	10	0	0	0	0	0	0	0	0	0	0	98	10		
11:00	118	17	106	12	0	0	0	0	0	0	0	0	0	0	112	15		
11:15	101	14	81	10	0	0	0	0	0	0	0	0	0	0	91	12		
11:30	94	9	111	4	0	0	0	0	0	0	0	0	0	0	103	7		
11:45	114	3	114	3	0	0	0	0	0	0	0	0	0	0	114	3		
Total	1885	5256	1847	5197	0	0	0	0	0	0	0	0	0	0	1866	5227		
Day Total	7141		7044		0		0		0		0		0		7093			
Peak HR	11:00 AM	4:15 PM	11:00 AM	4:15 PM													11:00 AM	4:15 PM
Volume	427	952	412	895													420	924

Central Avenue between
Marked Tree Road and DPW Driveway

City, State: Needham, MA

Client: Weston & Sampson/ D. Ostler

Site Code: ENG24-0073



PDI File #: 250468 ATR-A (Speed)

Count Date

Tuesday, February 25, 2025

Speed (60-minute)

EB																
Start Time:	1 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70+	Total	85th %ile	Ave Speed
12:00 AM	0	0	0	1	1	2	1	0	0	0	0	0	0	5	39.8	35.0
1:00 AM	0	0	0	0	0	2	0	0	0	0	0	0	0	2	35.9	35.5
2:00 AM	0	0	0	0	1	3	0	0	0	0	0	0	0	4	37.6	36.3
3:00 AM	0	0	0	0	1	7	3	0	1	0	0	0	0	12	40.0	38.6
4:00 AM	0	0	0	0	4	13	13	2	0	0	0	0	0	32	42.4	39.1
5:00 AM	0	0	0	3	34	88	29	0	0	0	0	0	0	154	40.0	36.6
6:00 AM	0	0	0	13	241	343	39	1	0	0	0	0	0	637	38.0	35.1
7:00 AM	0	4	5	69	517	319	27	0	0	0	0	0	0	941	37.0	33.5
8:00 AM	28	36	66	103	220	164	29	1	0	0	0	0	0	647	37.0	30.0
9:00 AM	6	8	12	49	257	227	39	0	0	0	0	0	0	598	38.0	33.5
10:00 AM	0	5	4	57	224	190	27	1	0	0	0	0	0	508	37.0	33.6
11:00 AM	0	0	2	67	206	136	17	2	0	0	1	0	0	431	37.0	33.3
12:00 PM	0	0	0	34	220	169	26	0	0	0	0	0	0	449	37.0	34.1
1:00 PM	0	4	11	40	191	131	19	3	0	0	0	0	0	399	37.3	33.4
2:00 PM	0	0	5	46	166	134	26	1	0	0	0	0	0	378	38.0	33.8
3:00 PM	0	1	10	27	171	167	31	3	0	0	0	0	0	410	38.0	34.2
4:00 PM	0	0	0	16	142	131	30	2	1	0	0	0	0	322	38.9	35.0
5:00 PM	0	0	1	13	128	116	29	1	0	0	0	0	0	288	38.0	34.8
6:00 PM	0	0	1	19	104	71	17	2	0	0	0	0	0	214	38.0	34.0
7:00 PM	0	0	0	3	53	52	12	1	1	0	0	0	0	122	39.0	35.2
8:00 PM	0	0	0	2	31	37	15	3	0	0	0	0	0	88	41.0	36.2
9:00 PM	0	1	1	2	23	23	9	1	0	0	0	0	0	60	40.0	34.8
10:00 PM	0	0	1	2	18	24	6	3	0	0	0	0	0	54	40.0	36.0
11:00 PM	0	0	0	1	3	6	5	1	0	0	0	0	0	16	42.8	37.8
Total	34	59	119	567	2956	2555	449	28	3	0	1	0	0	6771	38.0	33.8
Percent	0.50%	0.87%	1.76%	8.37%	43.66%	37.73%	6.63%	0.41%	0.04%	0.00%	0.01%	0.00%	0.00%			

AM Peak	8:00 AM	8:00 AM	8:00 AM	8:00 AM	7:00 AM	6:00 AM	6:00 AM	4:00 AM	3:00 AM		11:00 AM			7:00 AM
Volume	28	36	66	103	517	343	39	2	1	0	1	0	0	941

PM Peak	1:00 PM	1:00 PM	2:00 PM	12:00 PM	12:00 PM	3:00 PM	1:00 PM	4:00 PM						12:00 PM
Volume	0	4	11	46	220	169	31	3	1	0	0	0	0	449

15th Percentile:	30.0 MPH	Average Speed:	33.8 MPH	Posted Speed Limit:	30 MPH
50th Percentile:	34.0 MPH	10 MPH Pace:	30 to 39 MPH	Number of Vehicles > 30 MPH:	5679
85th Percentile:	38.0 MPH	Number in Pace:	5511	Percent of Vehicles > 30 MPH:	83.9%
95th Percentile:	40.0 MPH	Percent in Pace:	81.4%		

Central Avenue between
Marked Tree Road and DPW Driveway

City, State: Needham, MA

Client: Weston & Sampson/ D. Ostler

Site Code: ENG24-0073



PDI File #: 250468 ATR-A (Speed)

Count Date

Tuesday, February 25, 2025

Speed (60-minute)

WB																
Start Time:	1 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70+	Total	85th %ile	Ave Speed
12:00 AM	0	0	0	0	4	8	1	0	0	0	0	0	0	13	38.0	35.2
1:00 AM	0	0	0	0	0	2	0	0	0	0	0	0	0	2	37.0	37.0
2:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
3:00 AM	0	0	0	0	1	1	1	0	0	0	0	0	0	3	39.7	37.7
4:00 AM	0	0	0	1	0	4	0	0	0	0	0	0	0	5	37.8	35.2
5:00 AM	0	1	0	1	4	8	6	3	0	0	0	0	0	23	41.7	36.7
6:00 AM	0	0	0	0	20	54	17	2	0	0	0	0	1	94	41.0	37.5
7:00 AM	0	0	5	17	86	122	24	2	0	0	0	0	0	256	39.0	34.9
8:00 AM	0	3	8	45	124	109	21	1	0	0	0	0	0	311	38.0	33.4
9:00 AM	2	0	3	26	125	132	30	2	0	0	0	0	1	321	38.0	34.6
10:00 AM	1	1	3	37	145	123	27	2	0	0	0	0	0	339	38.0	33.9
11:00 AM	0	1	4	55	172	138	38	4	1	0	0	0	0	413	38.0	34.0
12:00 PM	0	1	4	35	138	167	51	2	0	0	1	0	0	399	39.0	34.9
1:00 PM	1	3	6	25	156	197	51	5	0	0	0	0	0	444	39.0	35.0
2:00 PM	0	0	11	38	217	283	50	5	1	0	0	0	0	605	39.0	34.8
3:00 PM	0	0	3	17	202	388	95	4	2	0	0	0	0	711	39.0	36.1
4:00 PM	0	3	3	12	222	512	135	13	1	1	0	0	0	902	40.0	36.5
5:00 PM	0	0	1	26	219	433	131	12	1	0	0	0	0	823	40.0	36.3
6:00 PM	0	2	1	14	170	324	50	1	1	0	0	0	0	563	39.0	35.6
7:00 PM	1	0	1	2	79	178	25	2	1	0	0	0	0	289	39.0	36.0
8:00 PM	0	0	0	3	53	96	33	1	0	0	0	0	0	186	40.0	36.3
9:00 PM	0	1	2	3	28	68	21	2	0	0	0	0	0	125	40.0	36.2
10:00 PM	0	0	0	1	13	45	17	3	0	0	0	0	0	79	40.3	37.2
11:00 PM	0	0	0	0	12	27	7	0	0	0	0	0	0	46	39.3	36.7
Total	5	16	55	358	2190	3419	831	66	8	1	1	0	2	6952	39.0	35.5
Percent	0.07%	0.23%	0.79%	5.15%	31.50%	49.18%	11.95%	0.95%	0.12%	0.01%	0.01%	0.00%	0.03%			

AM Peak	9:00 AM	8:00 AM	8:00 AM	11:00 AM	11:00 AM	11:00 AM	11:00 AM	11:00 AM	11:00 AM					6:00 AM	11:00 AM
Volume	2	3	8	55	172	138	38	4	1	0	0	0	1	413	

PM Peak	1:00 PM	1:00 PM	2:00 PM	2:00 PM	4:00 PM	4:00 PM	4:00 PM	4:00 PM	3:00 PM	4:00 PM	12:00 PM			4:00 PM
Volume	1	3	11	38	222	512	135	13	2	1	1	0	0	902

15th Percentile:	32.0 MPH	Average Speed:	35.5 MPH	Posted Speed Limit:	30 MPH
50th Percentile:	36.0 MPH	10 MPH Pace:	31 to 40 MPH	Number of Vehicles > 30 MPH:	6321
85th Percentile:	39.0 MPH	Number in Pace:	5758	Percent of Vehicles > 30 MPH:	90.9%
95th Percentile:	41.0 MPH	Percent in Pace:	82.8%		

Central Avenue between
Marked Tree Road and DPW Driveway

City, State: Needham, MA

Client: Weston & Sampson/ D. Ostler

Site Code: ENG24-0073



PDI File #: 250468 ATR-A (Speed)

Count Date

Tuesday, February 25, 2025

Speed (60-minute)

Combined EB and WB

Start Time:	1 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70+	Total	85th %ile	Ave Speed
12:00 AM	0	0	0	1	5	10	2	0	0	0	0	0	0	18	39.0	35.1
1:00 AM	0	0	0	0	0	4	0	0	0	0	0	0	0	4	37.0	36.3
2:00 AM	0	0	0	0	1	3	0	0	0	0	0	0	0	4	37.6	36.3
3:00 AM	0	0	0	0	2	8	4	0	1	0	0	0	0	15	40.0	38.4
4:00 AM	0	0	0	1	4	17	13	2	0	0	0	0	0	37	42.0	38.5
5:00 AM	0	1	0	4	38	96	35	3	0	0	0	0	0	177	41.0	36.7
6:00 AM	0	0	0	13	261	397	56	3	0	0	0	0	1	731	38.0	35.4
7:00 AM	0	4	10	86	603	441	51	2	0	0	0	0	0	1197	37.0	33.8
8:00 AM	28	39	74	148	344	273	50	2	0	0	0	0	0	958	37.0	31.1
9:00 AM	8	8	15	75	382	359	69	2	0	0	0	0	1	919	38.0	33.9
10:00 AM	1	6	7	94	369	313	54	3	0	0	0	0	0	847	38.0	33.7
11:00 AM	0	1	6	122	378	274	55	6	1	0	1	0	0	844	38.0	33.6
12:00 PM	0	1	4	69	358	336	77	2	0	0	1	0	0	848	38.0	34.5
1:00 PM	1	7	17	65	347	328	70	8	0	0	0	0	0	843	38.0	34.2
2:00 PM	0	0	16	84	383	417	76	6	1	0	0	0	0	983	38.0	34.4
3:00 PM	0	1	13	44	373	555	126	7	2	0	0	0	0	1121	39.0	35.4
4:00 PM	0	3	3	28	364	643	165	15	2	1	0	0	0	1224	39.0	36.1
5:00 PM	0	0	2	39	347	549	160	13	1	0	0	0	0	1111	40.0	35.9
6:00 PM	0	2	2	33	274	395	67	3	1	0	0	0	0	777	38.0	35.2
7:00 PM	1	0	1	5	132	230	37	3	2	0	0	0	0	411	39.0	35.8
8:00 PM	0	0	0	5	84	133	48	4	0	0	0	0	0	274	40.0	36.3
9:00 PM	0	2	3	5	51	91	30	3	0	0	0	0	0	185	40.0	35.8
10:00 PM	0	0	1	3	31	69	23	6	0	0	0	0	0	133	40.0	36.7
11:00 PM	0	0	0	1	15	33	12	1	0	0	0	0	0	62	40.0	37.0
Total	39	75	174	925	5146	5974	1280	94	11	1	2	0	2	13723	39.0	34.6
Percent	0.28%	0.55%	1.27%	6.74%	37.50%	43.53%	9.33%	0.68%	0.08%	0.01%	0.01%	0.00%	0.01%			

AM Peak	8:00 AM	8:00 AM	8:00 AM	8:00 AM	7:00 AM	7:00 AM	9:00 AM	11:00 AM	3:00 AM		11:00 AM		6:00 AM	7:00 AM
Volume	28	39	74	148	603	441	69	6	1	0	1	0	1	1197

PM Peak	1:00 PM	1:00 PM	1:00 PM	2:00 PM	2:00 PM	4:00 PM	4:00 PM	4:00 PM	3:00 PM	4:00 PM	12:00 PM			4:00 PM
Volume	1	7	17	84	383	643	165	15	2	1	1	0	0	1224

15th Percentile:	31.0 MPH	Average Speed:	34.6 MPH	Posted Speed Limit:	30 MPH
50th Percentile:	35.0 MPH	10 MPH Pace:	31 to 40 MPH	Number of Vehicles > 30 MPH:	12000
85th Percentile:	39.0 MPH	Number in Pace:	11142	Percent of Vehicles > 30 MPH:	87.4%
95th Percentile:	41.0 MPH	Percent in Pace:	81.2%		

Central Avenue between
Marked Tree Road and DPW Driveway

City, State: Needham, MA

Client: Weston & Sampson/ D. Ostler

Site Code: ENG24-0073



PDI File #: 250468 ATR-A (Speed)

Count Date

Wednesday, February 26, 2025

Speed (60-minute)

EB																
Start Time:	1 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70+	Total	85th %ile	Ave Speed
12:00 AM	0	0	0	0	1	1	0	1	0	0	0	0	0	3	45.1	39.3
1:00 AM	0	0	0	1	1	0	1	0	0	0	0	0	0	3	41.0	35.7
2:00 AM	0	0	0	0	1	1	0	0	0	0	0	0	0	2	36.3	34.5
3:00 AM	0	0	0	0	2	2	4	1	0	0	0	0	0	9	42.8	39.0
4:00 AM	0	0	0	1	4	12	7	5	0	0	0	0	0	29	46.4	39.4
5:00 AM	0	0	0	1	24	84	20	6	0	0	0	0	0	135	40.0	37.3
6:00 AM	0	0	0	33	241	353	29	1	0	0	0	0	0	657	38.0	34.9
7:00 AM	3	8	9	51	438	382	28	1	0	0	0	0	0	920	37.0	33.9
8:00 AM	6	23	32	119	359	241	11	2	0	0	0	0	0	793	36.0	32.0
9:00 AM	0	0	1	34	323	254	36	1	0	0	0	0	0	649	37.0	34.2
10:00 AM	0	0	5	42	224	186	26	0	0	0	0	0	0	483	38.0	33.9
11:00 AM	0	0	1	32	180	168	24	2	0	0	0	0	0	407	38.0	34.3
12:00 PM	0	2	8	38	201	181	29	1	0	0	0	0	0	460	38.0	33.9
1:00 PM	0	1	2	47	205	160	31	0	0	0	0	0	0	446	38.0	33.9
2:00 PM	0	1	2	54	213	139	24	1	0	0	0	0	1	435	37.0	33.6
3:00 PM	0	1	0	26	199	155	26	3	0	0	0	0	0	410	38.0	34.3
4:00 PM	0	0	1	28	147	151	31	2	0	0	0	0	0	360	39.0	34.7
5:00 PM	0	0	0	20	120	138	24	3	0	0	0	0	0	305	39.0	35.0
6:00 PM	0	0	0	12	110	90	17	1	0	0	0	0	0	230	38.0	34.5
7:00 PM	0	0	0	10	64	60	18	2	1	0	0	0	0	155	39.0	35.1
8:00 PM	0	0	0	5	22	29	13	0	1	0	0	0	0	70	40.0	35.9
9:00 PM	0	1	0	2	14	12	10	3	1	0	0	0	0	43	43.7	36.7
10:00 PM	0	0	1	1	6	6	8	1	1	0	0	0	0	24	43.0	37.5
11:00 PM	0	0	0	1	2	3	2	2	0	0	0	0	0	10	44.7	38.5
Total	9	37	62	558	3101	2808	419	39	4	0	0	0	1	7038	38.0	34.1
Percent	0.13%	0.53%	0.88%	7.93%	44.06%	39.90%	5.95%	0.55%	0.06%	0.00%	0.00%	0.00%	0.01%			

AM Peak	8:00 AM	8:00 AM	8:00 AM	8:00 AM	7:00 AM	7:00 AM	9:00 AM	5:00 AM							7:00 AM
Volume	6	23	32	119	438	382	36	6	0	0	0	0	0	920	

PM Peak	12:00 PM	12:00 PM	2:00 PM	2:00 PM	12:00 PM	1:00 PM	3:00 PM	7:00 PM						2:00 PM	12:00 PM
Volume	0	2	8	54	213	181	31	3	1	0	0	0	1	460	

15th Percentile:	31.0 MPH	Average Speed:	34.1 MPH	Posted Speed Limit:	30 MPH
50th Percentile:	34.0 MPH	10 MPH Pace:	30 to 39 MPH	Number of Vehicles > 30 MPH:	6080
85th Percentile:	38.0 MPH	Number in Pace:	5909	Percent of Vehicles > 30 MPH:	86.4%
95th Percentile:	40.0 MPH	Percent in Pace:	84.0%		

Central Avenue between
Marked Tree Road and DPW Driveway

City, State: Needham, MA

Client: Weston & Sampson/ D. Ostler

Site Code: ENG24-0073



PDI File #: 250468 ATR-A (Speed)

Count Date

Wednesday, February 26, 2025

Speed (60-minute)

WB																
Start Time:	1 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70+	Total	85th %ile	Ave Speed
12:00 AM	0	0	0	0	3	8	4	0	0	0	0	0	0	15	40.9	37.0
1:00 AM	0	0	0	1	1	4	1	0	0	0	0	0	0	7	39.1	35.3
2:00 AM	0	0	0	0	2	2	0	0	0	0	0	0	0	4	37.1	35.5
3:00 AM	0	0	0	0	1	1	2	0	0	0	0	0	0	4	40.0	37.8
4:00 AM	0	0	0	0	3	1	2	0	0	0	0	0	0	6	40.3	36.2
5:00 AM	0	1	0	1	1	5	6	3	1	0	0	0	0	18	46.0	39.2
6:00 AM	0	0	0	0	24	26	19	3	0	0	0	0	0	72	41.0	37.0
7:00 AM	0	0	1	11	81	96	32	5	0	0	0	0	0	226	40.0	35.4
8:00 AM	1	1	8	39	132	125	38	1	0	0	0	0	0	345	39.0	34.2
9:00 AM	1	2	5	27	91	140	33	6	1	1	0	0	0	307	39.0	34.8
10:00 AM	0	0	3	37	130	158	28	3	2	0	0	0	0	361	38.0	34.5
11:00 AM	1	0	5	26	149	180	35	4	1	0	0	0	0	401	39.0	34.9
12:00 PM	2	1	4	33	170	162	37	2	0	0	0	0	0	411	38.0	34.2
1:00 PM	1	2	6	44	181	206	43	2	1	0	0	0	0	486	38.0	34.4
2:00 PM	0	0	2	34	193	292	53	5	2	0	0	0	1	582	39.0	35.4
3:00 PM	0	2	2	30	262	364	65	4	0	0	0	0	0	729	39.0	35.3
4:00 PM	0	2	5	21	251	475	111	8	0	1	0	0	0	874	39.0	35.9
5:00 PM	4	0	1	14	260	462	87	7	0	0	0	0	0	835	39.0	35.6
6:00 PM	0	0	1	6	183	304	59	4	0	0	0	0	0	557	39.0	35.8
7:00 PM	0	0	0	3	85	159	48	2	1	0	0	0	0	298	40.0	36.3
8:00 PM	0	0	0	1	56	130	25	3	0	0	0	0	0	215	39.0	36.4
9:00 PM	0	0	0	2	39	66	23	2	0	0	0	0	0	132	40.0	36.5
10:00 PM	0	0	0	3	20	44	14	1	0	0	0	0	0	82	40.0	36.4
11:00 PM	0	0	0	0	7	17	6	1	0	0	0	0	0	31	40.5	36.7
Total	10	11	43	333	2325	3427	771	66	9	2	0	0	1	6998	39.0	35.4
Percent	0.14%	0.16%	0.61%	4.76%	33.22%	48.97%	11.02%	0.94%	0.13%	0.03%	0.00%	0.00%	0.01%			

AM Peak	8:00 AM	9:00 AM	8:00 AM	8:00 AM	11:00 AM	11:00 AM	8:00 AM	9:00 AM	10:00 AM	9:00 AM				11:00 AM
Volume	1	2	8	39	149	180	38	6	2	1	0	0	0	401

PM Peak	5:00 PM	1:00 PM	1:00 PM	1:00 PM	3:00 PM	4:00 PM	4:00 PM	4:00 PM	2:00 PM	4:00 PM			2:00 PM	4:00 PM
Volume	4	2	6	44	262	475	111	8	2	1	0	0	1	874

15th Percentile:	32.0 MPH	Average Speed:	35.4 MPH	Posted Speed Limit:	30 MPH
50th Percentile:	35.0 MPH	10 MPH Pace:	31 to 40 MPH	Number of Vehicles > 30 MPH:	6421
85th Percentile:	39.0 MPH	Number in Pace:	5903	Percent of Vehicles > 30 MPH:	91.8%
95th Percentile:	41.0 MPH	Percent in Pace:	84.4%		

Central Avenue between
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Speed (60-minute)

Combined EB and WB																
Start Time:	1 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70+	Total	85th %ile	Ave Speed
12:00 AM	0	0	0	0	4	9	4	1	0	0	0	0	0	18	41.5	37.4
1:00 AM	0	0	0	2	2	4	2	0	0	0	0	0	0	10	39.7	35.4
2:00 AM	0	0	0	0	3	3	0	0	0	0	0	0	0	6	37.3	35.2
3:00 AM	0	0	0	0	3	3	6	1	0	0	0	0	0	13	42.2	38.6
4:00 AM	0	0	0	1	7	13	9	5	0	0	0	0	0	35	44.0	38.8
5:00 AM	0	1	0	2	25	89	26	9	1	0	0	0	0	153	41.0	37.5
6:00 AM	0	0	0	33	265	379	48	4	0	0	0	0	0	729	38.0	35.1
7:00 AM	3	8	10	62	519	478	60	6	0	0	0	0	0	1146	37.0	34.2
8:00 AM	7	24	40	158	491	366	49	3	0	0	0	0	0	1138	37.0	32.7
9:00 AM	1	2	6	61	414	394	69	7	1	1	0	0	0	956	38.0	34.4
10:00 AM	0	0	8	79	354	344	54	3	2	0	0	0	0	844	38.0	34.1
11:00 AM	1	0	6	58	329	348	59	6	1	0	0	0	0	808	38.0	34.6
12:00 PM	2	3	12	71	371	343	66	3	0	0	0	0	0	871	38.0	34.0
1:00 PM	1	3	8	91	386	366	74	2	1	0	0	0	0	932	38.0	34.1
2:00 PM	0	1	4	88	406	431	77	6	2	0	0	0	2	1017	38.0	34.6
3:00 PM	0	3	2	56	461	519	91	7	0	0	0	0	0	1139	38.0	34.9
4:00 PM	0	2	6	49	398	626	142	10	0	1	0	0	0	1234	39.0	35.5
5:00 PM	4	0	1	34	380	600	111	10	0	0	0	0	0	1140	39.0	35.5
6:00 PM	0	0	1	18	293	394	76	5	0	0	0	0	0	787	39.0	35.5
7:00 PM	0	0	0	13	149	219	66	4	2	0	0	0	0	453	40.0	35.9
8:00 PM	0	0	0	6	78	159	38	3	1	0	0	0	0	285	39.0	36.3
9:00 PM	0	1	0	4	53	78	33	5	1	0	0	0	0	175	41.0	36.5
10:00 PM	0	0	1	4	26	50	22	2	1	0	0	0	0	106	41.0	36.6
11:00 PM	0	0	0	1	9	20	8	3	0	0	0	0	0	41	42.0	37.1
Total	19	48	105	891	5426	6235	1190	105	13	2	0	0	2	14036	38.0	34.7
Percent	0.14%	0.34%	0.75%	6.35%	38.66%	44.42%	8.48%	0.75%	0.09%	0.01%	0.00%	0.00%	0.01%			

AM Peak	8:00 AM	8:00 AM	8:00 AM	8:00 AM	7:00 AM	7:00 AM	9:00 AM	5:00 AM	10:00 AM	9:00 AM				7:00 AM
Volume	7	24	40	158	519	478	69	9	2	1	0	0	0	1146

PM Peak	5:00 PM	12:00 PM	12:00 PM	1:00 PM	3:00 PM	4:00 PM	4:00 PM	4:00 PM	2:00 PM	4:00 PM			2:00 PM	4:00 PM
Volume	4	3	12	91	461	626	142	10	2	1	0	0	2	1234

15th Percentile:	31.0 MPH	Average Speed:	34.7 MPH	Posted Speed Limit:	30 MPH
50th Percentile:	35.0 MPH	10 MPH Pace:	31 to 40 MPH	Number of Vehicles > 30 MPH:	12501
85th Percentile:	38.0 MPH	Number in Pace:	11711	Percent of Vehicles > 30 MPH:	89.1%
95th Percentile:	41.0 MPH	Percent in Pace:	83.4%		

ATTACHMENT D
STORMWATER MANAGEMENT REPORT



westonandsampson.com

55 Walkers Brook Drive, Suite 100
Reading, MA 01867
tel: 978.532.1900

REPORT

March 2025

Needham, MA

Fleet DPW Complex Phase I Fleet
Maintenance Facility

1421 Central Avenue,
Needham, MA 02492

Stormwater Report

STORMWATER REPORT

REPORT CONTENTS

Stormwater Report Narrative

Massachusetts Stormwater Checklist

Appendix A - Locus Map

Appendix B - NRCS Web Soil Survey Report, FEMA FIRM

Appendix C - Hydrology Maps & HydroCAD Reports

Appendix D - Supporting Calculations

Appendix E - Operation & Maintenance Manual

Stormwater Operation & Maintenance Plan
Long-term Pollution Prevention Plan
Illicit Discharge Statement

Appendix F - Geotechnical Information

I. INTRODUCTION

Project Overview

This report documents pre- and post-development hydrological and stormwater conditions associated with the proposed fleet maintenance garage addition project located at the Needham Cogswell Facility at 1421 Central Avenue (the site). The site is owned by the Town of Needham and occupies approximately 76 acres of land on one parcel, identified as Map 308, Block 2, per the Needham WebGIS database. Also located on the parcel is the Needham Recycling and Transfer Station, which lies approximately 500 feet to the west of the Cogswell Facility.

The existing work area is bounded to the east by wooded and residential areas, to the west by wooded areas and the recycling and transfer station, to the north by wooded area, and to the south by Central Avenue and additional wooded area. Wetland resource areas were delineated generally to the west, north, and east of the work area, as further discussed in Section II below.

The project proposes to connect a building addition (of approximately 12k square feet) to the east side of the existing Cogswell fleet facility to accommodate additional operational space for the vehicle fleet. Additionally, work is proposed within the Central Avenue right-of-way to accommodate a proposed sewer force main connection. The sewer improvements are not expected to require the addition of any new structural stormwater best management practices (BMPs), as the force main installation in the right-of-way will not result in the net addition of any impervious surface and will maintain flow patterns of runoff into the existing MS4 system.

The stormwater management system for the proposed project is designed to minimize the impacts of the project to adjacent areas by providing treatment of stormwater runoff, and attenuating peak flows during storm events relative to existing conditions. The proposed stormwater management system is designed to comply with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Handbook and the local stormwater management regulations. The stormwater management design aims to maintain existing drainage patterns to the extent practicable. Due to the poor soil conditions and the presence of shallow and exposed ledge on-site, infiltrative BMPs are not included in the stormwater design. Stormwater treatment is proposed via bioretention features as discussed further in Sections III and IV below.

Methodology

Weston & Sampson has completed a hydrologic analysis of the existing project site utilizing Soil Conservation Service (SCS) Runoff Curve Number (CN) methodology. The SCS method calculates the rate at which the runoff reaches the design point considering several factors: the slope and flow lengths of the subcatchment area, the soil type of the subcatchment area, and the type of surface cover in the subcatchment area. HydroCAD Version 10.00 computer modeling software was used in conjunction with the SCS method to determine the peak runoff rates and runoff volumes for the analyzed 24-hour design storm events. The proposed project site is being analyzed with the same methodology.

The HydroCAD program uses SCS and TR-20 methods to model drainage systems. TR-20 (Technical Release 20) was developed by the Soil Conservation Service to estimate runoff and peak discharges in small watersheds. TR-20 is generally accepted by engineers and reviewing authorities as the standard method for estimating runoff and peak discharges. A *Dynamic Storage-Indication* routing method was used for the HydroCAD model, which enables the model to respond to tailwater changes, and is thus a conservative routing method.

HydroCAD Version 10.00 uses up to four types of components to analyze the hydrology of a given site: *subcatchments*, *reaches*, *ponds*, and *links*. *Subcatchments* are areas of land that produce surface runoff. The area, weighted curve number (NC), and time of concentration (Tc) characterize each individual

subcatchment area. *Reaches* model streams, channels, or pipes that convey water from one point to another. A *pond* is any impoundment that fills with water from one or more sources and empties via outlet feature(s). *Links* are used to introduce hydrographs into a project from another source or to provide a junction for more than one hydrograph within a project. Refer to the HydroCAD reports in Appendix C for additional information.

Time of Concentration paths are identified in both the existing and proposed HydroCAD models assuming a sheet flow of 50 feet. For subcatchments deemed to have a time of concentration less than 5 minutes, a minimum time of concentration of 5 minutes was applied to the model.

Weston & Sampson used data from the Cornell University National Resource Climate Center (NRCC) online database to estimate the rainfall for the 2-, 10-, 25-, and 100-year 24-hour design storms. The NRCC Rainfall Data was selected instead of the National Oceanic and Atmospheric Administration (NOAA) rainfall data, as the NRCC data presents a more conservative 100-year storm. It is noted that the Needham Article 7 Stormwater regulations do not require a specific rainfall data source.

Table 1: NRCC Rainfall data: 24-hour design storm rainfall depths

Frequency	2-year	10-year	25-year	100-year
Rainfall (inches)	3.20	4.81	6.08	8.67

II. EXISTING HYDROLOGY

Overview

The area of proposed work is located at 1421 Central Avenue and is comprised of paved asphalt area, ledge outcrops, grassed area, and wooded area. Runoff generated on the existing paved area generally flows to the stormwater detention basin abutting the paved area to the south. This basin contains an overflow structure that conveys stormwater flows to an existing bioretention basin southwest of the Cogswell building for treatment; this bioretention basin also collects some runoff generated on the paved driveway. Runoff generated on the roof of the existing DPW fleet building is conveyed and ultimately discharged to the wooded wetland areas northwest of the building. Outside of the existing envelope of developed area, the site topography generally directs runoff to the east, west, and north to the wetland system, as depicted on the site development plans.

Soil Conditions

The site is mapped by the National Resource Conservation Service (NRCS) as containing soils classified as Hollis-Rock outcrop-Charlton complex, which is categorized as a Hydrologic Soil Group (HSG) D soil. HSG D soils are characterized by ledge and/or clay and tend to have little to no hydraulic conductivity. Due to this soil characterization, no groundwater recharge was modeled in the existing and proposed hydrology models.

A subsurface exploration program, inclusive of soil borings and test pits, was completed on-site by Weston & Sampson in November 2017 and July 2018 prior to the development of the initial DPW fleet facility on the site. A secondary subsurface exploration program by Weston & Sampson was completed in October and November of 2024 for the newly proposed facility addition. The subsurface explorations generally corroborate the NRCS mapping and reveal shall bedrock material throughout the site. Refer to Appendix F for the logs associated with the test pits performed in 2024.

Wetland Resource Areas

A Weston & Sampson wetland scientist performed a field delineation of the site on August 14, 2024 to identify wetland resource areas. Wetland resource areas were identified to the west, north, and northeast of the existing Cogswell building, as well as to the south of the Central Avenue right-of-way. The resource areas include bordering vegetated wetlands (BVW), isolated vegetated wetland (IVW), an intermittent stream, and a pond. The investigation area is not located within the 100-year FEMA floodplain. The field delineations of the wetland resource areas are depicted on the site development plans.

The Town of Needham Wetlands Protection Regulations requires the following buffer zones to be identified with all freshwater wetlands: a 25-foot no disturbance buffer zone; a 50-foot buffer zone where no construction is permitted where the buffer zone is forested, meadowland, or otherwise undeveloped; and a 100-foot buffer zone. Buffer zones have been identified accordingly on the site development plans.

Existing Hydrology Model

The existing conditions hydrology on-site has been modeled using HydroCAD. The model contains an overall watershed area of 2.43 acres with two (2) identified points-of-analysis (POAs), which are the points to where runoff generated on-site flows or discharges. Routed to each POA is one or more subcatchments, which have been delineated based on existing topographical patterns. Refer to the Existing Hydrology Map in Appendix C for a visual representation of the POAs and subcatchments; refer to the pre-development HydroCAD report in Appendix C for the modelling calculations.

POA-1 is identified as the wooded area and wetland system located to the northeast of the work area. Runoff generated by Subcatchment E-5 ultimately discharges to POA-1. The subcatchment spans an aggregated area of 0.87 acres, containing woods, grass, and ledge outcroppings.

POA-2 is identified as the wooded area and wetland system located to the west and northwest of the work area. Runoff generated by Subcatchments E-1, E-2, E-3, and E-4 ultimately discharge to POA-2. These subcatchments span an aggregated area of 1.56 acres, containing grass, gravel, ledge outcroppings, pavement, roof area, and woods.

Refer to the HydroCAD model for times of concentration, and refer Table 2 in Section IV below for the peak rates of runoff calculated at each of the POAs for the analyzed design storm events.

III. PROPOSED HYDROLOGY

Stormwater Management System Overview

The stormwater management system for the proposed facility is designed to minimize the impacts of the project to the Points-of-Analysis (POAs) by attenuating peak flows during storm events and providing treatment of stormwater runoff. The stormwater management design aims to maintain existing drainage patterns to the extent practicable. Due to the poor soil conditions and the presence of shallow and exposed ledge on-site, infiltrative BMPs are not included in the stormwater design. Stormwater treatment is proposed via (1) the previously designed and installed bioretention best management practice (BMP) located southwest of the parking area, and (2) a newly proposed bioretention BMP located east of the proposed building addition. Pretreatment is proposed in the form of a deep-sump, hooded catch basin and crushed stone sediment forebays.

Runoff generated by the roof area of the proposed building addition is designed to be captured by downspouts and conveyed to a roof drainage pipe and ultimately to the proposed bioretention basin (BMP-2P). Runoff generated by the eastern reaches of the new pavement area is also designed to sheet flow to BMP-2P. The hydrologic patterns associated with the existing paved area and existing building are to be maintained; the existing paved area will guide runoff to the stormwater detention basin to the south (BMP-1P). The existing footprint of BMP-1P is proposed to be shifted approximately 20 feet to the south to accommodate the site improvements; however, the storage capacity of the basin is proposed to be maintained. A new outlet control structure (OCS-1) is proposed within BMP-1P to accommodate the shifted footprint of the basin as described below. Lastly, the stormwater management of the roof area of the existing DPW fleet building, which conveys runoff to a pipe discharge to the wooded area to the northwest, is to remain unchanged.

List of Proposed Best Management Practices

Deep-sump, hooded catch basin: This pretreatment BMP contains a deep sump to remove suspended solids from collected stormwater runoff prior to pipe conveyance, and the installed hood will serve as temporary containment for oil and grease. The catch basin is proposed upgradient of the existing detention basin, which is proposed to be modified as described below.

Stormwater detention basin: This basin (BMP-1P) accepts flow from the proposed catch basin and the paved parking area; it offers storage capacity, peak flow reduction, and residence time for suspended solids to settle prior to the conveyance of runoff to the terminal BMP, which is the existing bioretention BMP southwest of the existing building (BMP-EP-2). While the detention basin was previously designed and constructed, the project proposes to modify a portion of the basin; a minor regrading effort will shift the basin to the south, and a new outlet control structure is proposed (OCS-1). The overall storage capacity of the basin is not proposed to be reduced relative to its original condition. OCS-1 is proposed with a weir and orifices to control peak flow rates, and the structure is proposed to connect to the existing drainage pipe connected to the downstream existing bioretention basin BMP-EP-2, which offers additional pretreatment and final stormwater treatment.

Stormwater Bioretention Basin: This proposed basin (BMP-2P) accepts runoff generated by the roof of the building addition, as well as the east portion of the new pavement area. The floor of the basin is designed to be planted with a seed mix and shallow-rooted plantings above a 2-foot deep layer of bioretention soil media to treat runoff as it percolates through the layer. At the bottom of the soil media layer is a layer of crushed stone containing perforated drainage pipes to convey the treated runoff to the basin's outlet control structure (OCS-2). OCS-2 is a concrete structure proposed with an internal weir and orifices to control peak flow rates, and the structure is equipped with an outlet pipe to convey treated flows to the wetland system northeast of the site (POA-1). OCS-2 also contains a top grate and a broad-crested stone overflow spillway to throttle outlet flows during large storm events.

Sediment forebays: Several sediment forebays are proposed on the site to provide pretreatment of stormwater runoff. The forebays contain two (2) components: (1) a flat area (generally 1% slope or less) of grass or crushed stone for runoff to collect upstream of (2) a crushed stone check dam to reduce flow velocity and strip suspended solids from the runoff. The check dams associated with the sediment forebays are identified on the site development plans.

Proposed Hydrology Model

The proposed conditions hydrology on-site has been modeled using HydroCAD. To maintain consistency with the existing hydrology model, the proposed model contains an overall watershed area of 2.43 acres with two (2) identified points-of-analysis (POAs). Routed to each POA is one or subcatchments, which have been delineated based on proposed topographical patterns. Refer to the Proposed Hydrology Map in Appendix C for a visual representation of the POAs and subcatchments; refer to the post-development HydroCAD report in Appendix C for the modelling calculations.

POA-1 is identified as the wooded area and wetland system located to the northeast of the work area. Runoff generated by Subcatchments P-4, P-5, and P-7 ultimately discharge to POA-1. These subcatchments span an aggregated area of 0.87 acres, containing grass, ledge outcroppings, crushed stone, pavement, roof area, and woods associated with the new building addition and the associated pavement and pervious areas to its east. Treatment BMP(s) within the subcatchments discharging to POA-1 include bioretention basin BMP-2P.

POA-2 is identified as the wooded area and wetland system located to the west and northwest of the work area. Runoff generated by Subcatchments P-1, P-2, P-3, and P-6 ultimately discharge to POA-2. These subcatchments span an aggregated area of 1.56 acres containing grass, crushed stone, ledge outcroppings, pavement, roof area, and woods generally associated with the already developed portions of the site. Treatment BMPs within the subcatchments discharging to POA-2 include detention basin BMP-1P and the existing bioretention basin BMP-EP-2.

Refer to Table 2 in Section IV below for the peak rates of runoff calculated at each of the POAs for the analyzed design storm events.

IV. CONSISTENCY WITH MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS

The project's consistency with the Massachusetts Stormwater Management Standards is discussed below. In certain circumstances, the requirements of the local Needham stormwater regulations (Article 7 of the Needham Bylaws) exceed the Massachusetts Stormwater Management Standards. These circumstances are identified and discussed within the relevant Standards below.

Standard 1: No New Untreated Discharges

The project does not propose to discharge any untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. Additionally, the proposed design attenuates stormwater such that discharge rates will be lower than existing conditions. Discharges have been designed to prevent scouring and erosion of downstream surfaces. Therefore, the Project complies with Standard 1.

Standard 2: Peak Rate Attenuation

The proposed stormwater management system is designed to attenuate peak discharge rates to each of the Points-of-Analysis (POAs) for each of the analyzed design storm events in compliance with Standard 2. Please refer to Table 2 below for a comparison of the pre- and post-development discharge rates at the POAs.

Table 2: Stormwater Peak Discharge Flow Rate Summary

Analysis Point	24 Hr Storm	Peak Discharge (cfs)		Difference in Peak Runoff (cfs)
		Pre-	Post-	
POA-1	2-yr	0.98	0.75	-0.23
	10-yr	1.94	1.34	-0.60
	25-yr	2.73	1.95	-0.78
	100-yr	4.37	2.47	-1.90
POA-2	2-yr	1.84	1.84	0.0
	10-yr	2.87	2.87	0.0
	25-yr	6.60	5.24	-1.36
	100-yr	9.64	9.40	-0.24

Per Section 7.7.4.2(c) of the Needham stormwater regulations, there shall be no change to the existing conditions of abutting properties from any increase in volume or peak rate of stormwater runoff. As demonstrated in Table 2 above, peak discharge rates to off-site locations are proposed to be decreased. However, volumes to the Points of Analysis and abutting properties cannot be decreased due to the lack of infiltration on-site. In other words, due to the HSG D soils and the presence of ledge on-site, infiltration of runoff on-site is inhibited. Under this condition, there is no mechanism by which volume of runoff on the site can be reduced other than by evaporation, which is not customarily modeled in hydrologic analyses. Accordingly, the applicant respectfully requests a waiver from the runoff volume reduction requirement of 7.7.4.2(c).

Standard 3: Recharge

Standard 3 requires the loss of groundwater recharge caused by the work to be minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. The soils on-site are classified as Hydrologic Soil Group D soils and the site contains many areas of exposed ledge; therefore, groundwater recharge on the site is extremely limited. Volume 1.1 of the Stormwater Handbook allows relief in this circumstance, in which the required recharge volume shall be met "only to the maximum extent practicable." The site design aims to maximize the amount of wooded and grass areas to the maximum extent practicable to enable as much recharge as possible, however limited it may be.

Standard 4: Water Quality

The proposed stormwater management system is designed to provide adequate pretreatment and to ultimately remove approximately 94% of the average annual post-construction load of total suspended solids (TSS) generated by on-site impervious areas, as demonstrated by the TSS removal summary calculations provided in Appendix D. Structural stormwater BMPs have been sized to capture the 1-inch water quality volume generated by impervious areas, as demonstrated by the water quality volume calculations in Appendix D.

Refer to Appendix E for the Long Term Pollution Prevention Plan, which has been designed in accordance with Standard 4.

Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

The project contains areas classified as LUHPPLs, associated with the light industrial facilities with vehicle service maintenance and cleaning areas. Stormwater discharges from areas classified as LUHPPLs require additional treatment beyond the requirements of Standard 4—each treatment train shall provide at least 44% TSS pretreatment prior to discharge to the final infiltration BMP. Additionally, a 1-inch water quality volume must be provided to treat the first inch of runoff generated by the total impervious area on the post-development site.

Each proposed stormwater treatment train includes two pretreatment devices in series (pretreatment devices used include sediment forebays and the deep-sump, hooded catch basin) to achieve the 44% TSS pretreatment requirement. Additionally, the 1-inch water quality volume requirement has been met, as described in Standard 4 above.

Refer to Appendix D for TSS removal and water quality volume calculations.

Refer to Appendix E for the Long Term Pollution Prevention Plan, which has been designed in accordance with Standard 5.

Standard 6: Critical Areas

The site is not located within any of the Critical Areas defined in Volume 1.1 of the Massachusetts Stormwater Handbook; therefore, Standard 6 does not apply.

Standard 7: Redevelopment

The project proposes some areas containing new impervious, paved surfaces; therefore, the relief allotted in Standard 7 for redevelopment projects was not considered.

Standard 8: Construction Period Pollution Prevention and Erosion and Sediment Control

The project is designed to control construction related impacts including erosion, sedimentation, and other pollutant sources, as reflected on the (1) the Site Preparation Plan, (2) Long-Term Pollution Prevention Plan and Operation & Maintenance Plan (Appendix E), and (3) Stormwater Pollution Prevention Plan (which will be prepared prior to construction in accordance with the EPA's Construction General Permit).

Short term water quality impacts are related to construction activities for the proposed development. Potential soil erosion and sedimentation to both on-site and downstream areas are of primary importance in this stage of development. The major cause of these construction impacts is the erosion of exposed soils caused by precipitation events before stabilization can take place. Several erosion control measures will be implemented during the construction phase of the project to minimize impacts. Compost filter tubes will be installed in down-gradient areas of the limit of work, silt sacks shall be placed in any catch basins proximate to the work area, and a stone construction entrance to prevent tracking of sediment onto local roads will be

installed. Additionally, the contractor shall provide temporary sedimentation basins during the construction process in accordance with the relevant requirements as noted on the Site Preparation plan.

Since the Project will disturb more than one (1) acre of land, a Notice of Intent (NOI) is required to be submitted to the Environmental Protection Agency (EPA) for coverage under the National Pollution Discharge Elimination System (NPDES) Construction General Permit. A Stormwater Pollution Prevention Plan (SWPPP) will be finalized and issued prior to construction in accordance with the Construction General Permit and EPA regulations. The Town, through the site's construction manager, will implement the measures in the SWPPP. The SWPPP, which is to be kept on site, includes erosion and sediment controls (stabilization practices and structural practices), temporary and permanent stormwater management measures, contractor inspection schedules and reporting of all SWPPP features, materials management, waste disposal, off-site vehicle tracking, spill prevention and response, sanitation, and non-stormwater discharges. The EPA NOI will be submitted to EPA in accordance with the governing regulations at least two weeks prior to the beginning of construction.

Standard 9: Operation and Maintenance Plan

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in Appendix E. The O&M Plan outlines procedures and timetables for the long-term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties.

Standard 10: Prohibition of Illicit Discharges

There are no known or suspected illicit discharges to the stormwater management system at the project site. An Illicit Discharge Statement is provided in Appendix E.



Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

¹ The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

² For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

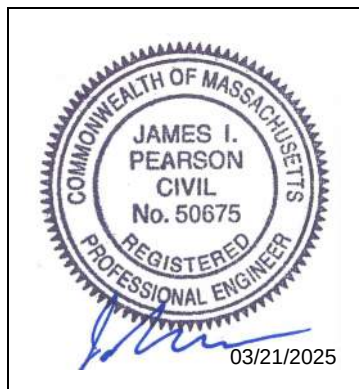
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature




Signature and Date

3/21/2025

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☐ New development
- ☐ Redevelopment
- ☒ Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
 - ☐ Credit 1
 - ☐ Credit 2
 - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- ☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☐ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - ☐ Static
 - ☐ Simple Dynamic
 - ☐ Dynamic Field¹
- ☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - ☒ Site is comprised solely of C and D soils and/or bedrock at the land surface
 - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
 - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

¹ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - ☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - ☐ is within the Zone II or Interim Wellhead Protection Area
 - ☐ is near or to other critical areas
 - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - ☒ involves runoff from land uses with higher potential pollutant loads.
 - ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- ☒ The BMP is sized (and calculations provided) based on:
 - ☒ The ½" or 1" Water Quality Volume or
 - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☒ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☒ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☐ Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- ☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - ☐ Limited Project
 - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - ☐ Bike Path and/or Foot Path
 - ☐ Redevelopment Project
 - ☐ Redevelopment portion of mix of new and redevelopment.
- ☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- ☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - ☒ Name of the stormwater management system owners;
 - ☒ Party responsible for operation and maintenance;
 - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
 - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
 - ☒ Description and delineation of public safety features;
 - ☒ Estimated operation and maintenance budget; and
 - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

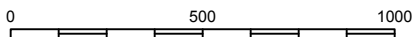
Appendix A

Locus Map



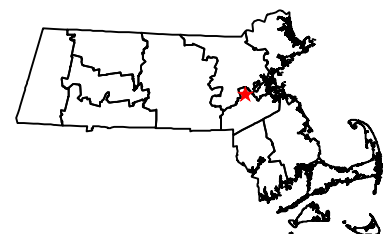
Weston & Sampson

SCALE IN FEET



**FIGURE 1
LOCUS MAP**

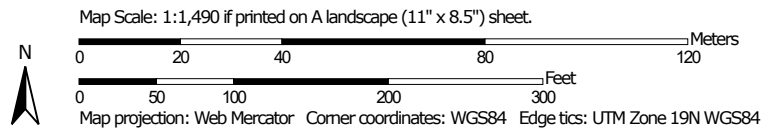
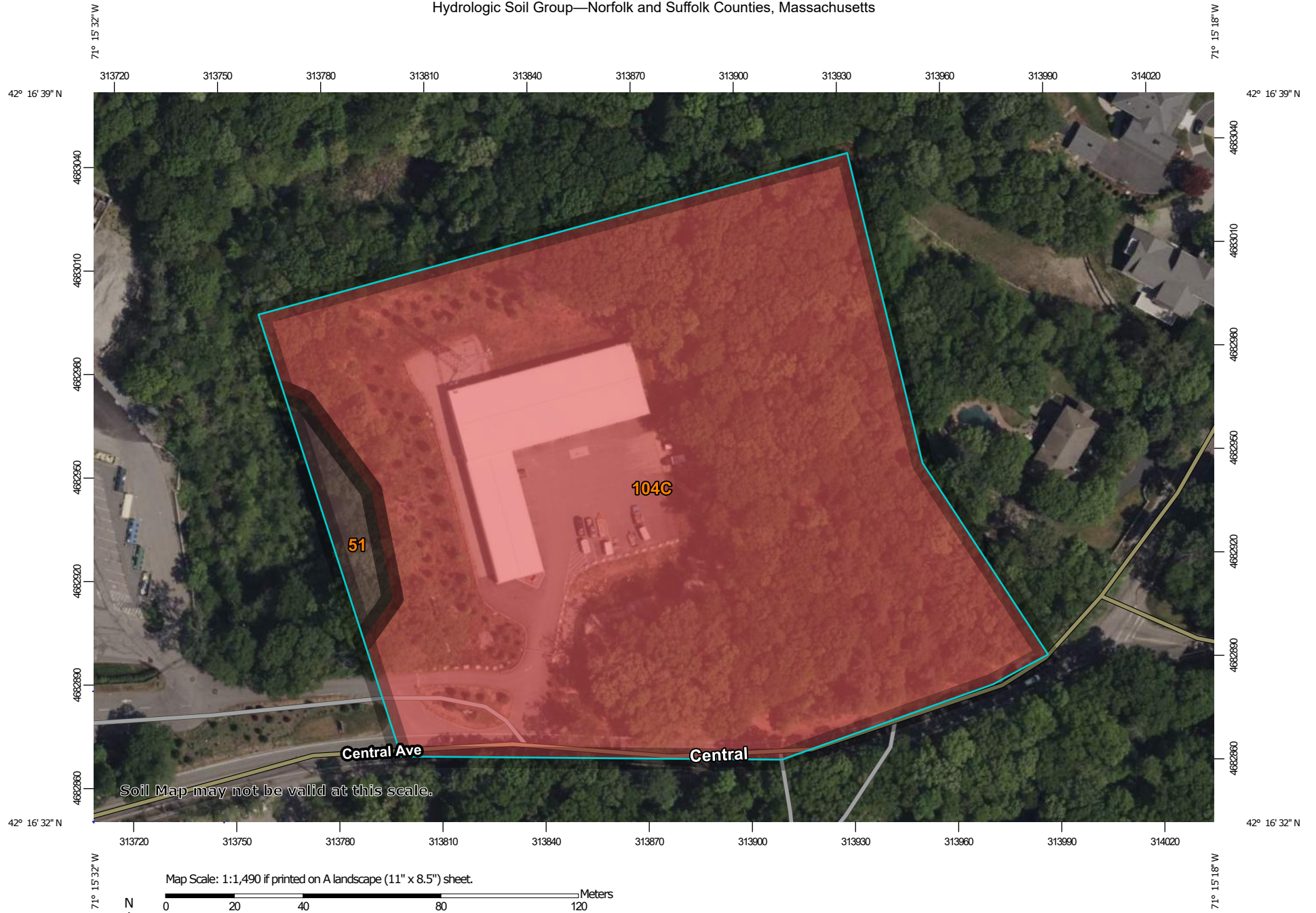
**COGSWELL FLEET MAINTENANCE
BUILDING IMPROVEMENTS
1407 CENTRAL AVENUE
NEEDHAM, MASSACHUSETTS
NORFOLK COUNTY**



Appendix B

NRCS Web Soil Survey Report
FEMA FIRM

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

10/2/2024
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Lines

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Points

-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

Water Features

-  Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

-  Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts

Survey Area Data: Version 20, Aug 27, 2024

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
51	Swansea muck, 0 to 1 percent slopes	B/D	0.2	3.0%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	D	6.6	97.0%
Totals for Area of Interest			6.8	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Massachusetts State Plane Mainland Zone (NAD 83 zone 2001). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1928 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NINGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was derived from digital orthophotography. Base map files were provided in digital format by Massachusetts Geographic Information Systems (MassGIS). Ortho imagery was produced at a scale of 1:5,000. Aerial photography is dated April 2005.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

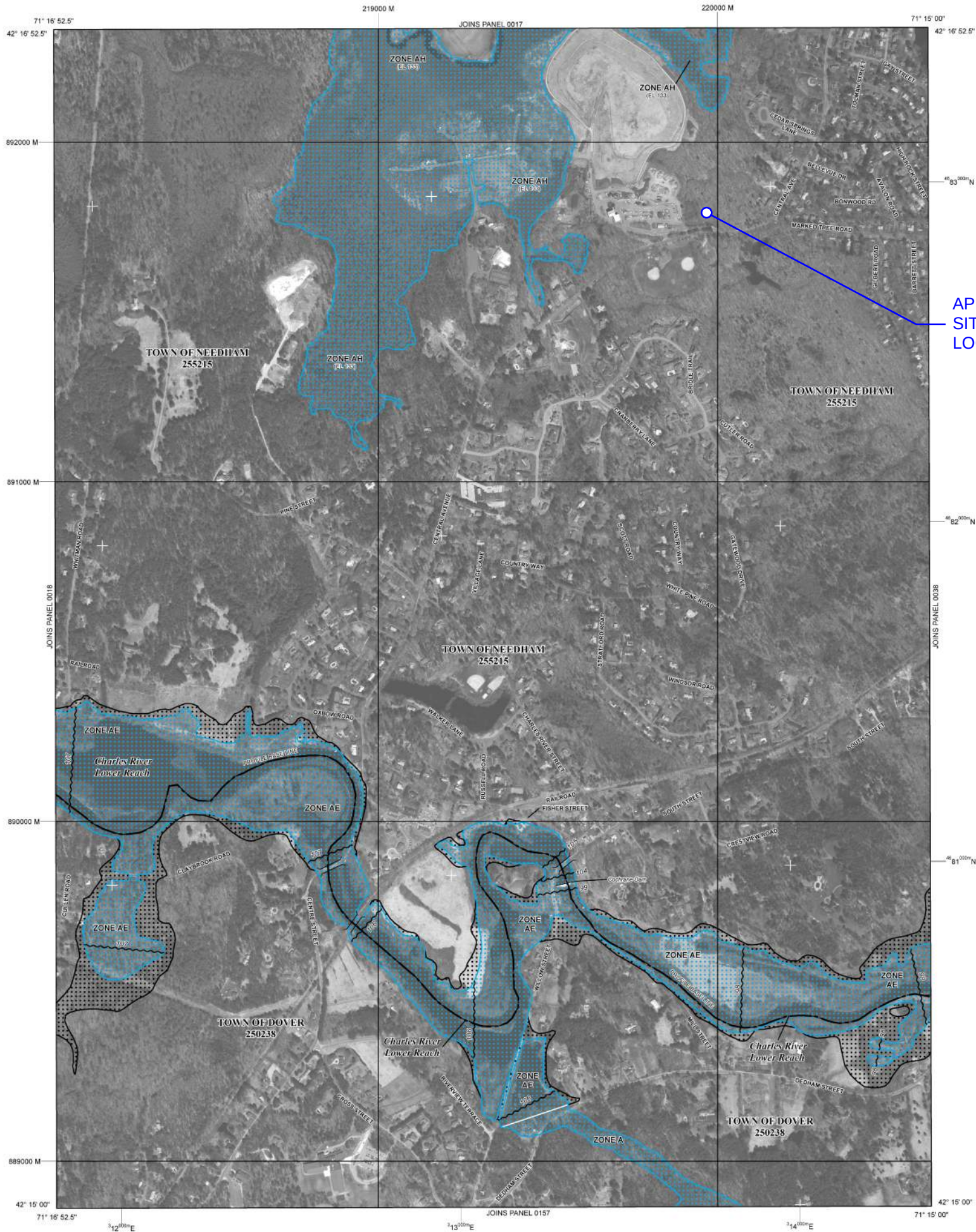
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unreviewed streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange (FMIX) at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.



APPROXIMATE
SITE
LOCATION

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
Base Flood Elevation line and value; elevation in feet*
Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line
Culvert
Bridge
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter ticks: Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection
1000-meter Universal Transverse Mercator grid values, zone 19N
Bench mark (see explanation in Notes to Users section of this FIRM panel)
* M1.5
River Mile
MAP REPOSITORIES
Refer to Map Repositories list on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
JULY 17, 2012
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0019E
FIRM
FLOOD INSURANCE RATE MAP
NORFOLK COUNTY,
MASSACHUSETTS
(ALL JURISDICTIONS)
PANEL 19 OF 430
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DOVER, TOWN OF	250238	0019	E
NEEDHAM, TOWN OF	255215	0019	E

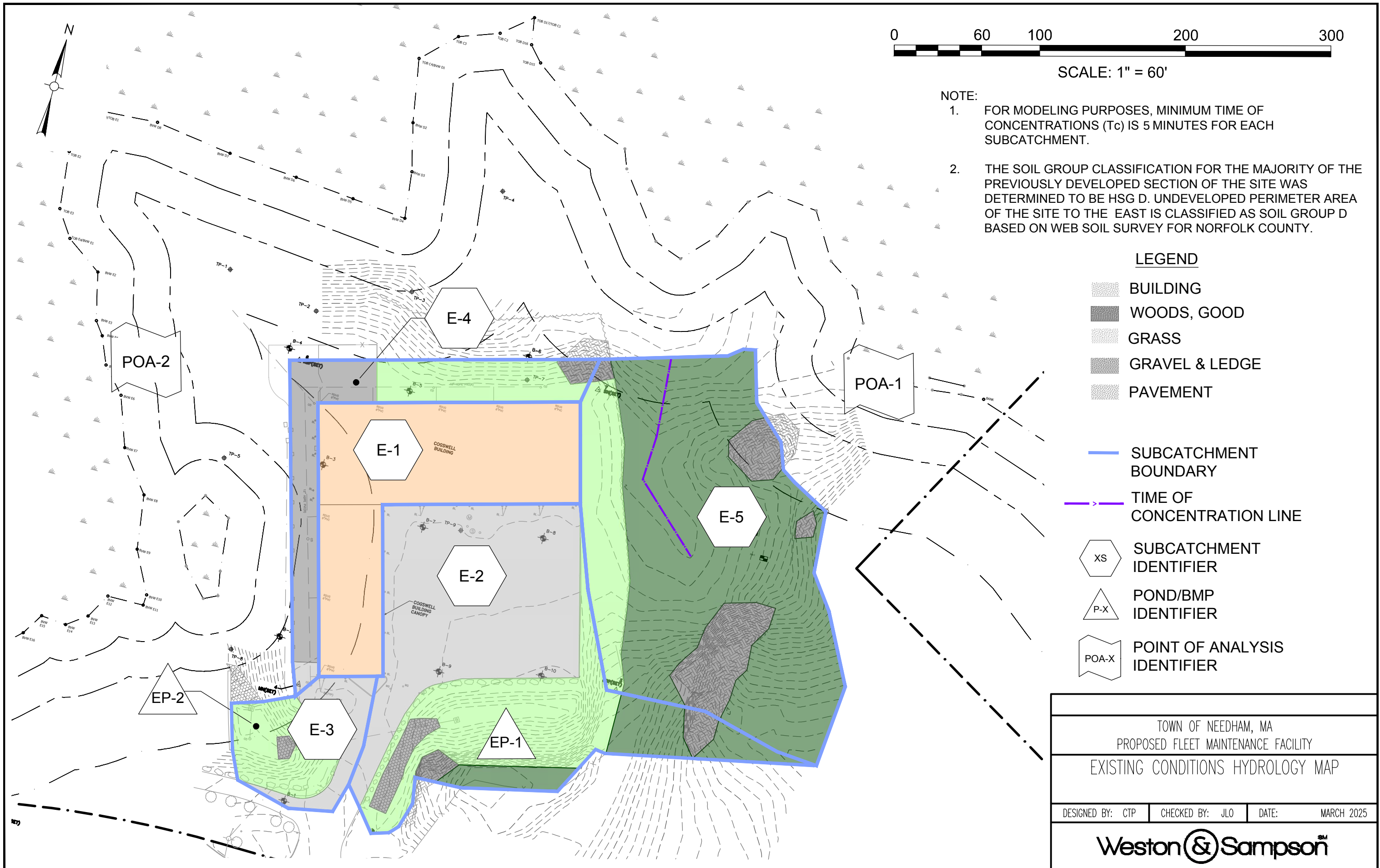
Notice to User: The **Map Number** shown below should be used when placing map orders, the **Community Number** shown above should be used on insurance applications for the subject community.

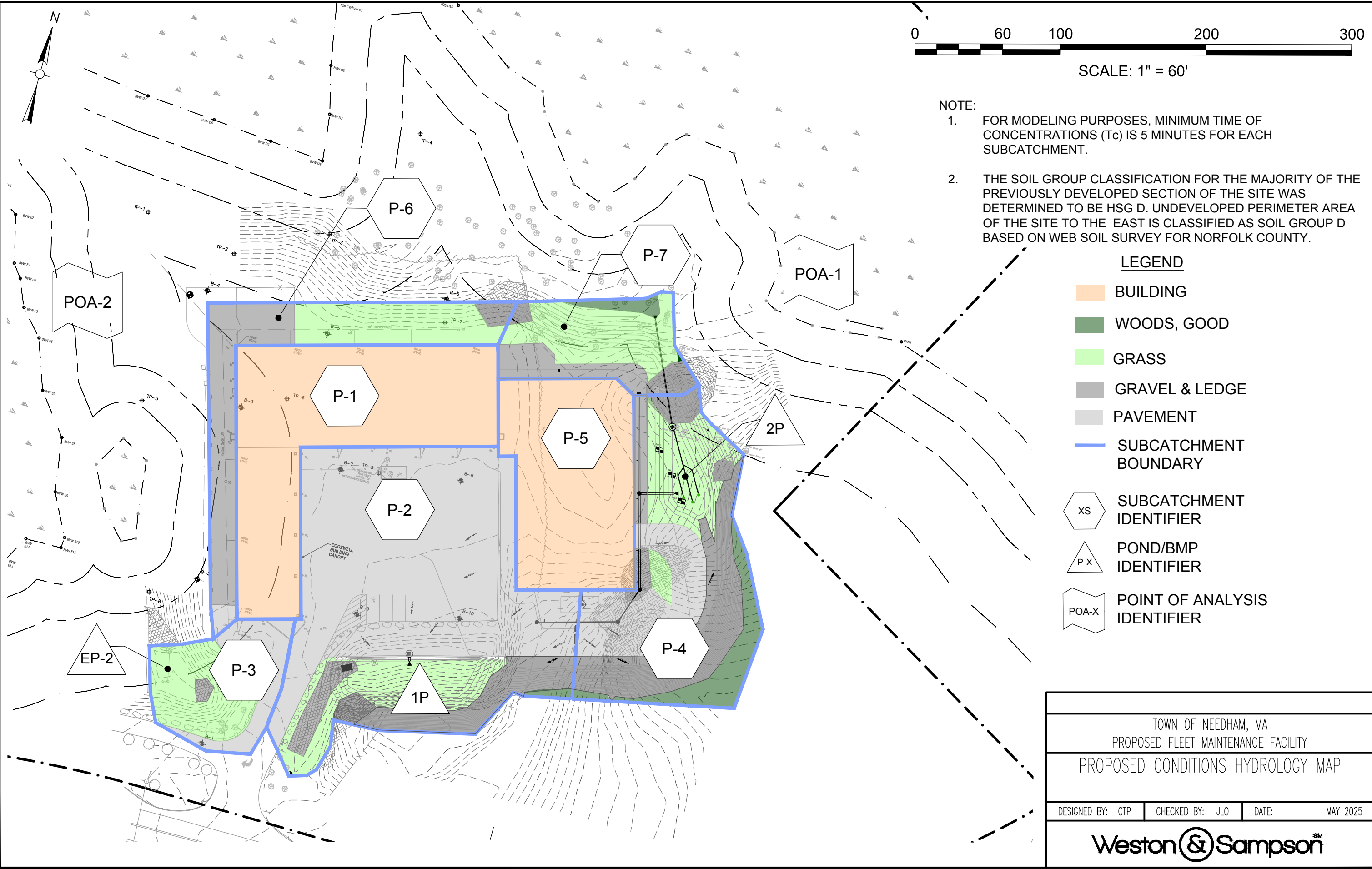
MAP NUMBER
25021C0019E
EFFECTIVE DATE
JULY 17, 2012

Federal Emergency Management Agency

Appendix C

Hydrology Maps & HydroCAD Reports





- NOTE:
1. FOR MODELING PURPOSES, MINIMUM TIME OF CONCENTRATIONS (T_c) IS 5 MINUTES FOR EACH SUBCATCHMENT.
 2. THE SOIL GROUP CLASSIFICATION FOR THE MAJORITY OF THE PREVIOUSLY DEVELOPED SECTION OF THE SITE WAS DETERMINED TO BE HSG D. UNDEVELOPED PERIMETER AREA OF THE SITE TO THE EAST IS CLASSIFIED AS SOIL GROUP D BASED ON WEB SOIL SURVEY FOR NORFOLK COUNTY.

LEGEND

- BUILDING
- WOODS, GOOD
- GRASS
- GRAVEL & LEDGE
- PAVEMENT
- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT IDENTIFIER
- POND/BMP IDENTIFIER
- POINT OF ANALYSIS IDENTIFIER

TOWN OF NEEDHAM, MA		
PROPOSED FLEET MAINTENANCE FACILITY		
PROPOSED CONDITIONS HYDROLOGY MAP		
DESIGNED BY: CTP	CHECKED BY: JLO	DATE: MAY 2025
Weston & Sampson SM		



Existing

Prepared by Weston & Sampson Engineers, Inc

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Page 2

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.20	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.81	2
3	25-yr	Type III 24-hr		Default	24.00	1	6.08	2
4	100-yr	Type III 24-hr		Default	24.00	1	8.67	2

Existing

Prepared by Weston & Sampson Engineers, Inc
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Area Listing (all nodes)		
Area (sq-ft)	CN	Description (subcatchment-numbers)
22,790	80	>75% Grass cover, Good, HSG D (E-2, E-3, E-4, E-5)
6,151	96	Gravel surface, HSG D (E-2, E-3, E-4)
5,885	98	Ledge Outcrop (E-2, E-4, E-5)
21,028	98	Paved parking, HSG D (E-2, E-3, E-4)
17,805	98	Unconnected roofs, HSG A (E-1)
32,049	77	Woods, Good, HSG D (E-2, E-5)
105,708	88	TOTAL AREA

Existing

Prepared by Weston & Sampson Engineers, Inc
HydroCAD® 10.20-5c s/n 00455 © 2023 HydroCAD Software Solutions LLC

Soil Listing (all nodes)		
Area (sq-ft)	Soil Group	Subcatchment Numbers
17,805	HSG A	E-1
0	HSG B	
0	HSG C	
82,018	HSG D	E-2, E-3, E-4, E-5
5,885	Other	E-2, E-4, E-5
105,708		TOTAL AREA

Ground Covers (all nodes)							Subcatc Number
HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	
0	0	0	22,790	0	22,790	>75% Grass cover, Good	
0	0	0	6,151	0	6,151	Gravel surface	
0	0	0	0	5,885	5,885	Ledge Outcrop	
0	0	0	21,028	0	21,028	Paved parking	
17,805	0	0	0	0	17,805	Unconnected roofs	
0	0	0	32,049	0	32,049	Woods, Good	
17,805	0	0	82,018	5,885	105,708	TOTAL AREA	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1:

Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=1.28 cfs 4,403 cf

Subcatchment E-2:

Runoff Area=33,716 sf 56.21% Impervious Runoff Depth=2.17"
Tc=5.0 min CN=90 Runoff=1.96 cfs 6,093 cf

Subcatchment E-3:

Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=2.00"
Tc=5.0 min CN=88 Runoff=0.36 cfs 1,129 cf

Subcatchment E-4:

Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=2.17"
Tc=5.0 min CN=90 Runoff=0.56 cfs 1,744 cf

Subcatchment E-5:

Runoff Area=37,753 sf 12.07% Impervious Runoff Depth=1.40"
Flow Length=147' Tc=18.2 min CN=80 Runoff=0.98 cfs 4,411 cf

Pond EP-1: Ex Detention Basin

Peak Elev=168.55' Storage=4,451 cf Inflow=1.96 cfs 6,093 cf
Outflow=0.10 cfs 1,759 cf

Pond EP-2: Ex Bioretention

Peak Elev=163.52' Storage=1,264 cf Inflow=0.36 cfs 2,888 cf
Primary=0.00 cfs 0 cf Secondary=0.11 cfs 1,645 cf Outflow=0.11 cfs 1,645 cf

Link POA-1: To wetland System - East

Inflow=0.98 cfs 4,411 cf
Primary=0.98 cfs 4,411 cf

Link POA-2: To wetland System - Northwest

Inflow=1.84 cfs 7,792 cf
Primary=1.84 cfs 7,792 cf

Total Runoff Area = 105,708 sf Runoff Volume = 17,780 cf Average Runoff Depth = 2.02"
57.70% Pervious = 60,990 sf 42.30% Impervious = 44,718 sf

Summary for Subcatchment E-1:

Runoff	=	1.28 cfs @ 12.07 hrs,	Volume=	4,403 cf,	Depth=	2.97"																												
Routed to Link POA-2 : To wetland System - Northwest																																		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																																		
Type III 24-hr 2-yr Rainfall=3.20"																																		
<table><tr><td>Area (sf)</td><td>CN</td><td colspan="5">Description</td></tr><tr><td>17,805</td><td>98</td><td colspan="5">Unconnected roofs, HSG A</td></tr><tr><td>17,805</td><td></td><td colspan="5">100.00% Impervious Area</td></tr><tr><td>17,805</td><td></td><td colspan="5">100.00% Unconnected</td></tr></table>							Area (sf)	CN	Description					17,805	98	Unconnected roofs, HSG A					17,805		100.00% Impervious Area					17,805		100.00% Unconnected				
Area (sf)	CN	Description																																
17,805	98	Unconnected roofs, HSG A																																
17,805		100.00% Impervious Area																																
17,805		100.00% Unconnected																																
Tc	Length	Slope	Velocity	Capacity	Description																													
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)																														
5.0					Direct Entry, Tc min																													

Summary for Subcatchment E-2:

Runoff	=	1.96 cfs @ 12.07 hrs,	Volume=	6,093 cf,	Depth=	2.17"																																																															
Routed to Pond EP-1 : Ex Detention Basin																																																																					
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																																																																					
Type III 24-hr 2-yr Rainfall=3.20"																																																																					
<table><tr><td>Area (sf)</td><td>CN</td><td colspan="5">Description</td></tr><tr><td>9,578</td><td>80</td><td colspan="5">>75% Grass cover, Good, HSG D</td></tr><tr><td>17,985</td><td>98</td><td colspan="5">Paved parking, HSG D</td></tr><tr><td>967</td><td>98</td><td colspan="5">Ledge Outcrop</td></tr><tr><td>931</td><td>96</td><td colspan="5">Gravel surface, HSG D</td></tr><tr><td>4,255</td><td>77</td><td colspan="5">Woods, Good, HSG D</td></tr><tr><td>33,716</td><td>90</td><td colspan="5">Weighted Average</td></tr><tr><td>14,764</td><td></td><td colspan="5">43.79% Pervious Area</td></tr><tr><td>18,952</td><td></td><td colspan="5">56.21% Impervious Area</td></tr></table>							Area (sf)	CN	Description					9,578	80	>75% Grass cover, Good, HSG D					17,985	98	Paved parking, HSG D					967	98	Ledge Outcrop					931	96	Gravel surface, HSG D					4,255	77	Woods, Good, HSG D					33,716	90	Weighted Average					14,764		43.79% Pervious Area					18,952		56.21% Impervious Area				
Area (sf)	CN	Description																																																																			
9,578	80	>75% Grass cover, Good, HSG D																																																																			
17,985	98	Paved parking, HSG D																																																																			
967	98	Ledge Outcrop																																																																			
931	96	Gravel surface, HSG D																																																																			
4,255	77	Woods, Good, HSG D																																																																			
33,716	90	Weighted Average																																																																			
14,764		43.79% Pervious Area																																																																			
18,952		56.21% Impervious Area																																																																			
Tc	Length	Slope	Velocity	Capacity	Description																																																																
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)																																																																	
5.0					Direct Entry, Tc min																																																																

Summary for Subcatchment E-3:

Runoff	=	0.36 cfs @	12.08 hrs,	Volume=	1,129 cf,	Depth=	2.00"
Routed to Pond EP-2 : Ex Bioretention							
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs							
Type III 24-hr 2-yr Rainfall=3.20"							
Area (sf)	CN	Description					
2,750	98	Paved parking, HSG D					
3,876	80	>75% Grass cover, Good, HSG D					
157	96	Gravel surface, HSG D					
6,783	88	Weighted Average					
4,033		59.46% Pervious Area					
2,750		40.54% Impervious Area					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description		
5.0					Direct Entry, Direct entry		

Summary for Subcatchment E-4:

Runoff	=	0.56 cfs @	12.07 hrs,	Volume=	1,744 cf,	Depth=	2.17"
Routed to Link POA-2 : To wetland System - Northwest							
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs							
Type III 24-hr 2-yr Rainfall=3.20"							
Area (sf)	CN	Description					
5,063	96	Gravel surface, HSG D					
3,935	80	>75% Grass cover, Good, HSG D					
*	360	Ledge Outcrop					
293	98	Paved parking, HSG D					
9,651	90	Weighted Average					
8,998		93.23% Pervious Area					
653		6.77% Impervious Area					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description		
5.0					Direct Entry,		

Summary for Subcatchment E-5:

Runoff = 0.98 cfs @ 12.26 hrs, Volume= 4,411 cf, Depth= 1.40"
Routed to Link POA-1 : To wetland System - East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
27,794	77	Woods, Good, HSG D
5,401	80	>75% Grass cover, Good, HSG D
4,558	98	Ledge Outcrop
37,753	80	Weighted Average
33,195		87.93% Pervious Area
4,558		12.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.4	43	0.0100	0.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	54	0.1200	1.73		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
18.2	147	Total			

Summary for Pond EP-1: Ex Detention Basin

Inflow Area = 33,716 sf, 56.21% Impervious, Inflow Depth = 2.17" for 2-yr event
Inflow = 1.96 cfs @ 12.07 hrs, Volume= 6,093 cf
Outflow = 0.10 cfs @ 14.35 hrs, Volume= 1,759 cf, Atten= 95%, Lag= 136.5 min
Primary = 0.10 cfs @ 14.35 hrs, Volume= 1,759 cf
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 168.55' @ 14.35 hrs Surf.Area= 2,531 sf Storage= 4,451 cf

Plug-Flow detention time= 388.4 min calculated for 1,758 cf (29% of inflow)
Center-of-Mass det. time= 251.3 min (1,057.3 - 806.0)

Volume	Invert	Avail.Storage	Storage Description		
#1	166.00'	8,849 cf	Existing Pond (Irregular)Listed below (Recalc)		

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,028	203.0	0	0	1,028
167.00	1,575	221.0	1,292	1,292	1,671
168.00	2,185	240.0	1,872	3,164	2,405
169.00	2,838	262.0	2,504	5,668	3,319
170.00	3,536	290.0	3,181	8,849	4,580

Device	Routing	Invert	Outlet Devices
#1	Primary	164.20'	12.0" Round Culvert L= 115.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 164.20' / 162.09' S= 0.0183 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	168.50'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 14.35 hrs HW=168.55' TW=163.32' (Dynamic Tailwater)
1=Culvert (Passes 0.10 cfs of 5.86 cfs potential flow)
2=Orifice/Grate (Weir Controls 0.10 cfs @ 0.71 fps)

Existing

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Type III 24-hr 2-yr Rainfall=3.20"

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Stage-Area-Storage for Pond EP-1: Ex Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,028	0	168.80	2,701	5,114
166.05	1,053	52	168.85	2,735	5,250
166.10	1,077	105	168.90	2,769	5,388
166.15	1,103	160	168.95	2,803	5,527
166.20	1,128	216	169.00	2,838	5,668
166.25	1,154	273	169.05	2,871	5,811
166.30	1,180	331	169.10	2,904	5,955
166.35	1,206	391	169.15	2,938	6,101
166.40	1,233	452	169.20	2,971	6,249
166.45	1,260	514	169.25	3,005	6,398
166.50	1,287	578	169.30	3,039	6,549
166.55	1,314	643	169.35	3,074	6,702
166.60	1,342	709	169.40	3,108	6,857
166.65	1,370	777	169.45	3,143	7,013
166.70	1,399	846	169.50	3,177	7,171
166.75	1,427	917	169.55	3,212	7,331
166.80	1,456	989	169.60	3,248	7,492
166.85	1,486	1,062	169.65	3,283	7,655
166.90	1,515	1,137	169.70	3,319	7,821
166.95	1,545	1,214	169.75	3,354	7,987
167.00	1,575	1,292	169.80	3,390	8,156
167.05	1,603	1,371	169.85	3,426	8,326
167.10	1,632	1,452	169.90	3,463	8,499
167.15	1,660	1,534	169.95	3,499	8,673
167.20	1,689	1,618	170.00	3,536	8,849
167.25	1,718	1,703			
167.30	1,748	1,790			
167.35	1,777	1,878			
167.40	1,807	1,968			
167.45	1,837	2,059			
167.50	1,868	2,151			
167.55	1,898	2,246			
167.60	1,929	2,341			
167.65	1,960	2,438			
167.70	1,992	2,537			
167.75	2,023	2,638			
167.80	2,055	2,740			
167.85	2,087	2,843			
167.90	2,120	2,948			
167.95	2,152	3,055			
168.00	2,185	3,164			
168.05	2,216	3,274			
168.10	2,246	3,385			
168.15	2,278	3,498			
168.20	2,309	3,613			
168.25	2,340	3,729			
168.30	2,372	3,847			
168.35	2,404	3,966			
168.40	2,436	4,087			
168.45	2,468	4,210			
168.50	2,501	4,334			
168.55	2,534	4,460			
168.60	2,567	4,587			
168.65	2,600	4,717			
168.70	2,633	4,847			
168.75	2,667	4,980			

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Type III 24-hr 2-yr Rainfall=3.20"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,499 sf, 53.59% Impervious, Inflow Depth = 0.86" for 2-yr event
 Inflow = 0.36 cfs @ 12.08 hrs, Volume= 2,888 cf
 Outflow = 0.11 cfs @ 15.01 hrs, Volume= 1,645 cf, Atten= 70%, Lag= 176.2 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link POA-2 : To wetland System - Northwest
 Secondary = 0.11 cfs @ 15.01 hrs, Volume= 1,645 cf
 Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 163.52' @ 15.01 hrs Surf.Area= 1,117 sf Storage= 1,264 cf

Plug-Flow detention time= 306.0 min calculated for 1,645 cf (57% of inflow)
 Center-of-Mass det. time= 149.9 min (1,112.2 - 962.2)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Existing Pond (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.11 cfs @ 15.01 hrs HW=163.52' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.34 fps)

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Type III 24-hr 2-yr Rainfall=3.20"

Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

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Type III 24-hr 2-yr Rainfall=3.20"

Summary for Link POA-1: To wetland System - East

Inflow Area = 37,753 sf, 12.07% Impervious, Inflow Depth = 1.40" for 2-yr event
Inflow = 0.98 cfs @ 12.26 hrs, Volume= 4,411 cf
Primary = 0.98 cfs @ 12.26 hrs, Volume= 4,411 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,955 sf, 59.10% Impervious, Inflow Depth = 1.38" for 2-yr event
Inflow = 1.84 cfs @ 12.07 hrs, Volume= 7,792 cf
Primary = 1.84 cfs @ 12.07 hrs, Volume= 7,792 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=4.57" Tc=5.0 min CN=98 Runoff=1.93 cfs 6,786 cf
Subcatchment E-2:	Runoff Area=33,716 sf 56.21% Impervious Runoff Depth=3.69" Tc=5.0 min CN=90 Runoff=3.26 cfs 10,377 cf
Subcatchment E-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=3.49" Tc=5.0 min CN=88 Runoff=0.63 cfs 1,972 cf
Subcatchment E-4:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=3.69" Tc=5.0 min CN=90 Runoff=0.93 cfs 2,970 cf
Subcatchment E-5:	Runoff Area=37,753 sf 12.07% Impervious Runoff Depth=2.73" Flow Length=147' Tc=18.2 min CN=80 Runoff=1.94 cfs 8,582 cf
Pond EP-1: Ex Detention Basin	Peak Elev=168.76' Storage=5,004 cf Inflow=3.26 cfs 10,377 cf Outflow=1.36 cfs 6,043 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.62' Storage=1,376 cf Inflow=1.63 cfs 8,015 cf Primary=0.00 cfs 0 cf Secondary=1.70 cfs 6,772 cf Outflow=1.70 cfs 6,772 cf
Link POA-1: To wetland System - East	Inflow=1.94 cfs 8,582 cf Primary=1.94 cfs 8,582 cf
Link POA-2: To wetland System - Northwest	Inflow=2.87 cfs 16,528 cf Primary=2.87 cfs 16,528 cf
Total Runoff Area = 105,708 sf Runoff Volume = 30,687 cf Average Runoff Depth = 3.48" 57.70% Pervious = 60,990 sf 42.30% Impervious = 44,718 sf	

Summary for Subcatchment E-1:

Runoff	=	1.93 cfs @ 12.07 hrs,	Volume=	6,786 cf,	Depth=	4.57"																												
Routed to Link POA-2 : To wetland System - Northwest																																		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																																		
Type III 24-hr 10-yr Rainfall=4.81"																																		
<table><tr><td>Area (sf)</td><td>CN</td><td colspan="5">Description</td></tr><tr><td>17,805</td><td>98</td><td colspan="5">Unconnected roofs, HSG A</td></tr><tr><td>17,805</td><td></td><td colspan="5">100.00% Impervious Area</td></tr><tr><td>17,805</td><td></td><td colspan="5">100.00% Unconnected</td></tr></table>							Area (sf)	CN	Description					17,805	98	Unconnected roofs, HSG A					17,805		100.00% Impervious Area					17,805		100.00% Unconnected				
Area (sf)	CN	Description																																
17,805	98	Unconnected roofs, HSG A																																
17,805		100.00% Impervious Area																																
17,805		100.00% Unconnected																																
Tc	Length	Slope	Velocity	Capacity	Description																													
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)																														
5.0					Direct Entry, Tc min																													

Summary for Subcatchment E-2:

Runoff	=	3.26 cfs @ 12.07 hrs,	Volume=	10,377 cf,	Depth=	3.69"																																																															
Routed to Pond EP-1 : Ex Detention Basin																																																																					
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																																																																					
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5.0					Direct Entry, Tc min																																																																

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Runoff = 0.63 cfs @ 12.07 hrs, Volume= 1,972 cf, Depth= 3.49"
Routed to Pond EP-2 : Ex Bioretention

Area (sf)	CN	Description
2,750	98	Paved parking, HSG D
3,876	80	>75% Grass cover, Good, HSG D
157	96	Gravel surface, HSG D
6,783	88	Weighted Average
4,033		59.46% Pervious Area
2,750		40.54% Impervious Area

Direct Entry, Direct entry

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Runoff = 0.93 cfs @ 12.07 hrs, Volume= 2,970 cf, Depth= 3.69"
Routed to Link POA-2 : To wetland System - Northwest

	Area (sf)	CN	Description
	5,063	96	Gravel surface, HSG D
*	3,935	80	>75% Grass cover, Good, HSG D
	360	98	Ledge Outcrop
	293	98	Paved parking, HSG D
	9,651	90	Weighted Average
	8,998		93.23% Pervious Area
	653		6.77% Impervious Area

Direct Entry,

Summary for Subcatchment E-5:

Runoff = 1.94 cfs @ 12.25 hrs, Volume= 8,582 cf, Depth= 2.73"
Routed to Link POA-1 : To wetland System - East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.81"

Area (sf)	CN	Description
27,794	77	Woods, Good, HSG D
5,401	80	>75% Grass cover, Good, HSG D
4,558	98	Ledge Outcrop
37,753	80	Weighted Average
33,195		87.93% Pervious Area
4,558		12.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.4	43	0.0100	0.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	54	0.1200	1.73		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
18.2	147	Total			

Summary for Pond EP-1: Ex Detention Basin

Inflow Area = 33,716 sf, 56.21% Impervious, Inflow Depth = 3.69" for 10-yr event
Inflow = 3.26 cfs @ 12.07 hrs, Volume= 10,377 cf
Outflow = 1.36 cfs @ 12.28 hrs, Volume= 6,043 cf, Atten= 58%, Lag= 12.2 min
Primary = 1.36 cfs @ 12.28 hrs, Volume= 6,043 cf
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 168.76' @ 12.28 hrs Surf.Area= 2,673 sf Storage= 5,004 cf

Plug-Flow detention time= 208.0 min calculated for 6,039 cf (58% of inflow)
Center-of-Mass det. time= 103.9 min (895.0 - 791.1)

Volume	Invert	Avail.Storage	Storage Description		
#1	166.00'	8,849 cf	Existing Pond (Irregular)Listed below (Recalc)		

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,028	203.0	0	0	1,028
167.00	1,575	221.0	1,292	1,292	1,671
168.00	2,185	240.0	1,872	3,164	2,405
169.00	2,838	262.0	2,504	5,668	3,319
170.00	3,536	290.0	3,181	8,849	4,580

Device	Routing	Invert	Outlet Devices
#1	Primary	164.20'	12.0" Round Culvert L= 115.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 164.20' / 162.09' S= 0.0183 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	168.50'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.35 cfs @ 12.28 hrs HW=168.76' TW=163.61' (Dynamic Tailwater)
1=Culvert (Passes 1.35 cfs of 6.01 cfs potential flow)
2=Orifice/Grate (Weir Controls 1.35 cfs @ 1.66 fps)

Existing

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Type III 24-hr 10-yr Rainfall=4.81"

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Stage-Area-Storage for Pond EP-1: Ex Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,028	0	168.80	2,701	5,114
166.05	1,053	52	168.85	2,735	5,250
166.10	1,077	105	168.90	2,769	5,388
166.15	1,103	160	168.95	2,803	5,527
166.20	1,128	216	169.00	2,838	5,668
166.25	1,154	273	169.05	2,871	5,811
166.30	1,180	331	169.10	2,904	5,955
166.35	1,206	391	169.15	2,938	6,101
166.40	1,233	452	169.20	2,971	6,249
166.45	1,260	514	169.25	3,005	6,398
166.50	1,287	578	169.30	3,039	6,549
166.55	1,314	643	169.35	3,074	6,702
166.60	1,342	709	169.40	3,108	6,857
166.65	1,370	777	169.45	3,143	7,013
166.70	1,399	846	169.50	3,177	7,171
166.75	1,427	917	169.55	3,212	7,331
166.80	1,456	989	169.60	3,248	7,492
166.85	1,486	1,062	169.65	3,283	7,655
166.90	1,515	1,137	169.70	3,319	7,821
166.95	1,545	1,214	169.75	3,354	7,987
167.00	1,575	1,292	169.80	3,390	8,156
167.05	1,603	1,371	169.85	3,426	8,326
167.10	1,632	1,452	169.90	3,463	8,499
167.15	1,660	1,534	169.95	3,499	8,673
167.20	1,689	1,618	170.00	3,536	8,849
167.25	1,718	1,703			
167.30	1,748	1,790			
167.35	1,777	1,878			
167.40	1,807	1,968			
167.45	1,837	2,059			
167.50	1,868	2,151			
167.55	1,898	2,246			
167.60	1,929	2,341			
167.65	1,960	2,438			
167.70	1,992	2,537			
167.75	2,023	2,638			
167.80	2,055	2,740			
167.85	2,087	2,843			
167.90	2,120	2,948			
167.95	2,152	3,055			
168.00	2,185	3,164			
168.05	2,216	3,274			
168.10	2,246	3,385			
168.15	2,278	3,498			
168.20	2,309	3,613			
168.25	2,340	3,729			
168.30	2,372	3,847			
168.35	2,404	3,966			
168.40	2,436	4,087			
168.45	2,468	4,210			
168.50	2,501	4,334			
168.55	2,534	4,460			
168.60	2,567	4,587			
168.65	2,600	4,717			
168.70	2,633	4,847			
168.75	2,667	4,980			

Existing

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Type III 24-hr 10-yr Rainfall=4.81"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,499 sf, 53.59% Impervious, Inflow Depth = 2.37" for 10-yr event
Inflow = 1.63 cfs @ 12.26 hrs, Volume= 8,015 cf
Outflow = 1.70 cfs @ 12.31 hrs, Volume= 6,772 cf, Atten= 0%, Lag= 2.8 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-2 : To wetland System - Northwest
Secondary = 1.70 cfs @ 12.31 hrs, Volume= 6,772 cf
Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 163.62' @ 12.31 hrs Surf.Area= 1,149 sf Storage= 1,376 cf

Plug-Flow detention time= 104.3 min calculated for 6,767 cf (84% of inflow)
Center-of-Mass det. time= 35.0 min (906.2 - 871.2)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Existing Pond (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.65 cfs @ 12.31 hrs HW=163.62' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.65 cfs @ 0.85 fps)

Existing

Type III 24-hr 10-yr Rainfall=4.81"

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Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

Existing

Type III 24-hr 10-yr Rainfall=4.81"

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Summary for Link POA-1: To wetland System - East

Inflow Area = 37,753 sf, 12.07% Impervious, Inflow Depth = 2.73" for 10-yr event
Inflow = 1.94 cfs @ 12.25 hrs, Volume= 8,582 cf
Primary = 1.94 cfs @ 12.25 hrs, Volume= 8,582 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,955 sf, 59.10% Impervious, Inflow Depth = 2.92" for 10-yr event
Inflow = 2.87 cfs @ 12.07 hrs, Volume= 16,528 cf
Primary = 2.87 cfs @ 12.07 hrs, Volume= 16,528 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=5.84" Tc=5.0 min CN=98 Runoff=2.45 cfs 8,668 cf
Subcatchment E-2:	Runoff Area=33,716 sf 56.21% Impervious Runoff Depth=4.92" Tc=5.0 min CN=90 Runoff=4.28 cfs 13,834 cf
Subcatchment E-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=4.70" Tc=5.0 min CN=88 Runoff=0.83 cfs 2,658 cf
Subcatchment E-4:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=4.92" Tc=5.0 min CN=90 Runoff=1.23 cfs 3,960 cf
Subcatchment E-5:	Runoff Area=37,753 sf 12.07% Impervious Runoff Depth=3.85" Flow Length=147' Tc=18.2 min CN=80 Runoff=2.73 cfs 12,123 cf
Pond EP-1: Ex Detention Basin	Peak Elev=168.99' Storage=5,653 cf Inflow=4.28 cfs 13,834 cf Outflow=2.66 cfs 9,500 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.69' Storage=1,452 cf Inflow=3.36 cfs 12,159 cf Primary=0.00 cfs 0 cf Secondary=3.37 cfs 10,915 cf Outflow=3.37 cfs 10,915 cf
Link POA-1: To wetland System - East	Inflow=2.73 cfs 12,123 cf Primary=2.73 cfs 12,123 cf
Link POA-2: To wetland System - Northwest	Inflow=6.60 cfs 23,543 cf Primary=6.60 cfs 23,543 cf
Total Runoff Area = 105,708 sf Runoff Volume = 41,244 cf Average Runoff Depth = 4.68" 57.70% Pervious = 60,990 sf 42.30% Impervious = 44,718 sf	

Summary for Subcatchment E-1:

Runoff = 2.45 cfs @ 12.07 hrs, Volume= 8,668 cf, Depth= 5.84"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
17,805	98	Unconnected roofs, HSG A
17,805		100.00% Impervious Area
17,805		100.00% Unconnected

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

Summary for Subcatchment E-2:

Runoff = 4.28 cfs @ 12.07 hrs, Volume= 13,834 cf, Depth= 4.92"
Routed to Pond EP-1 : Ex Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
9,578	80	>75% Grass cover, Good, HSG D
17,985	98	Paved parking, HSG D
967	98	Ledge Outcrop
931	96	Gravel surface, HSG D
4,255	77	Woods, Good, HSG D

33,716	90	Weighted Average
14,764		43.79% Pervious Area
18,952		56.21% Impervious Area

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

Summary for Subcatchment E-3:

Runoff = 0.83 cfs @ 12.07 hrs, Volume= 2,658 cf, Depth= 4.70"
Routed to Pond EP-2 : Ex Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
2,750	98	Paved parking, HSG D
3,876	80	>75% Grass cover, Good, HSG D
157	96	Gravel surface, HSG D
6,783	88	Weighted Average
4,033		59.46% Pervious Area
2,750		40.54% Impervious Area

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

Summary for Subcatchment E-4:

Runoff = 1.23 cfs @ 12.07 hrs, Volume= 3,960 cf, Depth= 4.92"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
5,063	96	Gravel surface, HSG D
3,935	80	>75% Grass cover, Good, HSG D
* 360	98	Ledge Outcrop
293	98	Paved parking, HSG D
9,651	90	Weighted Average
8,998		93.23% Pervious Area
653		6.77% Impervious Area

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

Summary for Subcatchment E-5:

Runoff = 2.73 cfs @ 12.25 hrs, Volume= 12,123 cf, Depth= 3.85"
Routed to Link POA-1 : To wetland System - East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
27,794	77	Woods, Good, HSG D
5,401	80	>75% Grass cover, Good, HSG D
4,558	98	Ledge Outcrop
37,753	80	Weighted Average
33,195		87.93% Pervious Area
4,558		12.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.4	43	0.0100	0.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	54	0.1200	1.73		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
18.2	147	Total			

Summary for Pond EP-1: Ex Detention Basin

Inflow Area = 33,716 sf, 56.21% Impervious, Inflow Depth = 4.92" for 25-yr event
Inflow = 4.28 cfs @ 12.07 hrs, Volume= 13,834 cf
Outflow = 2.66 cfs @ 12.17 hrs, Volume= 9,500 cf, Atten= 38%, Lag= 6.1 min
Primary = 2.66 cfs @ 12.17 hrs, Volume= 9,500 cf
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 168.99' @ 12.17 hrs Surf.Area= 2,834 sf Storage= 5,653 cf

Plug-Flow detention time= 173.3 min calculated for 9,494 cf (69% of inflow)
Center-of-Mass det. time= 80.3 min (863.7 - 783.4)

Volume	Invert	Avail.Storage	Storage Description		
#1	166.00'	8,849 cf	Existing Pond (Irregular)Listed below (Recalc)		

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,028	203.0	0	0	1,028
167.00	1,575	221.0	1,292	1,292	1,671
168.00	2,185	240.0	1,872	3,164	2,405
169.00	2,838	262.0	2,504	5,668	3,319
170.00	3,536	290.0	3,181	8,849	4,580

Device	Routing	Invert	Outlet Devices
#1	Primary	164.20'	12.0" Round Culvert L= 115.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 164.20' / 162.09' S= 0.0183 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	168.50'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.64 cfs @ 12.17 hrs HW=168.99' TW=163.68' (Dynamic Tailwater)
1=Culvert (Passes 2.64 cfs of 6.18 cfs potential flow)
2=Orifice/Grate (Orifice Controls 2.64 cfs @ 3.36 fps)

Existing

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Type III 24-hr 25-yr Rainfall=6.08"

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Stage-Area-Storage for Pond EP-1: Ex Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,028	0	168.80	2,701	5,114
166.05	1,053	52	168.85	2,735	5,250
166.10	1,077	105	168.90	2,769	5,388
166.15	1,103	160	168.95	2,803	5,527
166.20	1,128	216	169.00	2,838	5,668
166.25	1,154	273	169.05	2,871	5,811
166.30	1,180	331	169.10	2,904	5,955
166.35	1,206	391	169.15	2,938	6,101
166.40	1,233	452	169.20	2,971	6,249
166.45	1,260	514	169.25	3,005	6,398
166.50	1,287	578	169.30	3,039	6,549
166.55	1,314	643	169.35	3,074	6,702
166.60	1,342	709	169.40	3,108	6,857
166.65	1,370	777	169.45	3,143	7,013
166.70	1,399	846	169.50	3,177	7,171
166.75	1,427	917	169.55	3,212	7,331
166.80	1,456	989	169.60	3,248	7,492
166.85	1,486	1,062	169.65	3,283	7,655
166.90	1,515	1,137	169.70	3,319	7,821
166.95	1,545	1,214	169.75	3,354	7,987
167.00	1,575	1,292	169.80	3,390	8,156
167.05	1,603	1,371	169.85	3,426	8,326
167.10	1,632	1,452	169.90	3,463	8,499
167.15	1,660	1,534	169.95	3,499	8,673
167.20	1,689	1,618	170.00	3,536	8,849
167.25	1,718	1,703			
167.30	1,748	1,790			
167.35	1,777	1,878			
167.40	1,807	1,968			
167.45	1,837	2,059			
167.50	1,868	2,151			
167.55	1,898	2,246			
167.60	1,929	2,341			
167.65	1,960	2,438			
167.70	1,992	2,537			
167.75	2,023	2,638			
167.80	2,055	2,740			
167.85	2,087	2,843			
167.90	2,120	2,948			
167.95	2,152	3,055			
168.00	2,185	3,164			
168.05	2,216	3,274			
168.10	2,246	3,385			
168.15	2,278	3,498			
168.20	2,309	3,613			
168.25	2,340	3,729			
168.30	2,372	3,847			
168.35	2,404	3,966			
168.40	2,436	4,087			
168.45	2,468	4,210			
168.50	2,501	4,334			
168.55	2,534	4,460			
168.60	2,567	4,587			
168.65	2,600	4,717			
168.70	2,633	4,847			
168.75	2,667	4,980			

Existing

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Type III 24-hr 25-yr Rainfall=6.08"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,499 sf, 53.59% Impervious, Inflow Depth = 3.60" for 25-yr event
Inflow = 3.36 cfs @ 12.12 hrs, Volume= 12,159 cf
Outflow = 3.37 cfs @ 12.16 hrs, Volume= 10,915 cf, Atten= 0%, Lag= 1.9 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-2 : To wetland System - Northwest
Secondary = 3.37 cfs @ 12.16 hrs, Volume= 10,915 cf
Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 163.69' @ 12.16 hrs Surf.Area= 1,171 sf Storage= 1,452 cf

Plug-Flow detention time= 72.0 min calculated for 10,908 cf (90% of inflow)
Center-of-Mass det. time= 22.1 min (869.7 - 847.6)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Existing Pond (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=3.33 cfs @ 12.16 hrs HW=163.69' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 3.33 cfs @ 1.07 fps)

Existing

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Type III 24-hr 25-yr Rainfall=6.08"

Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

Existing

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Type III 24-hr 25-yr Rainfall=6.08"

Summary for Link POA-1: To wetland System - East

Inflow Area = 37,753 sf, 12.07% Impervious, Inflow Depth = 3.85" for 25-yr event
Inflow = 2.73 cfs @ 12.25 hrs, Volume= 12,123 cf
Primary = 2.73 cfs @ 12.25 hrs, Volume= 12,123 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,955 sf, 59.10% Impervious, Inflow Depth = 4.16" for 25-yr event
Inflow = 6.60 cfs @ 12.12 hrs, Volume= 23,543 cf
Primary = 6.60 cfs @ 12.12 hrs, Volume= 23,543 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=8.43" Tc=5.0 min CN=98 Runoff=3.50 cfs 12,508 cf
Subcatchment E-2:	Runoff Area=33,716 sf 56.21% Impervious Runoff Depth=7.47" Tc=5.0 min CN=90 Runoff=6.34 cfs 20,976 cf
Subcatchment E-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=7.22" Tc=5.0 min CN=88 Runoff=1.25 cfs 4,083 cf
Subcatchment E-4:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=7.47" Tc=5.0 min CN=90 Runoff=1.81 cfs 6,004 cf
Subcatchment E-5:	Runoff Area=37,753 sf 12.07% Impervious Runoff Depth=6.26" Flow Length=147' Tc=18.2 min CN=80 Runoff=4.37 cfs 19,681 cf
Pond EP-1: Ex Detention Basin	Peak Elev=169.41' Storage=6,885 cf Inflow=6.34 cfs 20,976 cf Outflow=3.61 cfs 16,642 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.73' Storage=1,498 cf Inflow=4.58 cfs 20,726 cf Primary=0.00 cfs 0 cf Secondary=4.58 cfs 19,483 cf Outflow=4.58 cfs 19,483 cf
Link POA-1: To wetland System - East	Inflow=4.37 cfs 19,681 cf Primary=4.37 cfs 19,681 cf
Link POA-2: To wetland System - Northwest	Inflow=9.64 cfs 37,995 cf Primary=9.64 cfs 37,995 cf

Total Runoff Area = 105,708 sf Runoff Volume = 63,253 cf Average Runoff Depth = 7.18"
57.70% Pervious = 60,990 sf 42.30% Impervious = 44,718 sf

Summary for Subcatchment E-1:

Runoff = 3.50 cfs @ 12.07 hrs, Volume= 12,508 cf, Depth= 8.43"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
17,805	98	Unconnected roofs, HSG A
17,805		100.00% Impervious Area
17,805		100.00% Unconnected

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

Summary for Subcatchment E-2:

Runoff = 6.34 cfs @ 12.07 hrs, Volume= 20,976 cf, Depth= 7.47"
Routed to Pond EP-1 : Ex Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
9,578	80	>75% Grass cover, Good, HSG D
17,985	98	Paved parking, HSG D
967	98	Ledge Outcrop
931	96	Gravel surface, HSG D
4,255	77	Woods, Good, HSG D

33,716	90	Weighted Average
14,764		43.79% Pervious Area
18,952		56.21% Impervious Area

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

Summary for Subcatchment E-3:

Runoff = 1.25 cfs @ 12.07 hrs, Volume= 4,083 cf, Depth= 7.22"
Routed to Pond EP-2 : Ex Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
2,750	98	Paved parking, HSG D
3,876	80	>75% Grass cover, Good, HSG D
157	96	Gravel surface, HSG D
6,783	88	Weighted Average
4,033		59.46% Pervious Area
2,750		40.54% Impervious Area

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

Summary for Subcatchment E-4:

Runoff = 1.81 cfs @ 12.07 hrs, Volume= 6,004 cf, Depth= 7.47"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
5,063	96	Gravel surface, HSG D
3,935	80	>75% Grass cover, Good, HSG D
* 360	98	Ledge Outcrop
293	98	Paved parking, HSG D
9,651	90	Weighted Average
8,998		93.23% Pervious Area
653		6.77% Impervious Area

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

Summary for Subcatchment E-5:

Runoff = 4.37 cfs @ 12.25 hrs, Volume= 19,681 cf, Depth= 6.26"
Routed to Link POA-1 : To wetland System - East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
27,794	77	Woods, Good, HSG D
5,401	80	>75% Grass cover, Good, HSG D
4,558	98	Ledge Outcrop
37,753	80	Weighted Average
33,195		87.93% Pervious Area
4,558		12.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.4	43	0.0100	0.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	54	0.1200	1.73		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
18.2	147	Total			

Summary for Pond EP-1: Ex Detention Basin

Inflow Area = 33,716 sf, 56.21% Impervious, Inflow Depth = 7.47" for 100-yr event
Inflow = 6.34 cfs @ 12.07 hrs, Volume= 20,976 cf
Outflow = 3.61 cfs @ 12.19 hrs, Volume= 16,642 cf, Atten= 43%, Lag= 7.1 min
Primary = 3.61 cfs @ 12.19 hrs, Volume= 16,642 cf
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 169.41' @ 12.19 hrs Surf.Area= 3,114 sf Storage= 6,885 cf

Plug-Flow detention time= 142.6 min calculated for 16,642 cf (79% of inflow)
Center-of-Mass det. time= 65.4 min (838.0 - 772.7)

Volume	Invert	Avail.Storage	Storage Description		
#1	166.00'	8,849 cf	Existing Pond (Irregular)Listed below (Recalc)		

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,028	203.0	0	0	1,028
167.00	1,575	221.0	1,292	1,292	1,671
168.00	2,185	240.0	1,872	3,164	2,405
169.00	2,838	262.0	2,504	5,668	3,319
170.00	3,536	290.0	3,181	8,849	4,580

Device	Routing	Invert	Outlet Devices
#1	Primary	164.20'	12.0" Round Culvert L= 115.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 164.20' / 162.09' S= 0.0183 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	168.50'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.60 cfs @ 12.19 hrs HW=169.40' TW=163.72' (Dynamic Tailwater)
1=Culvert (Passes 3.60 cfs of 6.40 cfs potential flow)
2=Orifice/Grate (Orifice Controls 3.60 cfs @ 4.58 fps)

Existing

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Type III 24-hr 100-yr Rainfall=8.67"

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Stage-Area-Storage for Pond EP-1: Ex Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,028	0	168.80	2,701	5,114
166.05	1,053	52	168.85	2,735	5,250
166.10	1,077	105	168.90	2,769	5,388
166.15	1,103	160	168.95	2,803	5,527
166.20	1,128	216	169.00	2,838	5,668
166.25	1,154	273	169.05	2,871	5,811
166.30	1,180	331	169.10	2,904	5,955
166.35	1,206	391	169.15	2,938	6,101
166.40	1,233	452	169.20	2,971	6,249
166.45	1,260	514	169.25	3,005	6,398
166.50	1,287	578	169.30	3,039	6,549
166.55	1,314	643	169.35	3,074	6,702
166.60	1,342	709	169.40	3,108	6,857
166.65	1,370	777	169.45	3,143	7,013
166.70	1,399	846	169.50	3,177	7,171
166.75	1,427	917	169.55	3,212	7,331
166.80	1,456	989	169.60	3,248	7,492
166.85	1,486	1,062	169.65	3,283	7,655
166.90	1,515	1,137	169.70	3,319	7,821
166.95	1,545	1,214	169.75	3,354	7,987
167.00	1,575	1,292	169.80	3,390	8,156
167.05	1,603	1,371	169.85	3,426	8,326
167.10	1,632	1,452	169.90	3,463	8,499
167.15	1,660	1,534	169.95	3,499	8,673
167.20	1,689	1,618	170.00	3,536	8,849
167.25	1,718	1,703			
167.30	1,748	1,790			
167.35	1,777	1,878			
167.40	1,807	1,968			
167.45	1,837	2,059			
167.50	1,868	2,151			
167.55	1,898	2,246			
167.60	1,929	2,341			
167.65	1,960	2,438			
167.70	1,992	2,537			
167.75	2,023	2,638			
167.80	2,055	2,740			
167.85	2,087	2,843			
167.90	2,120	2,948			
167.95	2,152	3,055			
168.00	2,185	3,164			
168.05	2,216	3,274			
168.10	2,246	3,385			
168.15	2,278	3,498			
168.20	2,309	3,613			
168.25	2,340	3,729			
168.30	2,372	3,847			
168.35	2,404	3,966			
168.40	2,436	4,087			
168.45	2,468	4,210			
168.50	2,501	4,334			
168.55	2,534	4,460			
168.60	2,567	4,587			
168.65	2,600	4,717			
168.70	2,633	4,847			
168.75	2,667	4,980			

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Type III 24-hr 100-yr Rainfall=8.67"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,499 sf, 53.59% Impervious, Inflow Depth = 6.14" for 100-yr event
Inflow = 4.58 cfs @ 12.11 hrs, Volume= 20,726 cf
Outflow = 4.58 cfs @ 12.12 hrs, Volume= 19,483 cf, Atten= 0%, Lag= 0.5 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-2 : To wetland System - Northwest
Secondary = 4.58 cfs @ 12.12 hrs, Volume= 19,483 cf
Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 163.73' @ 12.12 hrs Surf.Area= 1,185 sf Storage= 1,498 cf

Plug-Flow detention time= 46.9 min calculated for 19,469 cf (94% of inflow)
Center-of-Mass det. time= 14.8 min (841.1 - 826.3)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Existing Pond (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=4.51 cfs @ 12.12 hrs HW=163.73' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 4.51 cfs @ 1.19 fps)

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Type III 24-hr 100-yr Rainfall=8.67"

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Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

Existing

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Type III 24-hr 100-yr Rainfall=8.67"

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Summary for Link POA-1: To wetland System - East

Inflow Area = 37,753 sf, 12.07% Impervious, Inflow Depth = 6.26" for 100-yr event
Inflow = 4.37 cfs @ 12.25 hrs, Volume= 19,681 cf
Primary = 4.37 cfs @ 12.25 hrs, Volume= 19,681 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Existing

Type III 24-hr 100-yr Rainfall=8.67"

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Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,955 sf, 59.10% Impervious, Inflow Depth = 6.71" for 100-yr event
Inflow = 9.64 cfs @ 12.09 hrs, Volume= 37,995 cf
Primary = 9.64 cfs @ 12.09 hrs, Volume= 37,995 cf, Atten= 0%, Lag= 0.0 min

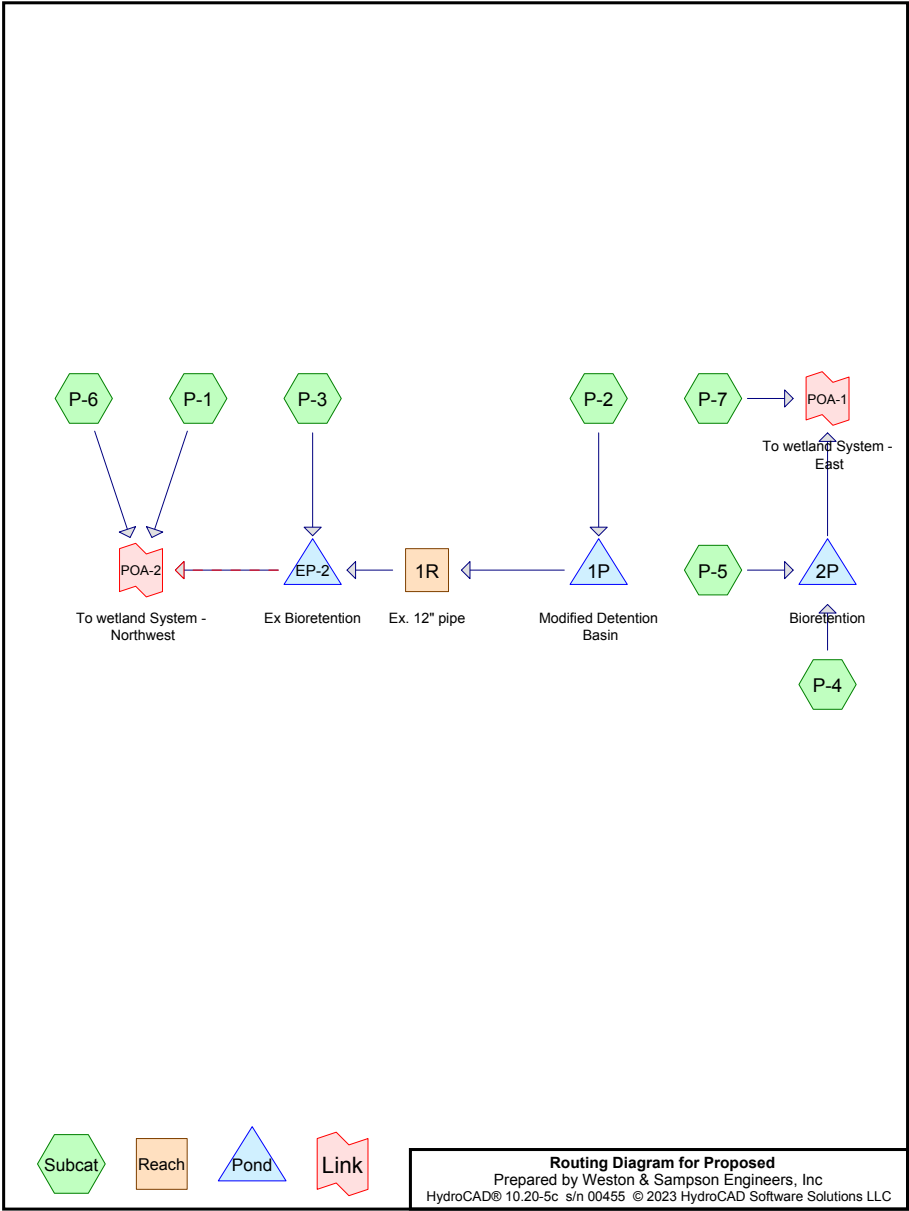
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.20	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.81	2
3	25-yr	Type III 24-hr		Default	24.00	1	6.08	2
4	100-yr	Type III 24-hr		Default	24.00	1	8.67	2



Proposed

Area Listing (all nodes)		
Area (sq-ft)	CN	Description (subcatchment-numbers)
20,262	80	>75% Grass cover, Good, HSG D (P-2, P-3, P-4, P-6, P-7)
3,499	91	Crushed stone bldg surround, HSG D (P-4, P-7)
6,151	96	Gravel surface, HSG D (P-2, P-3, P-6)
2,029	98	Ledge Outcrop (P-4, P-6, P-7)
8,575	96	Ledge cut slope (P-2, P-4)
31,963	98	Paved parking, HSG D (P-2, P-3, P-4, P-6)
30,185	98	Unconnected roofs, HSG A (P-1, P-5)
3,044	77	Woods, Good, HSG D (P-2, P-4, P-7)
105,708	93	TOTAL AREA

Proposed

Soil Listing (all nodes)		
Area (sq-ft)	Soil Group	Subcatchment Numbers
30,185	HSG A	P-1, P-5
0	HSG B	
0	HSG C	
64,919	HSG D	P-2, P-3, P-4, P-6, P-7
10,604	Other	P-2, P-4, P-6, P-7
105,708		TOTAL AREA

Ground Covers (all nodes)							Subc Num
HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	
0	0	0	20,262	0	20,262	>75% Grass cover, Good	
0	0	0	3,499	0	3,499	Crushed stone bldg surround	
0	0	0	6,151	0	6,151	Gravel surface	
0	0	0	0	2,029	2,029	Ledge Outcrop	
0	0	0	0	8,575	8,575	Ledge cut slope	
0	0	0	31,963	0	31,963	Paved parking	
30,185	0	0	0	0	30,185	Unconnected roofs	
0	0	0	3,044	0	3,044	Woods, Good	
30,185	0	0	64,919	10,604	105,708	TOTAL AREA	

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN	
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method	
Subcatchment P-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=1.28 cfs 4,403 cf
Subcatchment P-2:	Runoff Area=33,358 sf 73.04% Impervious Runoff Depth=2.64" Tc=5.0 min CN=95 Runoff=2.26 cfs 7,352 cf
Subcatchment P-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=2.00" Tc=5.0 min CN=88 Runoff=0.36 cfs 1,129 cf
Subcatchment P-4:	Runoff Area=18,655 sf 29.36% Impervious Runoff Depth=2.17" Tc=5.0 min CN=90 Runoff=1.08 cfs 3,371 cf
Subcatchment P-5:	Runoff Area=12,380 sf 100.00% Impervious Runoff Depth=2.97" Tc=5.0 min CN=98 Runoff=0.89 cfs 3,061 cf
Subcatchment P-6:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=2.17" Tc=5.0 min CN=90 Runoff=0.56 cfs 1,744 cf
Subcatchment P-7:	Runoff Area=7,076 sf 10.56% Impervious Runoff Depth=1.68" Tc=5.0 min CN=84 Runoff=0.32 cfs 992 cf
Reach 1R: Ex. 12" pipe	Avg. Flow Depth=0.12' Max Vel=2.81 fps Inflow=0.15 cfs 7,044 cf 12.0" Round Pipe n=0.013 L=91.0' S=0.0192 '/n Capacity=4.94 cfs Outflow=0.15 cfs 7,043 cf
Pond 1P: Modified Detention Basin	Peak Elev=168.10' Storage=4,776 cf Inflow=2.26 cfs 7,352 cf Outflow=0.15 cfs 7,044 cf
Pond 2P: Bioretention	Peak Elev=168.79' Storage=1,765 cf Inflow=1.97 cfs 6,433 cf Outflow=0.48 cfs 6,389 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.53' Storage=1,272 cf Inflow=0.39 cfs 8,172 cf Primary=0.00 cfs 0 cf Secondary=0.17 cfs 6,924 cf Outflow=0.17 cfs 6,924 cf
Link POA-1: To wetland System - East	Inflow=0.75 cfs 7,381 cf Primary=0.75 cfs 7,381 cf
Link POA-2: To wetland System - Northwest	Inflow=1.84 cfs 13,072 cf Primary=1.84 cfs 13,072 cf
Total Runoff Area = 105,708 sf Runoff Volume = 22,053 cf Average Runoff Depth = 2.50" 39.29% Pervious = 41,531 sf 60.71% Impervious = 64,177 sf	

Summary for Subcatchment P-1:

Runoff = 1.28 cfs @ 12.07 hrs, Volume= 4,403 cf, Depth= 2.97"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
17,805	98	Unconnected roofs, HSG A
17,805		100.00% Impervious Area
17,805		100.00% Unconnected

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

Summary for Subcatchment P-2:

Runoff = 2.26 cfs @ 12.07 hrs, Volume= 7,352 cf, Depth= 2.64"
Routed to Pond 1P : Modified Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
931	96	Gravel surface, HSG D
4,330	80	>75% Grass cover, Good, HSG D
24,365	98	Paved parking, HSG D
173	77	Woods, Good, HSG D
* 3,559	96	Ledge cut slope
33,358	95	Weighted Average
8,993		26.96% Pervious Area
24,365		73.04% Impervious Area

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

Type III 24-hr 2-yr Rainfall=3.20"

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Summary for Subcatchment P-4:

Runoff = 1.08 cfs @ 12.07 hrs, Volume= 3,371 cf, Depth= 2.17"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
* 4,555	98	Paved parking, HSG D
* 922	98	Ledge Outcrop
2,381	77	Woods, Good, HSG D
3,995	80	>75% Grass cover, Good, HSG D
* 5,016	96	Ledge cut slope
* 1,786	91	Crushed stone bldg surround, HSG D
18,655	90	Weighted Average
13,178		70.64% Pervious Area
5,477		29.36% Impervious Area

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

Summary for Subcatchment P-5:

Runoff = 0.89 cfs @ 12.07 hrs, Volume= 3,061 cf, Depth= 2.97"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
12,380	98	Unconnected roofs, HSG A
12,380		100.00% Impervious Area
12,380		100.00% Unconnected

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

Summary for Subcatchment P-6:

Runoff = 0.56 cfs @ 12.07 hrs, Volume= 1,744 cf, Depth= 2.17"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
5,063	96	Gravel surface, HSG D
3,935	80	>75% Grass cover, Good, HSG D
360	98	Ledge Outcrop
293	98	Paved parking, HSG D
9,651	90	Weighted Average
8,998		93.23% Pervious Area
653		6.77% Impervious Area

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

Summary for Subcatchment P-7:

Runoff = 0.32 cfs @ 12.08 hrs, Volume= 992 cf, Depth= 1.68"
Routed to Link POA-1 : To wetland System - East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
490	77	Woods, Good, HSG D
4,126	80	>75% Grass cover, Good, HSG D
* 747	98	Ledge Outcrop
* 1,713	91	Crushed stone bldg surround, HSG D
7,076	84	Weighted Average
6,329		89.44% Pervious Area
747		10.56% Impervious Area

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

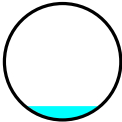
Summary for Reach 1R: Ex. 12" pipe

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth > 2.53" for 2-yr event
Inflow = 0.15 cfs @ 13.56 hrs, Volume= 7,044 cf
Outflow = 0.15 cfs @ 13.57 hrs, Volume= 7,043 cf, Atten= 0%, Lag= 0.4 min
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.81 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.63 fps, Avg. Travel Time= 0.9 min

Peak Storage= 5 cf @ 13.57 hrs
Average Depth at Peak Storage= 0.12' , Surface Width= 0.65'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.94 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 91.0' Slope= 0.0192 '/'
Inlet Invert= 163.84', Outlet Invert= 162.09'



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Type III 24-hr 2-yr Rainfall=3.20"

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Stage-Area-Storage for Reach 1R: Ex. 12" pipe

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)	Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
163.84	0.0	0	164.40	0.5	41
163.85	0.0	0	164.41	0.5	42
163.86	0.0	0	164.42	0.5	43
163.87	0.0	1	164.43	0.5	44
163.88	0.0	1	164.44	0.5	45
163.89	0.0	1	164.45	0.5	46
163.90	0.0	2	164.46	0.5	47
163.91	0.0	2	164.47	0.5	47
163.92	0.0	3	164.48	0.5	48
163.93	0.0	3	164.49	0.5	49
163.94	0.0	4	164.50	0.5	50
163.95	0.0	4	164.51	0.6	51
163.96	0.1	5	164.52	0.6	52
163.97	0.1	5	164.53	0.6	53
163.98	0.1	6	164.54	0.6	53
163.99	0.1	7	164.55	0.6	54
164.00	0.1	7	164.56	0.6	55
164.01	0.1	8	164.57	0.6	56
164.02	0.1	9	164.58	0.6	57
164.03	0.1	9	164.59	0.6	57
164.04	0.1	10	164.60	0.6	58
164.05	0.1	11	164.61	0.6	59
164.06	0.1	12	164.62	0.7	60
164.07	0.1	12	164.63	0.7	61
164.08	0.1	13	164.64	0.7	61
164.09	0.2	14	164.65	0.7	62
164.10	0.2	15	164.66	0.7	63
164.11	0.2	16	164.67	0.7	63
164.12	0.2	16	164.68	0.7	64
164.13	0.2	17	164.69	0.7	65
164.14	0.2	18	164.70	0.7	65
164.15	0.2	19	164.71	0.7	66
164.16	0.2	20	164.72	0.7	67
164.17	0.2	21	164.73	0.7	67
164.18	0.2	21	164.74	0.7	68
164.19	0.2	22	164.75	0.8	68
164.20	0.3	23	164.76	0.8	69
164.21	0.3	24	164.77	0.8	69
164.22	0.3	25	164.78	0.8	70
164.23	0.3	26	164.79	0.8	70
164.24	0.3	27	164.80	0.8	71
164.25	0.3	28	164.81	0.8	71
164.26	0.3	28	164.82	0.8	71
164.27	0.3	29	164.83	0.8	71
164.28	0.3	30	164.84	0.8	71
164.29	0.3	31			
164.30	0.4	32			
164.31	0.4	33			
164.32	0.4	34			
164.33	0.4	35			
164.34	0.4	36			
164.35	0.4	37			
164.36	0.4	38			
164.37	0.4	38			
164.38	0.4	39			
164.39	0.4	40			

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Type III 24-hr 2-yr Rainfall=3.20"

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Summary for Pond 1P: Modified Detention Basin

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth = 2.64" for 2-yr event
 Inflow = 2.26 cfs @ 12.07 hrs, Volume= 7,352 cf
 Outflow = 0.15 cfs @ 13.56 hrs, Volume= 7,044 cf, Atten= 94%, Lag= 89.4 min
 Primary = 0.15 cfs @ 13.56 hrs, Volume= 7,044 cf
 Routed to Reach 1R : Ex. 12" pipe

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 168.10' @ 13.56 hrs Surf.Area= 2,700 sf Storage= 4,776 cf

Plug-Flow detention time= 1,151.9 min calculated for 7,039 cf (96% of inflow)
 Center-of-Mass det. time= 1,128.9 min (1,908.9 - 780.0)

Volume	Invert	Avail.Storage	Storage Description
#1	166.00'	11,442 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,859	209.0	0	0	1,859
167.00	2,243	224.0	2,048	2,048	2,419
168.00	2,656	240.0	2,447	4,495	3,054
169.00	3,095	256.0	2,873	7,367	3,733
170.00	3,564	272.0	3,327	10,694	4,455
170.20	3,914	334.0	748	11,442	7,445

Device	Routing	Invert	Outlet Devices
#1	Primary	163.90'	8.0" Round Culvert L= 3.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 163.90' / 163.84' S= 0.0200 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	169.90'	2.0" x 2.0" Horiz. Top grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	166.00'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	168.00'	12.0" W x 3.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Device 1	168.67'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=0.15 cfs @ 13.56 hrs HW=168.10' TW=163.96' (Dynamic Tailwater)

- 1=Culvert (Passes 0.15 cfs of 2.61 cfs potential flow)
- 2=Top grate (Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.04 cfs @ 6.92 fps)
- 4=Orifice/Grate (Orifice Controls 0.11 cfs @ 1.04 fps)
- 5=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

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Type III 24-hr 2-yr Rainfall=3.20"

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Stage-Area-Storage for Pond 1P: Modified Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,859	0	168.80	3,005	6,757
166.05	1,877	93	168.85	3,027	6,908
166.10	1,896	188	168.90	3,050	7,060
166.15	1,914	283	168.95	3,072	7,213
166.20	1,933	379	169.00	3,095	7,367
166.25	1,952	476	169.05	3,118	7,523
166.30	1,970	574	169.10	3,140	7,679
166.35	1,989	673	169.15	3,163	7,837
166.40	2,008	773	169.20	3,186	7,995
166.45	2,027	874	169.25	3,209	8,155
166.50	2,046	976	169.30	3,232	8,316
166.55	2,066	1,079	169.35	3,255	8,478
166.60	2,085	1,183	169.40	3,279	8,642
166.65	2,105	1,287	169.45	3,302	8,806
166.70	2,124	1,393	169.50	3,325	8,972
166.75	2,144	1,500	169.55	3,349	9,139
166.80	2,163	1,607	169.60	3,372	9,307
166.85	2,183	1,716	169.65	3,396	9,476
166.90	2,203	1,826	169.70	3,420	9,647
166.95	2,223	1,936	169.75	3,444	9,818
167.00	2,243	2,048	169.80	3,468	9,991
167.05	2,263	2,161	169.85	3,492	10,165
167.10	2,283	2,274	169.90	3,516	10,340
167.15	2,303	2,389	169.95	3,540	10,516
167.20	2,323	2,505	170.00	3,564	10,694
167.25	2,343	2,621	170.05	3,650	10,874
167.30	2,363	2,739	170.10	3,737	11,059
167.35	2,384	2,858	170.15	3,825	11,248
167.40	2,404	2,977	170.20	3,914	11,442
167.45	2,425	3,098			
167.50	2,445	3,220			
167.55	2,466	3,342			
167.60	2,487	3,466			
167.65	2,507	3,591			
167.70	2,528	3,717			
167.75	2,549	3,844			
167.80	2,571	3,972			
167.85	2,592	4,101			
167.90	2,613	4,231			
167.95	2,635	4,362			
168.00	2,656	4,495			
168.05	2,677	4,628			
168.10	2,698	4,762			
168.15	2,720	4,898			
168.20	2,741	5,034			
168.25	2,763	5,172			
168.30	2,784	5,311			
168.35	2,806	5,450			
168.40	2,828	5,591			
168.45	2,849	5,733			
168.50	2,871	5,876			
168.55	2,893	6,020			
168.60	2,915	6,165			
168.65	2,938	6,312			
168.70	2,960	6,459			
168.75	2,982	6,608			

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Type III 24-hr 2-yr Rainfall=3.20"

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Summary for Pond 2P: Bioretention

Inflow Area = 31,035 sf, 57.54% Impervious, Inflow Depth = 2.49" for 2-yr event
 Inflow = 1.97 cfs @ 12.07 hrs, Volume= 6,433 cf
 Outflow = 0.48 cfs @ 12.45 hrs, Volume= 6,389 cf, Atten= 76%, Lag= 22.9 min
 Primary = 0.48 cfs @ 12.45 hrs, Volume= 6,389 cf
 Routed to Link POA-1 : To wetland System - East

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 168.79' @ 12.45 hrs Surf.Area= 1,259 sf Storage= 1,765 cf

Plug-Flow detention time= 38.5 min calculated for 6,384 cf (99% of inflow)
 Center-of-Mass det. time= 34.4 min (816.4 - 781.9)

Volume	Invert	Avail.Storage	Storage Description
#1	164.83'	5,838 cf	Bioretention basin (Irregular) Listed below (Recalc) 7,555 cf Overall - 1,717 cf Embedded = 5,838 cf
#2	164.83'	172 cf	8" layer underdrain stone (Irregular) Listed below (Recalc) Inside #1 431 cf Overall x 40.0% Voids
#3	165.50'	386 cf	24" layer filter media (Irregular) Listed below (Recalc) Inside #1 1,286 cf Overall x 30.0% Voids
		6,397 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
166.00	643	121.0	752	752	785
167.00	643	121.0	643	1,395	906
167.50	643	121.0	322	1,717	966
168.00	864	144.0	375	2,092	1,456
169.00	1,378	180.0	1,111	3,203	2,398
170.00	2,100	233.0	1,726	4,930	4,152
171.00	3,189	339.0	2,626	7,555	8,985

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
165.50	643	121.0	431	431	724

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
165.50	643	121.0	0	0	643
167.50	643	121.0	1,286	1,286	885

Device	Routing	Invert	Outlet Devices
#1	Primary	165.00'	6.0" Round Culvert L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 164.67' S= 0.0042 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	170.75'	2.0" x 2.0" Horiz. Top Grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	165.00'	4.0" Round 4" dia underdrains L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 165.00' S= 0.0000 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf

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#4	Device 3	165.50'	2.000 in/hr Percolation through filter media over Surface area above 165.50' Excluded Surface area = 643 sf
#5	Device 1	169.50'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#6	Device 1	165.00'	3.0" Vert. Bottom underdrain orifice C= 0.600 Limited to weir flow at low heads
#7	Device 1	169.25'	12.0" W x 3.0" H Vert. Mid-level orifice C= 0.600 Limited to weir flow at low heads
#8	Primary	170.75'	8.0' long x 15.0' breadth Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.48 cfs @ 12.45 hrs HW=168.79' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 0.48 cfs of 1.05 cfs potential flow)
- 2=Top Grate (Controls 0.00 cfs)
- 3=4" dia underdrains (Passes 0.03 cfs of 0.48 cfs potential flow)
- 4=Percolation through filter media (Exfiltration Controls 0.03 cfs)
- 5=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)
- 6=Bottom underdrain orifice (Orifice Controls 0.45 cfs @ 9.21 fps)
- 7=Mid-level orifice (Controls 0.00 cfs)
- 8=Spillway (Controls 0.00 cfs)

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Stage-Area-Storage for Pond 2P: Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
164.83	643	0	170.43	2,540	4,767
164.93	643	26	170.53	2,649	5,027
165.03	643	51	170.63	2,760	5,297
165.13	643	77	170.73	2,873	5,579
165.23	643	103	170.83	2,988	5,872
165.33	643	129	170.93	3,105	6,176
165.43	643	154			
165.53	643	178			
165.63	643	197			
165.73	643	217			
165.83	643	236			
165.93	643	255			
166.03	643	275			
166.13	643	294			
166.23	643	313			
166.33	643	332			
166.43	643	352			
166.53	643	371			
166.63	643	390			
166.73	643	410			
166.83	643	429			
166.93	643	448			
167.03	643	467			
167.13	643	487			
167.23	643	506			
167.33	643	525			
167.43	643	545			
167.53	655	578			
167.63	697	645			
167.73	741	717			
167.83	785	793			
167.93	831	874			
168.03	878	960			
168.13	924	1,050			
168.23	972	1,144			
168.33	1,020	1,244			
168.43	1,070	1,349			
168.53	1,122	1,458			
168.63	1,174	1,573			
168.73	1,227	1,693			
168.83	1,282	1,818			
168.93	1,338	1,950			
169.03	1,397	2,086			
169.13	1,463	2,229			
169.23	1,531	2,379			
169.33	1,600	2,535			
169.43	1,670	2,699			
169.53	1,742	2,869			
169.63	1,815	3,047			
169.73	1,890	3,233			
169.83	1,967	3,425			
169.93	2,045	3,626			
170.03	2,129	3,834			
170.13	2,229	4,052			
170.23	2,330	4,280			
170.33	2,434	4,518			

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Type III 24-hr 2-yr Rainfall=3.20"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,141 sf, 67.55% Impervious, Inflow Depth > 2.44" for 2-yr event
Inflow = 0.39 cfs @ 12.08 hrs, Volume= 8,172 cf
Outflow = 0.17 cfs @ 13.52 hrs, Volume= 6,924 cf, Atten= 56%, Lag= 86.8 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-2 : To wetland System - Northwest
Secondary = 0.17 cfs @ 13.52 hrs, Volume= 6,924 cf
Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 163.53' @ 13.52 hrs Surf.Area= 1,119 sf Storage= 1,272 cf

Plug-Flow detention time= 519.7 min calculated for 6,920 cf (85% of inflow)
Center-of-Mass det. time= 192.2 min (1,950.4 - 1,758.2)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Custom Stage Data (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Top grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Top grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.17 cfs @ 13.52 hrs HW=163.53' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.40 fps)

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Type III 24-hr 2-yr Rainfall=3.20"

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Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

Summary for Link POA-1: To wetland System - East

Inflow Area = 38,111 sf, 48.82% Impervious, Inflow Depth = 2.32" for 2-yr event
Inflow = 0.75 cfs @ 12.09 hrs, Volume= 7,381 cf
Primary = 0.75 cfs @ 12.09 hrs, Volume= 7,381 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,597 sf, 67.42% Impervious, Inflow Depth > 2.32" for 2-yr event
Inflow = 1.84 cfs @ 12.07 hrs, Volume= 13,072 cf
Primary = 1.84 cfs @ 12.07 hrs, Volume= 13,072 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN	
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method	
Subcatchment P-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=4.57" Tc=5.0 min CN=98 Runoff=1.93 cfs 6,786 cf
Subcatchment P-2:	Runoff Area=33,358 sf 73.04% Impervious Runoff Depth=4.23" Tc=5.0 min CN=95 Runoff=3.52 cfs 11,763 cf
Subcatchment P-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=3.49" Tc=5.0 min CN=88 Runoff=0.63 cfs 1,972 cf
Subcatchment P-4:	Runoff Area=18,655 sf 29.36% Impervious Runoff Depth=3.69" Tc=5.0 min CN=90 Runoff=1.80 cfs 5,742 cf
Subcatchment P-5:	Runoff Area=12,380 sf 100.00% Impervious Runoff Depth=4.57" Tc=5.0 min CN=98 Runoff=1.35 cfs 4,718 cf
Subcatchment P-6:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=3.69" Tc=5.0 min CN=90 Runoff=0.93 cfs 2,970 cf
Subcatchment P-7:	Runoff Area=7,076 sf 10.56% Impervious Runoff Depth=3.10" Tc=5.0 min CN=84 Runoff=0.59 cfs 1,826 cf
Reach 1R: Ex. 12" pipe	Avg. Flow Depth=0.28' Max Vel=4.74 fps Inflow=0.87 cfs 11,415 cf 12.0" Round Pipe n=0.013 L=91.0' S=0.0192 ' Capacity=4.94 cfs Outflow=0.87 cfs 11,414 cf
Pond 1P: Modified Detention Basin	Peak Elev=168.60' Storage=6,159 cf Inflow=3.52 cfs 11,763 cf Outflow=0.87 cfs 11,415 cf
Pond 2P: Bioretention	Peak Elev=169.54' Storage=2,881 cf Inflow=3.15 cfs 10,460 cf Outflow=1.11 cfs 10,416 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.59' Storage=1,344 cf Inflow=1.08 cfs 13,386 cf Primary=0.00 cfs 0 cf Secondary=1.13 cfs 12,139 cf Outflow=1.13 cfs 12,139 cf
Link POA-1: To wetland System - East	Inflow=1.34 cfs 12,242 cf Primary=1.34 cfs 12,242 cf
Link POA-2: To wetland System - Northwest	Inflow=2.87 cfs 21,895 cf Primary=2.87 cfs 21,895 cf
Total Runoff Area = 105,708 sf Runoff Volume = 35,777 cf Average Runoff Depth = 4.06"	
39.29% Pervious = 41,531 sf 60.71% Impervious = 64,177 sf	

Summary for Subcatchment P-1:

Runoff = 1.93 cfs @ 12.07 hrs, Volume= 6,786 cf, Depth= 4.57"

Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Type III 24-hr 10-yr Rainfall=4.81"

Area (sf)	CN	Description
17,805	98	Unconnected roofs, HSG A
17,805		100.00% Impervious Area
17,805		100.00% Unconnected

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

Summary for Subcatchment P-2:

Runoff	=	3.52 cfs @	12.07 hrs,	Volume=	11,763 cf,	Depth=	4.23"																		
Routed to Pond 1P : Modified Detention Basin																									
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																									
Type III 24-hr 10-yr Rainfall=4.81"																									
<table><tr><td>Area (sf)</td><td>CN</td><td>Description</td></tr><tr><td>931</td><td>96</td><td>Gravel surface, HSG D</td></tr><tr><td>4,330</td><td>80</td><td>>75% Grass cover, Good, HSG D</td></tr><tr><td>24,365</td><td>98</td><td>Paved parking, HSG D</td></tr><tr><td>173</td><td>77</td><td>Woods, Good, HSG D</td></tr><tr><td>* 3,559</td><td>96</td><td>Ledge cut slope</td></tr></table>								Area (sf)	CN	Description	931	96	Gravel surface, HSG D	4,330	80	>75% Grass cover, Good, HSG D	24,365	98	Paved parking, HSG D	173	77	Woods, Good, HSG D	* 3,559	96	Ledge cut slope
Area (sf)	CN	Description																							
931	96	Gravel surface, HSG D																							
4,330	80	>75% Grass cover, Good, HSG D																							
24,365	98	Paved parking, HSG D																							
173	77	Woods, Good, HSG D																							
* 3,559	96	Ledge cut slope																							
<table><tr><td>33,358</td><td>95</td><td>Weighted Average</td></tr><tr><td>8,993</td><td></td><td>26.96% Pervious Area</td></tr><tr><td>24,365</td><td></td><td>73.04% Impervious Area</td></tr></table>								33,358	95	Weighted Average	8,993		26.96% Pervious Area	24,365		73.04% Impervious Area									
33,358	95	Weighted Average																							
8,993		26.96% Pervious Area																							
24,365		73.04% Impervious Area																							
Tc	Length	Slope	Velocity	Capacity	Description																				
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)																					
5.0					Direct Entry, Tc min																				

Summary for Subcatchment P-3:

Runoff = 0.63 cfs @ 12.07 hrs, Volume= 1,972 cf, Depth= 3.49"

Routed to Pond EP-2 : Ex Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Type III 24-hr 10-yr Rainfall=4.81"

Area (sf)	CN	Description
2,750	98	Paved parking, HSG D
3,876	80	>75% Grass cover, Good, HSG D
157	96	Gravel surface, HSG D
6,783	88	Weighted Average
4,033		59.46% Pervious Area
2,750		40.54% Impervious Area

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

Summary for Subcatchment P-4:

Runoff = 1.80 cfs @ 12.07 hrs, Volume= 5,742 cf, Depth= 3.69"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.81"

	Area (sf)	CN	Description
*	4,555	98	Paved parking, HSG D
*	922	98	Ledge Outcrop
	2,381	77	Woods, Good, HSG D
	3,995	80	>75% Grass cover, Good, HSG D
*	5,016	96	Ledge cut slope
*	1,786	91	Crushed stone bldg surround, HSG D
	18,655	90	Weighted Average
	13,178		70.64% Pervious Area
	5,477		29.36% Impervious Area

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

Summary for Subcatchment P-5:

Runoff = 1.35 cfs @ 12.07 hrs, Volume= 4,718 cf, Depth= 4.57"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.81"

	Area (sf)	CN	Description
	12,380	98	Unconnected roofs, HSG A
	12,380		100.00% Impervious Area
	12,380		100.00% Unconnected

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

Summary for Subcatchment P-6:

Runoff = 0.93 cfs @ 12.07 hrs, Volume= 2,970 cf, Depth= 3.69"					
Routed to Link POA-2 : To wetland System - Northwest					
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs					
Type III 24-hr 10-yr Rainfall=4.81"					
	Area (sf)	CN	Description		
	5,063	96	Gravel surface, HSG D		
	3,935	80	>75% Grass cover, Good, HSG D		
*	360	98	Ledge Outcrop		
	293	98	Paved parking, HSG D		
	9,651	90	Weighted Average		
	8,998		93.23% Pervious Area		
	653		6.77% Impervious Area		
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
5.0					Direct Entry,

Summary for Subcatchment P-7:

Runoff	=	0.59 cfs @ 12.07 hrs,	Volume=	1,826 cf,	Depth=	3.10"
Routed to Link POA-1 : To wetland System - East						
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs						
Type III 24-hr 10-yr Rainfall=4.81"						
	Area (sf)	CN	Description			
	490	77	Woods, Good, HSG D			
	4,126	80	>75% Grass cover, Good, HSG D			
*	747	98	Ledge Outcrop			
*	1,713	91	Crushed stone bldg surround, HSG D			
	7,076	84	Weighted Average			
	6,329		89.44% Pervious Area			
	747		10.56% Impervious Area			
Tc	Length	Slope	Velocity	Capacity	Description	
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)		
5.0					Direct Entry,	

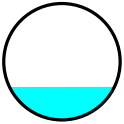
Summary for Reach 1R: Ex. 12" pipe

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth > 4.11" for 10-yr event
Inflow = 0.87 cfs @ 12.44 hrs, Volume= 11,415 cf
Outflow = 0.87 cfs @ 12.45 hrs, Volume= 11,414 cf, Atten= 0%, Lag= 0.5 min
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.74 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.73 fps, Avg. Travel Time= 0.9 min

Peak Storage= 17 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 0.90'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.94 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 91.0' Slope= 0.0192 '/'
Inlet Invert= 163.84', Outlet Invert= 162.09'



Stage-Area-Storage for Reach 1R: Ex. 12" pipe

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)	Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
163.84	0.0	0	164.40	0.5	41
163.85	0.0	0	164.41	0.5	42
163.86	0.0	0	164.42	0.5	43
163.87	0.0	1	164.43	0.5	44
163.88	0.0	1	164.44	0.5	45
163.89	0.0	1	164.45	0.5	46
163.90	0.0	2	164.46	0.5	47
163.91	0.0	2	164.47	0.5	47
163.92	0.0	3	164.48	0.5	48
163.93	0.0	3	164.49	0.5	49
163.94	0.0	4	164.50	0.5	50
163.95	0.0	4	164.51	0.6	51
163.96	0.1	5	164.52	0.6	52
163.97	0.1	5	164.53	0.6	53
163.98	0.1	6	164.54	0.6	53
163.99	0.1	7	164.55	0.6	54
164.00	0.1	7	164.56	0.6	55
164.01	0.1	8	164.57	0.6	56
164.02	0.1	9	164.58	0.6	57
164.03	0.1	9	164.59	0.6	57
164.04	0.1	10	164.60	0.6	58
164.05	0.1	11	164.61	0.6	59
164.06	0.1	12	164.62	0.7	60
164.07	0.1	12	164.63	0.7	61
164.08	0.1	13	164.64	0.7	61
164.09	0.2	14	164.65	0.7	62
164.10	0.2	15	164.66	0.7	63
164.11	0.2	16	164.67	0.7	63
164.12	0.2	16	164.68	0.7	64
164.13	0.2	17	164.69	0.7	65
164.14	0.2	18	164.70	0.7	65
164.15	0.2	19	164.71	0.7	66
164.16	0.2	20	164.72	0.7	67
164.17	0.2	21	164.73	0.7	67
164.18	0.2	21	164.74	0.7	68
164.19	0.2	22	164.75	0.8	68
164.20	0.3	23	164.76	0.8	69
164.21	0.3	24	164.77	0.8	69
164.22	0.3	25	164.78	0.8	70
164.23	0.3	26	164.79	0.8	70
164.24	0.3	27	164.80	0.8	71
164.25	0.3	28	164.81	0.8	71
164.26	0.3	28	164.82	0.8	71
164.27	0.3	29	164.83	0.8	71
164.28	0.3	30	164.84	0.8	71
164.29	0.3	31			
164.30	0.4	32			
164.31	0.4	33			
164.32	0.4	34			
164.33	0.4	35			
164.34	0.4	36			
164.35	0.4	37			
164.36	0.4	38			
164.37	0.4	38			
164.38	0.4	39			
164.39	0.4	40			

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Type III 24-hr 10-yr Rainfall=4.81"

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Summary for Pond 1P: Modified Detention Basin

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth = 4.23" for 10-yr event
Inflow = 3.52 cfs @ 12.07 hrs, Volume= 11,763 cf
Outflow = 0.87 cfs @ 12.44 hrs, Volume= 11,415 cf, Atten= 75%, Lag= 22.3 min
Primary = 0.87 cfs @ 12.44 hrs, Volume= 11,415 cf
Routed to Reach 1R : Ex. 12" pipe

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 168.60' @ 12.44 hrs Surf.Area= 2,914 sf Storage= 6,159 cf

Plug-Flow detention time= 757.8 min calculated for 11,415 cf (97% of inflow)
Center-of-Mass det. time= 739.8 min (1,508.1 - 768.3)

Volume	Invert	Avail.Storage	Storage Description		
#1	166.00'	11,442 cf	Custom Stage Data (Irregular) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,859	209.0	0	0	1,859
167.00	2,243	224.0	2,048	2,048	2,419
168.00	2,656	240.0	2,447	4,495	3,054
169.00	3,095	256.0	2,873	7,367	3,733
170.00	3,564	272.0	3,327	10,694	4,455
170.20	3,914	334.0	748	11,442	7,445

Device	Routing	Invert	Outlet Devices
#1	Primary	163.90'	8.0" Round Culvert L= 3.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 163.90' / 163.84' S= 0.0200 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	169.90'	2.0" x 2.0" Horiz. Top grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	166.00'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	168.00'	12.0" W x 3.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Device 1	168.67'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=0.87 cfs @ 12.44 hrs HW=168.60' TW=164.12' (Dynamic Tailwater)

- 1=Culvert (Passes 0.87 cfs of 2.77 cfs potential flow)
- 2=Top grate (Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.04 cfs @ 7.70 fps)
- 4=Orifice/Grate (Orifice Controls 0.82 cfs @ 3.30 fps)
- 5=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

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Type III 24-hr 10-yr Rainfall=4.81"

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Stage-Area-Storage for Pond 1P: Modified Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,859	0	168.80	3,005	6,757
166.05	1,877	93	168.85	3,027	6,908
166.10	1,896	188	168.90	3,050	7,060
166.15	1,914	283	168.95	3,072	7,213
166.20	1,933	379	169.00	3,095	7,367
166.25	1,952	476	169.05	3,118	7,523
166.30	1,970	574	169.10	3,140	7,679
166.35	1,989	673	169.15	3,163	7,837
166.40	2,008	773	169.20	3,186	7,995
166.45	2,027	874	169.25	3,209	8,155
166.50	2,046	976	169.30	3,232	8,316
166.55	2,066	1,079	169.35	3,255	8,478
166.60	2,085	1,183	169.40	3,279	8,642
166.65	2,105	1,287	169.45	3,302	8,806
166.70	2,124	1,393	169.50	3,325	8,972
166.75	2,144	1,500	169.55	3,349	9,139
166.80	2,163	1,607	169.60	3,372	9,307
166.85	2,183	1,716	169.65	3,396	9,476
166.90	2,203	1,826	169.70	3,420	9,647
166.95	2,223	1,936	169.75	3,444	9,818
167.00	2,243	2,048	169.80	3,468	9,991
167.05	2,263	2,161	169.85	3,492	10,165
167.10	2,283	2,274	169.90	3,516	10,340
167.15	2,303	2,389	169.95	3,540	10,516
167.20	2,323	2,505	170.00	3,564	10,694
167.25	2,343	2,621	170.05	3,650	10,874
167.30	2,363	2,739	170.10	3,737	11,059
167.35	2,384	2,858	170.15	3,825	11,248
167.40	2,404	2,977	170.20	3,914	11,442
167.45	2,425	3,098			
167.50	2,445	3,220			
167.55	2,466	3,342			
167.60	2,487	3,466			
167.65	2,507	3,591			
167.70	2,528	3,717			
167.75	2,549	3,844			
167.80	2,571	3,972			
167.85	2,592	4,101			
167.90	2,613	4,231			
167.95	2,635	4,362			
168.00	2,656	4,495			
168.05	2,677	4,628			
168.10	2,698	4,762			
168.15	2,720	4,898			
168.20	2,741	5,034			
168.25	2,763	5,172			
168.30	2,784	5,311			
168.35	2,806	5,450			
168.40	2,828	5,591			
168.45	2,849	5,733			
168.50	2,871	5,876			
168.55	2,893	6,020			
168.60	2,915	6,165			
168.65	2,938	6,312			
168.70	2,960	6,459			
168.75	2,982	6,608			

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Type III 24-hr 10-yr Rainfall=4.81"

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Summary for Pond 2P: Bioretention

Inflow Area = 31,035 sf, 57.54% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 3.15 cfs @ 12.07 hrs, Volume= 10,460 cf
Outflow = 1.11 cfs @ 12.33 hrs, Volume= 10,416 cf, Atten= 65%, Lag= 15.8 min
Primary = 1.11 cfs @ 12.33 hrs, Volume= 10,416 cf
Routed to Link POA-1 : To wetland System - East

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 169.54' @ 12.33 hrs Surf.Area= 1,747 sf Storage= 2,881 cf

Plug-Flow detention time= 42.2 min calculated for 10,409 cf (100% of inflow)
Center-of-Mass det. time= 39.7 min (811.2 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	164.83'	5,838 cf	Bioretention basin (Irregular) Listed below (Recalc) 7,555 cf Overall - 1,717 cf Embedded = 5,838 cf
#2	164.83'	172 cf	8" layer underdrain stone (Irregular) Listed below (Recalc) Inside #1 431 cf Overall x 40.0% Voids
#3	165.50'	386 cf	24" layer filter media (Irregular) Listed below (Recalc) Inside #1 1,286 cf Overall x 30.0% Voids
			6,397 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
166.00	643	121.0	752	752	785
167.00	643	121.0	643	1,395	906
167.50	643	121.0	322	1,717	966
168.00	864	144.0	375	2,092	1,456
169.00	1,378	180.0	1,111	3,203	2,398
170.00	2,100	233.0	1,726	4,930	4,152
171.00	3,189	339.0	2,626	7,555	8,985

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
165.50	643	121.0	431	431	724

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
165.50	643	121.0	0	0	643
167.50	643	121.0	1,286	1,286	885

Device	Routing	Invert	Outlet Devices
#1	Primary	165.00'	6.0" Round Culvert L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 164.67' S= 0.0042 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	170.75'	2.0" x 2.0" Horiz. Top Grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	165.00'	4.0" Round 4" dia underdrains L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 165.00' S= 0.0000 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf

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#4	Device 3	165.50'	2.000 in/hr Percolation through filter media over Surface area above 165.50' Excluded Surface area = 643 sf
#5	Device 1	169.50'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#6	Device 1	165.00'	3.0" Vert. Bottom underdrain orifice C= 0.600 Limited to weir flow at low heads
#7	Device 1	169.25'	12.0" W x 3.0" H Vert. Mid-level orifice C= 0.600 Limited to weir flow at low heads
#8	Primary	170.75'	8.0' long x 15.0' breadth Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.10 cfs @ 12.33 hrs HW=169.54' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 1.10 cfs of 1.16 cfs potential flow)
- 2=Top Grate (Controls 0.00 cfs)
- 3=4" dia underdrains (Passes 0.05 cfs of 0.53 cfs potential flow)
- 4=Percolation through filter media (Exfiltration Controls 0.05 cfs)
- 5=Sharp-Crested Rectangular Weir (Weir Controls 0.09 cfs @ 0.62 fps)
- 6=Bottom underdrain orifice (Orifice Controls 0.50 cfs @ 10.11 fps)
- 7=Mid-level orifice (Orifice Controls 0.47 cfs @ 1.87 fps)
- 8=Spillway (Controls 0.00 cfs)

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Type III 24-hr 10-yr Rainfall=4.81"

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Stage-Area-Storage for Pond 2P: Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
164.83	643	0	170.43	2,540	4,767
164.93	643	26	170.53	2,649	5,027
165.03	643	51	170.63	2,760	5,297
165.13	643	77	170.73	2,873	5,579
165.23	643	103	170.83	2,988	5,872
165.33	643	129	170.93	3,105	6,176
165.43	643	154			
165.53	643	178			
165.63	643	197			
165.73	643	217			
165.83	643	236			
165.93	643	255			
166.03	643	275			
166.13	643	294			
166.23	643	313			
166.33	643	332			
166.43	643	352			
166.53	643	371			
166.63	643	390			
166.73	643	410			
166.83	643	429			
166.93	643	448			
167.03	643	467			
167.13	643	487			
167.23	643	506			
167.33	643	525			
167.43	643	545			
167.53	655	578			
167.63	697	645			
167.73	741	717			
167.83	785	793			
167.93	831	874			
168.03	878	960			
168.13	924	1,050			
168.23	972	1,144			
168.33	1,020	1,244			
168.43	1,070	1,349			
168.53	1,122	1,458			
168.63	1,174	1,573			
168.73	1,227	1,693			
168.83	1,282	1,818			
168.93	1,338	1,950			
169.03	1,397	2,086			
169.13	1,463	2,229			
169.23	1,531	2,379			
169.33	1,600	2,535			
169.43	1,670	2,699			
169.53	1,742	2,869			
169.63	1,815	3,047			
169.73	1,890	3,233			
169.83	1,967	3,425			
169.93	2,045	3,626			
170.03	2,129	3,834			
170.13	2,229	4,052			
170.23	2,330	4,280			
170.33	2,434	4,518			

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,141 sf, 67.55% Impervious, Inflow Depth > 4.00" for 10-yr event
Inflow = 1.08 cfs @ 12.15 hrs, Volume= 13,386 cf
Outflow = 1.13 cfs @ 12.20 hrs, Volume= 12,139 cf, Atten= 0%, Lag= 3.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-2 : To wetland System - Northwest
Secondary = 1.13 cfs @ 12.20 hrs, Volume= 12,139 cf
Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 163.59' @ 12.20 hrs Surf.Area= 1,140 sf Storage= 1,344 cf

Plug-Flow detention time= 306.3 min calculated for 12,139 cf (91% of inflow)
Center-of-Mass det. time= 80.0 min (1,483.9 - 1,404.0)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Custom Stage Data (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Top grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Top grate** (Controls 0.00 cfs)

Secondary OutFlow Max=1.13 cfs @ 12.20 hrs HW=163.59' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.13 cfs @ 0.75 fps)

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Type III 24-hr 10-yr Rainfall=4.81"

Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

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Type III 24-hr 10-yr Rainfall=4.81"

Summary for Link POA-1: To wetland System - East

Inflow Area = 38,111 sf, 48.82% Impervious, Inflow Depth = 3.85" for 10-yr event
Inflow = 1.34 cfs @ 12.32 hrs, Volume= 12,242 cf
Primary = 1.34 cfs @ 12.32 hrs, Volume= 12,242 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,597 sf, 67.42% Impervious, Inflow Depth > 3.89" for 10-yr event
Inflow = 2.87 cfs @ 12.07 hrs, Volume= 21,895 cf
Primary = 2.87 cfs @ 12.07 hrs, Volume= 21,895 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=5.84" Tc=5.0 min CN=98 Runoff=2.45 cfs 8,668 cf
Subcatchment P-2:	Runoff Area=33,358 sf 73.04% Impervious Runoff Depth=5.49" Tc=5.0 min CN=95 Runoff=4.50 cfs 15,264 cf
Subcatchment P-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=4.70" Tc=5.0 min CN=88 Runoff=0.83 cfs 2,658 cf
Subcatchment P-4:	Runoff Area=18,655 sf 29.36% Impervious Runoff Depth=4.92" Tc=5.0 min CN=90 Runoff=2.37 cfs 7,654 cf
Subcatchment P-5:	Runoff Area=12,380 sf 100.00% Impervious Runoff Depth=5.84" Tc=5.0 min CN=98 Runoff=1.70 cfs 6,027 cf
Subcatchment P-6:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=4.92" Tc=5.0 min CN=90 Runoff=1.23 cfs 3,960 cf
Subcatchment P-7:	Runoff Area=7,076 sf 10.56% Impervious Runoff Depth=4.27" Tc=5.0 min CN=84 Runoff=0.81 cfs 2,519 cf
Reach 1R: Ex. 12" pipe	Avg. Flow Depth=0.46' Max Vel=6.03 fps Inflow=2.10 cfs 14,906 cf 12.0" Round Pipe n=0.013 L=91.0' S=0.0192 '/' Capacity=4.94 cfs Outflow=2.14 cfs 14,906 cf
Pond 1P: Modified Detention Basin	Peak Elev=168.89' Storage=7,032 cf Inflow=4.50 cfs 15,264 cf Outflow=2.10 cfs 14,906 cf
Pond 2P: Bioretention	Peak Elev=170.00' Storage=3,767 cf Inflow=4.07 cfs 13,681 cf Outflow=1.22 cfs 13,637 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.66' Storage=1,416 cf Inflow=2.54 cfs 17,564 cf Primary=0.00 cfs 0 cf Secondary=2.53 cfs 16,317 cf Outflow=2.53 cfs 16,317 cf
Link POA-1: To wetland System - East	Inflow=1.95 cfs 16,156 cf Primary=1.95 cfs 16,156 cf
Link POA-2: To wetland System - Northwest	Inflow=5.24 cfs 28,944 cf Primary=5.24 cfs 28,944 cf

Total Runoff Area = 105,708 sf Runoff Volume = 46,750 cf Average Runoff Depth = 5.31"
39.29% Pervious = 41,531 sf 60.71% Impervious = 64,177 sf

Summary for Subcatchment P-1:

Runoff	=	2.45 cfs @ 12.07 hrs,	Volume=	8,668 cf,	Depth=	5.84"																												
Routed to Link POA-2 : To wetland System - Northwest																																		
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																																		
Type III 24-hr 25-yr Rainfall=6.08"																																		
<table><tr><th>Area (sf)</th><th>CN</th><th colspan="5">Description</th></tr><tr><td>17,805</td><td>98</td><td colspan="5">Unconnected roofs, HSG A</td></tr><tr><td>17,805</td><td></td><td colspan="5">100.00% Impervious Area</td></tr><tr><td>17,805</td><td></td><td colspan="5">100.00% Unconnected</td></tr></table>							Area (sf)	CN	Description					17,805	98	Unconnected roofs, HSG A					17,805		100.00% Impervious Area					17,805		100.00% Unconnected				
Area (sf)	CN	Description																																
17,805	98	Unconnected roofs, HSG A																																
17,805		100.00% Impervious Area																																
17,805		100.00% Unconnected																																
Tc	Length	Slope	Velocity	Capacity	Description																													
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)																														
5.0					Direct Entry, Tc min																													

Summary for Subcatchment P-2:

Runoff	=	4.50 cfs @ 12.07 hrs,	Volume=	15,264 cf,	Depth=	5.49"																																																															
Routed to Pond 1P : Modified Detention Basin																																																																					
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs																																																																					
Type III 24-hr 25-yr Rainfall=6.08"																																																																					
<table><tr><th>Area (sf)</th><th>CN</th><th colspan="5">Description</th></tr><tr><td>931</td><td>96</td><td colspan="5">Gravel surface, HSG D</td></tr><tr><td>4,330</td><td>80</td><td colspan="5">>75% Grass cover, Good, HSG D</td></tr><tr><td>24,365</td><td>98</td><td colspan="5">Paved parking, HSG D</td></tr><tr><td>173</td><td>77</td><td colspan="5">Woods, Good, HSG D</td></tr><tr><td>*</td><td>3,559</td><td colspan="5">Ledge cut slope</td></tr><tr><td>33,358</td><td>95</td><td colspan="5">Weighted Average</td></tr><tr><td>8,993</td><td></td><td colspan="5">26.96% Pervious Area</td></tr><tr><td>24,365</td><td></td><td colspan="5">73.04% Impervious Area</td></tr></table>							Area (sf)	CN	Description					931	96	Gravel surface, HSG D					4,330	80	>75% Grass cover, Good, HSG D					24,365	98	Paved parking, HSG D					173	77	Woods, Good, HSG D					*	3,559	Ledge cut slope					33,358	95	Weighted Average					8,993		26.96% Pervious Area					24,365		73.04% Impervious Area				
Area (sf)	CN	Description																																																																			
931	96	Gravel surface, HSG D																																																																			
4,330	80	>75% Grass cover, Good, HSG D																																																																			
24,365	98	Paved parking, HSG D																																																																			
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24,365		73.04% Impervious Area																																																																			
Tc	Length	Slope	Velocity	Capacity	Description																																																																
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)																																																																	
5.0					Direct Entry, Tc min																																																																

Summary for Subcatchment P-3:

Runoff = 0.83 cfs @ 12.07 hrs, Volume= 2,658 cf, Depth= 4.70"
Routed to Pond EP-2 : Ex Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
2,750	98	Paved parking, HSG D
3,876	80	>75% Grass cover, Good, HSG D
157	96	Gravel surface, HSG D
6,783	88	Weighted Average
4,033		59.46% Pervious Area
2,750		40.54% Impervious Area

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

Summary for Subcatchment P-4:

Runoff = 2.37 cfs @ 12.07 hrs, Volume= 7,654 cf, Depth= 4.92"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
* 4,555	98	Paved parking, HSG D
* 922	98	Ledge Outcrop
2,381	77	Woods, Good, HSG D
3,995	80	>75% Grass cover, Good, HSG D
* 5,016	96	Ledge cut slope
* 1,786	91	Crushed stone bldg surround, HSG D
18,655	90	Weighted Average
13,178		70.64% Pervious Area
5,477		29.36% Impervious Area

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

Summary for Subcatchment P-5:

Runoff = 1.70 cfs @ 12.07 hrs, Volume= 6,027 cf, Depth= 5.84"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
12,380	98	Unconnected roofs, HSG A
12,380		100.00% Impervious Area
12,380		100.00% Unconnected

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

Summary for Subcatchment P-6:

Runoff = 1.23 cfs @ 12.07 hrs, Volume= 3,960 cf, Depth= 4.92"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
5,063	96	Gravel surface, HSG D
3,935	80	>75% Grass cover, Good, HSG D
360	98	Ledge Outcrop
293	98	Paved parking, HSG D

9,651	90	Weighted Average
8,998		93.23% Pervious Area
653		6.77% Impervious Area

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

Summary for Subcatchment P-7:

Runoff = 0.81 cfs @ 12.07 hrs, Volume= 2,519 cf, Depth= 4.27"
Routed to Link POA-1 : To wetland System - East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.08"

Area (sf)	CN	Description
490	77	Woods, Good, HSG D
4,126	80	>75% Grass cover, Good, HSG D
* 747	98	Ledge Outcrop
* 1,713	91	Crushed stone bldg surround, HSG D
7,076	84	Weighted Average
6,329		89.44% Pervious Area
747		10.56% Impervious Area

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

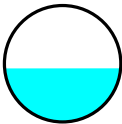
Summary for Reach 1R: Ex. 12" pipe

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth > 5.36" for 25-yr event
Inflow = 2.10 cfs @ 12.23 hrs, Volume= 14,906 cf
Outflow = 2.14 cfs @ 12.22 hrs, Volume= 14,906 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.03 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 0.9 min

Peak Storage= 32 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.46' , Surface Width= 1.00'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.94 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 91.0' Slope= 0.0192 '/'
Inlet Invert= 163.84', Outlet Invert= 162.09'



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Type III 24-hr 25-yr Rainfall=6.08"

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Stage-Area-Storage for Reach 1R: Ex. 12" pipe

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)	Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
163.84	0.0	0	164.40	0.5	41
163.85	0.0	0	164.41	0.5	42
163.86	0.0	0	164.42	0.5	43
163.87	0.0	1	164.43	0.5	44
163.88	0.0	1	164.44	0.5	45
163.89	0.0	1	164.45	0.5	46
163.90	0.0	2	164.46	0.5	47
163.91	0.0	2	164.47	0.5	47
163.92	0.0	3	164.48	0.5	48
163.93	0.0	3	164.49	0.5	49
163.94	0.0	4	164.50	0.5	50
163.95	0.0	4	164.51	0.6	51
163.96	0.1	5	164.52	0.6	52
163.97	0.1	5	164.53	0.6	53
163.98	0.1	6	164.54	0.6	53
163.99	0.1	7	164.55	0.6	54
164.00	0.1	7	164.56	0.6	55
164.01	0.1	8	164.57	0.6	56
164.02	0.1	9	164.58	0.6	57
164.03	0.1	9	164.59	0.6	57
164.04	0.1	10	164.60	0.6	58
164.05	0.1	11	164.61	0.6	59
164.06	0.1	12	164.62	0.7	60
164.07	0.1	12	164.63	0.7	61
164.08	0.1	13	164.64	0.7	61
164.09	0.2	14	164.65	0.7	62
164.10	0.2	15	164.66	0.7	63
164.11	0.2	16	164.67	0.7	63
164.12	0.2	16	164.68	0.7	64
164.13	0.2	17	164.69	0.7	65
164.14	0.2	18	164.70	0.7	65
164.15	0.2	19	164.71	0.7	66
164.16	0.2	20	164.72	0.7	67
164.17	0.2	21	164.73	0.7	67
164.18	0.2	21	164.74	0.7	68
164.19	0.2	22	164.75	0.8	68
164.20	0.3	23	164.76	0.8	69
164.21	0.3	24	164.77	0.8	69
164.22	0.3	25	164.78	0.8	70
164.23	0.3	26	164.79	0.8	70
164.24	0.3	27	164.80	0.8	71
164.25	0.3	28	164.81	0.8	71
164.26	0.3	28	164.82	0.8	71
164.27	0.3	29	164.83	0.8	71
164.28	0.3	30	164.84	0.8	71
164.29	0.3	31			
164.30	0.4	32			
164.31	0.4	33			
164.32	0.4	34			
164.33	0.4	35			
164.34	0.4	36			
164.35	0.4	37			
164.36	0.4	38			
164.37	0.4	38			
164.38	0.4	39			
164.39	0.4	40			

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Type III 24-hr 25-yr Rainfall=6.08"

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Summary for Pond 1P: Modified Detention Basin

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth = 5.49" for 25-yr event
 Inflow = 4.50 cfs @ 12.07 hrs, Volume= 15,264 cf
 Outflow = 2.10 cfs @ 12.23 hrs, Volume= 14,906 cf, Atten= 53%, Lag= 9.6 min
 Primary = 2.10 cfs @ 12.23 hrs, Volume= 14,906 cf
 Routed to Reach 1R : Ex. 12" pipe

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 168.89' @ 12.23 hrs Surf.Area= 3,045 sf Storage= 7,032 cf

Plug-Flow detention time= 598.6 min calculated for 14,896 cf (98% of inflow)
 Center-of-Mass det. time= 585.5 min (1,347.9 - 762.4)

Volume	Invert	Avail.Storage	Storage Description
#1	166.00'	11,442 cf	Custom Stage Data (Irregular) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,859	209.0	0	0	1,859
167.00	2,243	224.0	2,048	2,048	2,419
168.00	2,656	240.0	2,447	4,495	3,054
169.00	3,095	256.0	2,873	7,367	3,733
170.00	3,564	272.0	3,327	10,694	4,455
170.20	3,914	334.0	748	11,442	7,445

Device	Routing	Invert	Outlet Devices
#1	Primary	163.90'	8.0" Round Culvert L= 3.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 163.90' / 163.84' S= 0.0200 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	169.90'	2.0" x 2.0" Horiz. Top grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	166.00'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	168.00'	12.0" W x 3.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Device 1	168.67'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=2.08 cfs @ 12.23 hrs HW=168.89' TW=164.29' (Dynamic Tailwater)

- 1=Culvert (Passes 2.08 cfs of 2.84 cfs potential flow)
- 2=Top grate (Controls 0.00 cfs)
- 3=Orifice/Grate (Orifice Controls 0.04 cfs @ 8.12 fps)
- 4=Orifice/Grate (Orifice Controls 1.05 cfs @ 4.20 fps)
- 5=Sharp-Crested Rectangular Weir (Weir Controls 0.99 cfs @ 1.53 fps)

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Type III 24-hr 25-yr Rainfall=6.08"

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Stage-Area-Storage for Pond 1P: Modified Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,859	0	168.80	3,005	6,757
166.05	1,877	93	168.85	3,027	6,908
166.10	1,896	188	168.90	3,050	7,060
166.15	1,914	283	168.95	3,072	7,213
166.20	1,933	379	169.00	3,095	7,367
166.25	1,952	476	169.05	3,118	7,523
166.30	1,970	574	169.10	3,140	7,679
166.35	1,989	673	169.15	3,163	7,837
166.40	2,008	773	169.20	3,186	7,995
166.45	2,027	874	169.25	3,209	8,155
166.50	2,046	976	169.30	3,232	8,316
166.55	2,066	1,079	169.35	3,255	8,478
166.60	2,085	1,183	169.40	3,279	8,642
166.65	2,105	1,287	169.45	3,302	8,806
166.70	2,124	1,393	169.50	3,325	8,972
166.75	2,144	1,500	169.55	3,349	9,139
166.80	2,163	1,607	169.60	3,372	9,307
166.85	2,183	1,716	169.65	3,396	9,476
166.90	2,203	1,826	169.70	3,420	9,647
166.95	2,223	1,936	169.75	3,444	9,818
167.00	2,243	2,048	169.80	3,468	9,991
167.05	2,263	2,161	169.85	3,492	10,165
167.10	2,283	2,274	169.90	3,516	10,340
167.15	2,303	2,389	169.95	3,540	10,516
167.20	2,323	2,505	170.00	3,564	10,694
167.25	2,343	2,621	170.05	3,650	10,874
167.30	2,363	2,739	170.10	3,737	11,059
167.35	2,384	2,858	170.15	3,825	11,248
167.40	2,404	2,977	170.20	3,914	11,442
167.45	2,425	3,098			
167.50	2,445	3,220			
167.55	2,466	3,342			
167.60	2,487	3,466			
167.65	2,507	3,591			
167.70	2,528	3,717			
167.75	2,549	3,844			
167.80	2,571	3,972			
167.85	2,592	4,101			
167.90	2,613	4,231			
167.95	2,635	4,362			
168.00	2,656	4,495			
168.05	2,677	4,628			
168.10	2,698	4,762			
168.15	2,720	4,898			
168.20	2,741	5,034			
168.25	2,763	5,172			
168.30	2,784	5,311			
168.35	2,806	5,450			
168.40	2,828	5,591			
168.45	2,849	5,733			
168.50	2,871	5,876			
168.55	2,893	6,020			
168.60	2,915	6,165			
168.65	2,938	6,312			
168.70	2,960	6,459			
168.75	2,982	6,608			

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Type III 24-hr 25-yr Rainfall=6.08"

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Summary for Pond 2P: Bioretention

Inflow Area = 31,035 sf, 57.54% Impervious, Inflow Depth = 5.29" for 25-yr event
 Inflow = 4.07 cfs @ 12.07 hrs, Volume= 13,681 cf
 Outflow = 1.22 cfs @ 12.39 hrs, Volume= 13,637 cf, Atten= 70%, Lag= 18.8 min
 Primary = 1.22 cfs @ 12.39 hrs, Volume= 13,637 cf
 Routed to Link POA-1 : To wetland System - East

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 170.00' @ 12.39 hrs Surf.Area= 2,099 sf Storage= 3,767 cf

Plug-Flow detention time= 41.4 min calculated for 13,628 cf (100% of inflow)
 Center-of-Mass det. time= 39.5 min (805.5 - 766.0)

Volume	Invert	Avail.Storage	Storage Description
#1	164.83'	5,838 cf	Bioretention basin (Irregular) Listed below (Recalc) 7,555 cf Overall - 1,717 cf Embedded = 5,838 cf
#2	164.83'	172 cf	8" layer underdrain stone (Irregular) Listed below (Recalc) Inside #1 431 cf Overall x 40.0% Voids
#3	165.50'	386 cf	24" layer filter media (Irregular) Listed below (Recalc) Inside #1 1,286 cf Overall x 30.0% Voids
		6,397 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
166.00	643	121.0	752	752	785
167.00	643	121.0	643	1,395	906
167.50	643	121.0	322	1,717	966
168.00	864	144.0	375	2,092	1,456
169.00	1,378	180.0	1,111	3,203	2,398
170.00	2,100	233.0	1,726	4,930	4,152
171.00	3,189	339.0	2,626	7,555	8,985

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
165.50	643	121.0	431	431	724

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
165.50	643	121.0	0	0	643
167.50	643	121.0	1,286	1,286	885

Device	Routing	Invert	Outlet Devices
#1	Primary	165.00'	6.0" Round Culvert L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 164.67' S= 0.0042 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	170.75'	2.0" x 2.0" Horiz. Top Grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	165.00'	4.0" Round 4" dia underdrains L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 165.00' S= 0.0000 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf

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Type III 24-hr 25-yr Rainfall=6.08"

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#4	Device 3	165.50'	2.000 in/hr Percolation through filter media over Surface area above 165.50' Excluded Surface area = 643 sf
#5	Device 1	169.50'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#6	Device 1	165.00'	3.0" Vert. Bottom underdrain orifice C= 0.600 Limited to weir flow at low heads
#7	Device 1	169.25'	12.0" W x 3.0" H Vert. Mid-level orifice C= 0.600 Limited to weir flow at low heads
#8	Primary	170.75'	8.0' long x 15.0' breadth Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.22 cfs @ 12.39 hrs HW=170.00' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Barrel Controls 1.22 cfs @ 6.21 fps)
- 2=Top Grate (Controls 0.00 cfs)
- 3=4" dia underdrains (Passes < 0.56 cfs potential flow)
- 4=Percolation through filter media (Passes < 0.07 cfs potential flow)
- 5=Sharp-Crested Rectangular Weir (Passes < 4.46 cfs potential flow)
- 6=Bottom underdrain orifice (Passes < 0.52 cfs potential flow)
- 7=Mid-level orifice (Passes < 0.95 cfs potential flow)
- 8=Spillway (Controls 0.00 cfs)

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Stage-Area-Storage for Pond 2P: Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
164.83	643	0	170.43	2,540	4,767
164.93	643	26	170.53	2,649	5,027
165.03	643	51	170.63	2,760	5,297
165.13	643	77	170.73	2,873	5,579
165.23	643	103	170.83	2,988	5,872
165.33	643	129	170.93	3,105	6,176
165.43	643	154			
165.53	643	178			
165.63	643	197			
165.73	643	217			
165.83	643	236			
165.93	643	255			
166.03	643	275			
166.13	643	294			
166.23	643	313			
166.33	643	332			
166.43	643	352			
166.53	643	371			
166.63	643	390			
166.73	643	410			
166.83	643	429			
166.93	643	448			
167.03	643	467			
167.13	643	487			
167.23	643	506			
167.33	643	525			
167.43	643	545			
167.53	655	578			
167.63	697	645			
167.73	741	717			
167.83	785	793			
167.93	831	874			
168.03	878	960			
168.13	924	1,050			
168.23	972	1,144			
168.33	1,020	1,244			
168.43	1,070	1,349			
168.53	1,122	1,458			
168.63	1,174	1,573			
168.73	1,227	1,693			
168.83	1,282	1,818			
168.93	1,338	1,950			
169.03	1,397	2,086			
169.13	1,463	2,229			
169.23	1,531	2,379			
169.33	1,600	2,535			
169.43	1,670	2,699			
169.53	1,742	2,869			
169.63	1,815	3,047			
169.73	1,890	3,233			
169.83	1,967	3,425			
169.93	2,045	3,626			
170.03	2,129	3,834			
170.13	2,229	4,052			
170.23	2,330	4,280			
170.33	2,434	4,518			

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Type III 24-hr 25-yr Rainfall=6.08"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,141 sf, 67.55% Impervious, Inflow Depth > 5.25" for 25-yr event
Inflow = 2.54 cfs @ 12.21 hrs, Volume= 17,564 cf
Outflow = 2.53 cfs @ 12.22 hrs, Volume= 16,317 cf, Atten= 0%, Lag= 0.7 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-2 : To wetland System - Northwest
Secondary = 2.53 cfs @ 12.22 hrs, Volume= 16,317 cf
Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 163.66' @ 12.22 hrs Surf.Area= 1,161 sf Storage= 1,416 cf

Plug-Flow detention time= 231.6 min calculated for 16,317 cf (93% of inflow)
Center-of-Mass det. time= 52.0 min (1,315.9 - 1,263.9)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Custom Stage Data (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Top grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Top grate** (Controls 0.00 cfs)

Secondary OutFlow Max=2.49 cfs @ 12.22 hrs HW=163.65' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 2.49 cfs @ 0.97 fps)

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Type III 24-hr 25-yr Rainfall=6.08"

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Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

Summary for Link POA-1: To wetland System - East

Inflow Area = 38,111 sf, 48.82% Impervious, Inflow Depth = 5.09" for 25-yr event
Inflow = 1.95 cfs @ 12.11 hrs, Volume= 16,156 cf
Primary = 1.95 cfs @ 12.11 hrs, Volume= 16,156 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,597 sf, 67.42% Impervious, Inflow Depth > 5.14" for 25-yr event
Inflow = 5.24 cfs @ 12.09 hrs, Volume= 28,944 cf
Primary = 5.24 cfs @ 12.09 hrs, Volume= 28,944 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points Runoff by SCS TR-20 method, UH=SCS, Weighted-CN Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method	
Subcatchment P-1:	Runoff Area=17,805 sf 100.00% Impervious Runoff Depth=8.43" Tc=5.0 min CN=98 Runoff=3.50 cfs 12,508 cf
Subcatchment P-2:	Runoff Area=33,358 sf 73.04% Impervious Runoff Depth=8.07" Tc=5.0 min CN=95 Runoff=6.49 cfs 22,430 cf
Subcatchment P-3:	Runoff Area=6,783 sf 40.54% Impervious Runoff Depth=7.22" Tc=5.0 min CN=88 Runoff=1.25 cfs 4,083 cf
Subcatchment P-4:	Runoff Area=18,655 sf 29.36% Impervious Runoff Depth=7.47" Tc=5.0 min CN=90 Runoff=3.51 cfs 11,606 cf
Subcatchment P-5:	Runoff Area=12,380 sf 100.00% Impervious Runoff Depth=8.43" Tc=5.0 min CN=98 Runoff=2.44 cfs 8,697 cf
Subcatchment P-6:	Runoff Area=9,651 sf 6.77% Impervious Runoff Depth=7.47" Tc=5.0 min CN=90 Runoff=1.81 cfs 6,004 cf
Subcatchment P-7:	Runoff Area=7,076 sf 10.56% Impervious Runoff Depth=6.74" Tc=5.0 min CN=84 Runoff=1.24 cfs 3,974 cf
Reach 1R: Ex. 12" pipe	Avg. Flow Depth=0.56' Max Vel=6.59 fps Inflow=2.98 cfs 22,062 cf 12.0" Round Pipe n=0.013 L=91.0' S=0.0192 '/' Capacity=4.94 cfs Outflow=3.00 cfs 22,061 cf
Pond 1P: Modified Detention Basin	Peak Elev=169.43' Storage=8,748 cf Inflow=6.49 cfs 22,430 cf Outflow=2.98 cfs 22,062 cf
Pond 2P: Bioretention	Peak Elev=170.85' Storage=5,920 cf Inflow=5.94 cfs 20,303 cf Outflow=1.96 cfs 20,259 cf
Pond EP-2: Ex Bioretention	Peak Elev=163.72' Storage=1,486 cf Inflow=4.17 cfs 26,144 cf Primary=0.00 cfs 0 cf Secondary=4.24 cfs 24,897 cf Outflow=4.24 cfs 24,897 cf
Link POA-1: To wetland System - East	Inflow=2.47 cfs 24,233 cf Primary=2.47 cfs 24,233 cf
Link POA-2: To wetland System - Northwest	Inflow=9.40 cfs 43,409 cf Primary=9.40 cfs 43,409 cf
Total Runoff Area = 105,708 sf Runoff Volume = 69,303 cf Average Runoff Depth = 7.87" 39.29% Pervious = 41,531 sf 60.71% Impervious = 64,177 sf	

Summary for Subcatchment P-1:

Runoff = 3.50 cfs @ 12.07 hrs, Volume= 12,508 cf, Depth= 8.43"
Routed to Link POA-2 : To wetland System - Northwest

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
17,805	98	Unconnected roofs, HSG A
17,805		100.00% Impervious Area
17,805		100.00% Unconnected

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

Summary for Subcatchment P-2:

Runoff = 6.49 cfs @ 12.07 hrs, Volume= 22,430 cf, Depth= 8.07"
Routed to Pond 1P : Modified Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
931	96	Gravel surface, HSG D
4,330	80	>75% Grass cover, Good, HSG D
24,365	98	Paved parking, HSG D
173	77	Woods, Good, HSG D
* 3,559	96	Ledge cut slope
33,358	95	Weighted Average
8,993		26.96% Pervious Area
24,365		73.04% Impervious Area

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

Summary for Subcatchment P-3:

Runoff = 1.25 cfs @ 12.07 hrs, Volume= 4,083 cf, Depth= 7.22"
Routed to Pond EP-2 : Ex Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

Area (sf)	CN	Description
2,750	98	Paved parking, HSG D
3,876	80	>75% Grass cover, Good, HSG D
157	96	Gravel surface, HSG D
6,783	88	Weighted Average
4,033		59.46% Pervious Area
2,750		40.54% Impervious Area

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

Summary for Subcatchment P-4:

Runoff = 3.51 cfs @ 12.07 hrs, Volume= 11,606 cf, Depth= 7.47"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

	Area (sf)	CN	Description
*	4,555	98	Paved parking, HSG D
*	922	98	Ledge Outcrop
	2,381	77	Woods, Good, HSG D
	3,995	80	>75% Grass cover, Good, HSG D
*	5,016	96	Ledge cut slope
*	1,786	91	Crushed stone bldg surround, HSG D
	18,655	90	Weighted Average
	13,178		70.64% Pervious Area
	5,477		29.36% Impervious Area

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

Summary for Subcatchment P-5:

Runoff = 2.44 cfs @ 12.07 hrs, Volume= 8,697 cf, Depth= 8.43"
Routed to Pond 2P : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.67"

	Area (sf)	CN	Description
	12,380	98	Unconnected roofs, HSG A
	12,380		100.00% Impervious Area
	12,380		100.00% Unconnected

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

Summary for Subcatchment P-6:

Runoff	=	1.81 cfs @	12.07 hrs,	Volume=	6,004 cf,	Depth=	7.47"
Routed to Link POA-2 : To wetland System - Northwest							
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs							
Type III 24-hr 100-yr Rainfall=8.67"							
	Area (sf)	CN	Description				
	5,063	96	Gravel surface, HSG D				
	3,935	80	>75% Grass cover, Good, HSG D				
*	360	98	Ledge Outcrop				
	293	98	Paved parking, HSG D				
	9,651	90	Weighted Average				
	8,998		93.23% Pervious Area				
	653		6.77% Impervious Area				
Tc	Length	Slope	Velocity	Capacity	Description		
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)			
5.0					Direct Entry,		

Summary for Subcatchment P-7:

Runoff	=	1.24 cfs @	12.07 hrs,	Volume=	3,974 cf,	Depth=	6.74"
Routed to Link POA-1 : To wetland System - East							
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs							
Type III 24-hr 100-yr Rainfall=8.67"							
	Area (sf)	CN	Description				
	490	77	Woods, Good, HSG D				
	4,126	80	>75% Grass cover, Good, HSG D				
*	747	98	Ledge Outcrop				
*	1,713	91	Crushed stone bldg surround, HSG D				
	7,076	84	Weighted Average				
	6,329		89.44% Pervious Area				
	747		10.56% Impervious Area				
Tc	Length	Slope	Velocity	Capacity	Description		
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)			
5.0					Direct Entry,		

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Type III 24-hr 100-yr Rainfall=8.67"

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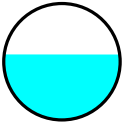
Summary for Reach 1R: Ex. 12" pipe

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth > 7.94" for 100-yr event
Inflow = 2.98 cfs @ 12.22 hrs, Volume= 22,062 cf
Outflow = 3.00 cfs @ 12.21 hrs, Volume= 22,061 cf, Atten= 0%, Lag= 0.0 min
Routed to Pond EP-2 : Ex Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.86 fps, Avg. Travel Time= 0.8 min

Peak Storage= 41 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.56' , Surface Width= 0.99'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 4.94 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 91.0' Slope= 0.0192 '/'
Inlet Invert= 163.84', Outlet Invert= 162.09'



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Type III 24-hr 100-yr Rainfall=8.67"

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Stage-Area-Storage for Reach 1R: Ex. 12" pipe

Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)	Elevation (feet)	End-Area (sq-ft)	Storage (cubic-feet)
163.84	0.0	0	164.40	0.5	41
163.85	0.0	0	164.41	0.5	42
163.86	0.0	0	164.42	0.5	43
163.87	0.0	1	164.43	0.5	44
163.88	0.0	1	164.44	0.5	45
163.89	0.0	1	164.45	0.5	46
163.90	0.0	2	164.46	0.5	47
163.91	0.0	2	164.47	0.5	47
163.92	0.0	3	164.48	0.5	48
163.93	0.0	3	164.49	0.5	49
163.94	0.0	4	164.50	0.5	50
163.95	0.0	4	164.51	0.6	51
163.96	0.1	5	164.52	0.6	52
163.97	0.1	5	164.53	0.6	53
163.98	0.1	6	164.54	0.6	53
163.99	0.1	7	164.55	0.6	54
164.00	0.1	7	164.56	0.6	55
164.01	0.1	8	164.57	0.6	56
164.02	0.1	9	164.58	0.6	57
164.03	0.1	9	164.59	0.6	57
164.04	0.1	10	164.60	0.6	58
164.05	0.1	11	164.61	0.6	59
164.06	0.1	12	164.62	0.7	60
164.07	0.1	12	164.63	0.7	61
164.08	0.1	13	164.64	0.7	61
164.09	0.2	14	164.65	0.7	62
164.10	0.2	15	164.66	0.7	63
164.11	0.2	16	164.67	0.7	63
164.12	0.2	16	164.68	0.7	64
164.13	0.2	17	164.69	0.7	65
164.14	0.2	18	164.70	0.7	65
164.15	0.2	19	164.71	0.7	66
164.16	0.2	20	164.72	0.7	67
164.17	0.2	21	164.73	0.7	67
164.18	0.2	21	164.74	0.7	68
164.19	0.2	22	164.75	0.8	68
164.20	0.3	23	164.76	0.8	69
164.21	0.3	24	164.77	0.8	69
164.22	0.3	25	164.78	0.8	70
164.23	0.3	26	164.79	0.8	70
164.24	0.3	27	164.80	0.8	71
164.25	0.3	28	164.81	0.8	71
164.26	0.3	28	164.82	0.8	71
164.27	0.3	29	164.83	0.8	71
164.28	0.3	30	164.84	0.8	71
164.29	0.3	31			
164.30	0.4	32			
164.31	0.4	33			
164.32	0.4	34			
164.33	0.4	35			
164.34	0.4	36			
164.35	0.4	37			
164.36	0.4	38			
164.37	0.4	38			
164.38	0.4	39			
164.39	0.4	40			

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Type III 24-hr 100-yr Rainfall=8.67"

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Summary for Pond 1P: Modified Detention Basin

Inflow Area = 33,358 sf, 73.04% Impervious, Inflow Depth = 8.07" for 100-yr event
Inflow = 6.49 cfs @ 12.07 hrs, Volume= 22,430 cf
Outflow = 2.98 cfs @ 12.22 hrs, Volume= 22,062 cf, Atten= 54%, Lag= 9.1 min
Primary = 2.98 cfs @ 12.22 hrs, Volume= 22,062 cf
Routed to Reach 1R : Ex. 12" pipe

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 169.43' @ 12.23 hrs Surf.Area= 3,294 sf Storage= 8,748 cf

Plug-Flow detention time= 430.2 min calculated for 22,062 cf (98% of inflow)
Center-of-Mass det. time= 419.5 min (1,174.0 - 754.4)

Volume	Invert	Avail.Storage	Storage Description		
#1	166.00'	11,442 cf	Custom Stage Data (Irregular) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.00	1,859	209.0	0	0	1,859
167.00	2,243	224.0	2,048	2,048	2,419
168.00	2,656	240.0	2,447	4,495	3,054
169.00	3,095	256.0	2,873	7,367	3,733
170.00	3,564	272.0	3,327	10,694	4,455
170.20	3,914	334.0	748	11,442	7,445

Device	Routing	Invert	Outlet Devices
#1	Primary	163.90'	8.0" Round Culvert L= 3.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 163.90' / 163.84' S= 0.0200 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	169.90'	2.0" x 2.0" Horiz. Top grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	166.00'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	168.00'	12.0" W x 3.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Device 1	168.67'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=2.98 cfs @ 12.22 hrs HW=169.43' TW=164.40' (Dynamic Tailwater)

- 1=Culvert (Inlet Controls 2.98 cfs @ 8.52 fps)
- 2=Top grate (Controls 0.00 cfs)
- 3=Orifice/Grate (Passes < 0.05 cfs potential flow)
- 4=Orifice/Grate (Passes < 1.37 cfs potential flow)
- 5=Sharp-Crested Rectangular Weir (Passes < 6.16 cfs potential flow)

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Type III 24-hr 100-yr Rainfall=8.67"

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Stage-Area-Storage for Pond 1P: Modified Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
166.00	1,859	0	168.80	3,005	6,757
166.05	1,877	93	168.85	3,027	6,908
166.10	1,896	188	168.90	3,050	7,060
166.15	1,914	283	168.95	3,072	7,213
166.20	1,933	379	169.00	3,095	7,367
166.25	1,952	476	169.05	3,118	7,523
166.30	1,970	574	169.10	3,140	7,679
166.35	1,989	673	169.15	3,163	7,837
166.40	2,008	773	169.20	3,186	7,995
166.45	2,027	874	169.25	3,209	8,155
166.50	2,046	976	169.30	3,232	8,316
166.55	2,066	1,079	169.35	3,255	8,478
166.60	2,085	1,183	169.40	3,279	8,642
166.65	2,105	1,287	169.45	3,302	8,806
166.70	2,124	1,393	169.50	3,325	8,972
166.75	2,144	1,500	169.55	3,349	9,139
166.80	2,163	1,607	169.60	3,372	9,307
166.85	2,183	1,716	169.65	3,396	9,476
166.90	2,203	1,826	169.70	3,420	9,647
166.95	2,223	1,936	169.75	3,444	9,818
167.00	2,243	2,048	169.80	3,468	9,991
167.05	2,263	2,161	169.85	3,492	10,165
167.10	2,283	2,274	169.90	3,516	10,340
167.15	2,303	2,389	169.95	3,540	10,516
167.20	2,323	2,505	170.00	3,564	10,694
167.25	2,343	2,621	170.05	3,650	10,874
167.30	2,363	2,739	170.10	3,737	11,059
167.35	2,384	2,858	170.15	3,825	11,248
167.40	2,404	2,977	170.20	3,914	11,442
167.45	2,425	3,098			
167.50	2,445	3,220			
167.55	2,466	3,342			
167.60	2,487	3,466			
167.65	2,507	3,591			
167.70	2,528	3,717			
167.75	2,549	3,844			
167.80	2,571	3,972			
167.85	2,592	4,101			
167.90	2,613	4,231			
167.95	2,635	4,362			
168.00	2,656	4,495			
168.05	2,677	4,628			
168.10	2,698	4,762			
168.15	2,720	4,898			
168.20	2,741	5,034			
168.25	2,763	5,172			
168.30	2,784	5,311			
168.35	2,806	5,450			
168.40	2,828	5,591			
168.45	2,849	5,733			
168.50	2,871	5,876			
168.55	2,893	6,020			
168.60	2,915	6,165			
168.65	2,938	6,312			
168.70	2,960	6,459			
168.75	2,982	6,608			

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Type III 24-hr 100-yr Rainfall=8.67"

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Summary for Pond 2P: Bioretention

Inflow Area = 31,035 sf, 57.54% Impervious, Inflow Depth = 7.85" for 100-yr event
Inflow = 5.94 cfs @ 12.07 hrs, Volume= 20,303 cf
Outflow = 1.96 cfs @ 12.36 hrs, Volume= 20,259 cf, Atten= 67%, Lag= 17.1 min
Primary = 1.96 cfs @ 12.36 hrs, Volume= 20,259 cf
Routed to Link POA-1 : To wetland System - East

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 170.85' @ 12.36 hrs Surf.Area= 3,007 sf Storage= 5,920 cf

Plug-Flow detention time= 45.4 min calculated for 20,245 cf (100% of inflow)
Center-of-Mass det. time= 44.0 min (802.4 - 758.4)

Volume	Invert	Avail.Storage	Storage Description
#1	164.83'	5,838 cf	Bioretention basin (Irregular) Listed below (Recalc) 7,555 cf Overall - 1,717 cf Embedded = 5,838 cf
#2	164.83'	172 cf	8" layer underdrain stone (Irregular) Listed below (Recalc) Inside #1 431 cf Overall x 40.0% Voids
#3	165.50'	386 cf	24" layer filter media (Irregular) Listed below (Recalc) Inside #1 1,286 cf Overall x 30.0% Voids
			6,397 cf Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
166.00	643	121.0	752	752	785
167.00	643	121.0	643	1,395	906
167.50	643	121.0	322	1,717	966
168.00	864	144.0	375	2,092	1,456
169.00	1,378	180.0	1,111	3,203	2,398
170.00	2,100	233.0	1,726	4,930	4,152
171.00	3,189	339.0	2,626	7,555	8,985

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
164.83	643	121.0	0	0	643
165.50	643	121.0	431	431	724

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
165.50	643	121.0	0	0	643
167.50	643	121.0	1,286	1,286	885

Device	Routing	Invert	Outlet Devices
#1	Primary	165.00'	6.0" Round Culvert L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 164.67' S= 0.0042 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Device 1	170.75'	2.0" x 2.0" Horiz. Top Grate X 6.00 columns X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#3	Device 1	165.00'	4.0" Round 4" dia underdrains L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 165.00' / 165.00' S= 0.0000 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf

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#4	Device 3	165.50'	2.000 in/hr Percolation through filter media over Surface area above 165.50' Excluded Surface area = 643 sf
#5	Device 1	169.50'	4.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)
#6	Device 1	165.00'	3.0" Vert. Bottom underdrain orifice C= 0.600 Limited to weir flow at low heads
#7	Device 1	169.25'	12.0" W x 3.0" H Vert. Mid-level orifice C= 0.600 Limited to weir flow at low heads
#8	Primary	170.75'	8.0' long x 15.0' breadth Spillway Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.95 cfs @ 12.36 hrs HW=170.85' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Barrel Controls 1.32 cfs @ 6.73 fps)
- 2=Top Grate (Passes < 0.77 cfs potential flow)
- 3=4" dia underdrains (Passes < 0.61 cfs potential flow)
- 4=Percolation through filter media (Passes < 0.11 cfs potential flow)
- 5=Sharp-Crested Rectangular Weir (Passes < 19.04 cfs potential flow)
- 6=Bottom underdrain orifice (Passes < 0.57 cfs potential flow)
- 7=Mid-level orifice (Passes < 1.46 cfs potential flow)
- 8=Spillway (Weir Controls 0.63 cfs @ 0.83 fps)

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Stage-Area-Storage for Pond 2P: Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
164.83	643	0	170.43	2,540	4,767
164.93	643	26	170.53	2,649	5,027
165.03	643	51	170.63	2,760	5,297
165.13	643	77	170.73	2,873	5,579
165.23	643	103	170.83	2,988	5,872
165.33	643	129	170.93	3,105	6,176
165.43	643	154			
165.53	643	178			
165.63	643	197			
165.73	643	217			
165.83	643	236			
165.93	643	255			
166.03	643	275			
166.13	643	294			
166.23	643	313			
166.33	643	332			
166.43	643	352			
166.53	643	371			
166.63	643	390			
166.73	643	410			
166.83	643	429			
166.93	643	448			
167.03	643	467			
167.13	643	487			
167.23	643	506			
167.33	643	525			
167.43	643	545			
167.53	655	578			
167.63	697	645			
167.73	741	717			
167.83	785	793			
167.93	831	874			
168.03	878	960			
168.13	924	1,050			
168.23	972	1,144			
168.33	1,020	1,244			
168.43	1,070	1,349			
168.53	1,122	1,458			
168.63	1,174	1,573			
168.73	1,227	1,693			
168.83	1,282	1,818			
168.93	1,338	1,950			
169.03	1,397	2,086			
169.13	1,463	2,229			
169.23	1,531	2,379			
169.33	1,600	2,535			
169.43	1,670	2,699			
169.53	1,742	2,869			
169.63	1,815	3,047			
169.73	1,890	3,233			
169.83	1,967	3,425			
169.93	2,045	3,626			
170.03	2,129	3,834			
170.13	2,229	4,052			
170.23	2,330	4,280			
170.33	2,434	4,518			

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Type III 24-hr 100-yr Rainfall=8.67"

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Summary for Pond EP-2: Ex Bioretention

Inflow Area = 40,141 sf, 67.55% Impervious, Inflow Depth > 7.82" for 100-yr event
 Inflow = 4.17 cfs @ 12.08 hrs, Volume= 26,144 cf
 Outflow = 4.24 cfs @ 12.10 hrs, Volume= 24,897 cf, Atten= 0%, Lag= 1.1 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Routed to Link POA-2 : To wetland System - Northwest
 Secondary = 4.24 cfs @ 12.10 hrs, Volume= 24,897 cf
 Routed to Link POA-2 : To wetland System - Northwest

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 163.72' @ 12.10 hrs Surf.Area= 1,181 sf Storage= 1,486 cf

Plug-Flow detention time= 155.4 min calculated for 24,879 cf (95% of inflow)
 Center-of-Mass det. time= 30.6 min (1,143.1 - 1,112.5)

Volume	Invert	Avail.Storage	Storage Description		
#1	162.00'	1,797 cf	Custom Stage Data (Irregular) Listed below		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
162.00	458	91.0	0	0	458
163.00	951	126.0	690	690	1,072
164.00	1,271	142.0	1,107	1,797	1,439

Device	Routing	Invert	Outlet Devices
#1	Secondary	163.50'	16.6' long x 2.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 Coef. (English) 2.48 2.60 2.60 2.60 2.64 2.65 2.68 2.75 2.74 2.76 2.89 3.05 3.19 3.32
#2	Primary	157.90'	12.0" Round Culvert L= 25.4' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 157.90' / 156.82' S= 0.0425 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	163.78'	12.0" Horiz. Top grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=162.00' TW=0.00' (Dynamic Tailwater)

└─**2=Culvert** (Passes 0.00 cfs of 5.66 cfs potential flow)

└─**3=Top grate** (Controls 0.00 cfs)

Secondary OutFlow Max=4.22 cfs @ 12.10 hrs HW=163.72' TW=0.00' (Dynamic Tailwater)

└─**1=Broad-Crested Rectangular Weir** (Weir Controls 4.22 cfs @ 1.16 fps)

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Stage-Area-Storage for Pond EP-2: Ex Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
162.00	458	0	163.12	989	823
162.02	468	14	163.14	996	845
162.04	478	28	163.16	1,002	867
162.06	488	41	163.18	1,009	889
162.08	497	55	163.20	1,015	911
162.10	507	69	163.22	1,021	933
162.12	517	83	163.24	1,028	955
162.14	527	97	163.26	1,034	978
162.16	537	110	163.28	1,041	1,000
162.18	547	124	163.30	1,047	1,022
162.20	557	138	163.32	1,053	1,044
162.22	566	152	163.34	1,060	1,066
162.24	576	166	163.36	1,066	1,088
162.26	586	179	163.38	1,073	1,110
162.28	596	193	163.40	1,079	1,133
162.30	606	207	163.42	1,085	1,155
162.32	616	221	163.44	1,092	1,177
162.34	626	234	163.46	1,098	1,199
162.36	635	248	163.48	1,105	1,221
162.38	645	262	163.50	1,111	1,243
162.40	655	276	163.52	1,117	1,265
162.42	665	290	163.54	1,124	1,288
162.44	675	303	163.56	1,130	1,310
162.46	685	317	163.58	1,137	1,332
162.48	695	331	163.60	1,143	1,354
162.50	705	345	163.62	1,149	1,376
162.52	714	359	163.64	1,156	1,398
162.54	724	372	163.66	1,162	1,420
162.56	734	386	163.68	1,169	1,443
162.58	744	400	163.70	1,175	1,465
162.60	754	414	163.72	1,181	1,487
162.62	764	428	163.74	1,188	1,509
162.64	774	441	163.76	1,194	1,531
162.66	783	455	163.78	1,201	1,553
162.68	793	469	163.80	1,207	1,575
162.70	803	483	163.82	1,213	1,598
162.72	813	497	163.84	1,220	1,620
162.74	823	510	163.86	1,226	1,642
162.76	833	524	163.88	1,233	1,664
162.78	843	538	163.90	1,239	1,686
162.80	852	552	163.92	1,245	1,708
162.82	862	566	163.94	1,252	1,730
162.84	872	579	163.96	1,258	1,753
162.86	882	593	163.98	1,265	1,775
162.88	892	607	164.00	1,271	1,797
162.90	902	621			
162.92	912	634			
162.94	921	648			
162.96	931	662			
162.98	941	676			
163.00	951	690			
163.02	957	712			
163.04	964	734			
163.06	970	756			
163.08	977	778			
163.10	983	800			

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Summary for Link POA-1: To wetland System - East

Inflow Area = 38,111 sf, 48.82% Impervious, Inflow Depth = 7.63" for 100-yr event
Inflow = 2.47 cfs @ 12.08 hrs, Volume= 24,233 cf
Primary = 2.47 cfs @ 12.08 hrs, Volume= 24,233 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Summary for Link POA-2: To wetland System - Northwest

Inflow Area = 67,597 sf, 67.42% Impervious, Inflow Depth > 7.71" for 100-yr event
Inflow = 9.40 cfs @ 12.08 hrs, Volume= 43,409 cf
Primary = 9.40 cfs @ 12.08 hrs, Volume= 43,409 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Appendix D

Supporting Calculations

Fleet Maintenance Garage Addition (Cogswell Facility)
1421 Central Avenue
Needham, MA
March 2025

MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required

Water Quality Volume runoff (in.)*	1.0
Total Post Development Site Impervious Area (sf)	78,408
Required Water Quality Volume (cf)	6,534

*Water Quality volume runoff is equal to 1.0 inches of runoff times the total impervious area of the post development project site.

Water Quality Volume Provided*

Bioretention Basin EP-2	1,243
Bioretention Basin 2P	5,636
Total Provided Water Quality Volume (cf)	6,879

*Volume provided below lowest outlet pipe in cubic feet (cf)

TSS Removal Calculation Worksheet

Location: New pavement area (east) to Bioretention 2P

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Sediment forebay 1	0.25	1.00	0.25	0.75
Sediment forebay 2	0.25	0.75	0.19	0.56
Bioretention basin	0.90	0.56	0.51	0.06

Total TSS Removal = 94%

Project: Needham Fleet Facility
 Prepared By: JLO
 Date: March 2025

*Equals remaining load from previous BMP (E) which enters the BMP

TSS Removal Calculation Worksheet

Location: Paved area (west) to Bioretention EP-2

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep sump CB / Sediment forebay 1	0.25	1.00	0.25	0.75
Sediment forebay 2	0.25	0.75	0.19	0.56
Bioretention basin	0.90	0.56	0.51	0.06

Total TSS Removal = 94%

Project: Needham Fleet Facility
 Prepared By: JLO
 Date: March 2025

*Equals remaining load from previous BMP (E)
 which enters the BMP

Appendix E

Operation & Maintenance Manual

Stormwater Operation & Maintenance Plan

Long-term Pollution Prevention Plan

Illicit Discharge Statement

STORMWATER OPERATION AND MAINTENANCE MANUAL

Proposed DPW Fleet Maintenance Facility
1421 Central Avenue
Needham, MA 02492

Responsible parties during construction:

Contractor - TBD

Hank Haff, Director
Needham Building Design & Construction Department
500 Dedham Ave.
Needham, MA 02492
781-455-7550 ext. 72347

Responsible parties post-construction:

Carys Lustig, Director of Public Works
500 Dedham Ave.
Needham, MA 02492
781-455-7550 ext. 72301

Note: In the event of any change in future property owner or responsible party, the incumbent will provide a hard copy of this Operation and Maintenance Manual to the new responsible party. Prior to said transfer of ownership, the incumbent will conduct a walkthrough of the various stormwater controls in the field with the new responsible party, to familiarize the new responsible party with the site features and associated maintenance measures.

Construction Period Erosion & Sediment Control Standards

During the construction phase of the project, proposed erosion control devices and measures, as identified on the project site plans, shall be maintained in a manner that is consistent with the site plans, local/state approvals and conditions, and the EPA Construction General Permit.

If any of the erosion and sediment control measures outlined in this document are inconsistent with the project's SWPPP, the more stringent measure shall govern. Contact information of the owner and the general contractor shall also be listed in the SWPPP for this site. The SWPPP includes information regarding construction period allowable and illicit discharges, housekeeping, and emergency response procedures. General guidelines pertaining to the inspection and maintenance of construction phase erosion and sediment controls are below:

1. Compost filter tube (or wattle): Inspect compost filter tubes at least once a week and within 24 hours after a storm that generated more than a half-inch of precipitation. Remove sediment when it has accumulated to one-half the height of the filter tube. If the filter tube is overtopped during a storm event, install an additional filter tube on top of the original or further up the slope from the failure point.
2. Silt fencing (if applicable on the site): Inspect silt fence at least once a week and within 24 hours after a storm that generates more than a half-inch of precipitation. Repair or reinstall any upended or loose stakes such that the stakes are appropriately anchored into the soil. Remove any accumulated sediment deposits routinely during weekly inspections, or with greater frequency. Repair or replace silt fencing within 24 hours of observed damage or failure (when the fence has been overtopped, undercut, or bypassed by runoff, when the fence has been knocked over, or when the geotextile has decomposed or been stretched or torn).

3. Stabilized construction entrances (or anti tracking pad): Inspect stabilized construction entrances at least once a week and within 24 hours after a storm that generates more than a half-inch of precipitation. Maintain the surface to prevent tracking and washing of sediment onto paved surfaces. Provide periodic top dressing with additional stone or additional length as conditions demand. Immediately remove all sediment spilled, dropped, washed, or tracked onto paved surfaces. If sediment is routinely tracking out onto the street, increase the length of the construction entrance.
4. Inlet protection devices: Inspect inlet protection devices at least once a week and within 24 hours after a storm that generates more than a half-inch of precipitation. Dispose accumulated sediment properly during inspections. Remove all inlet protection devices within 30 days after permanent site stabilization has been achieved.

Post-Development Control Standards

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee).

The estimated annual budget for the maintenance of post-development stormwater controls is approximately \$10,000 per year.

When conducting maintenance of the site stormwater controls, in the absence of evidence of contamination, cleanings and sediment material may be taken to a landfill or other facility permitted by MassDEP to accept Solid Waste without any prior approval by MassDEP. Please note that current MassDEP regulations prevent landfills from accepting materials that contain free-draining liquids. In the event of contamination by a spill or other means, all cleaned materials must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000 and handled as hazardous waste.

1. Parking lots, driveways, and paved areas: Sweep at least on a quarterly basis, and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of offsite in accordance with state and other applicable requirements. Street sweeping shall be performed using a high efficiency vacuum street sweeping machine or a regenerative air sweeper. A mechanical rotary broom sweeper may be used if sweeping is performed on a monthly basis.
2. Catch basins, outlet control structure, yard drains & cleanouts, manholes, and piping: Inspect quarterly—target two of the quarterly inspections at the end of foliage and snow-removal seasons. These features shall be cleaned during quarterly inspections, or whenever the depth of deposits is observed to be greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the associated catch basin or underground drainage feature. Accumulated sediment and hydrocarbons present must be removed and properly disposed of offsite in accordance with MADEP and other applicable requirements.

The structures should be cleaned quarterly regardless of the amount of sediment in the structure. If structures are found to be filled with sediment during a cleaning, the frequency of cleaning shall be increased. Catch basins and outlet control structures (OCS) shall be cleaned with clamshell buckets or by hand tools where necessary. Catch basin hoods shall be inspected annually. Open and close the access hatch and flush or rod the anti-siphon device to ensure proper operation.

- OCS-1: Remove debris and sediment accumulating near the trash rack on the outside wall of the structure monthly. Inspect the sump of the inlet side of the structure and remove sediment and debris monthly. Inspect the small low-level orifice cored into the weir wall and ensure it is not clogged by sediment or debris.

3. Outlets: Inspect riprap aprons once biannually (once during spring in March or April and once during fall in October or November) to determine if high flows have caused scour beneath the riprap or dislodged the riprap. Replace riprap as needed. Inspect the outlet pipe and remove any accumulated sediment to ensure the discharge capacity is maximized.
4. Bioretention Basin and detention basin:
 - a. General inspections:
 - i. Inspect the basin monthly and after rainfall. Remove any observed trash, debris, and leaves. Inspect vegetated basin floor and note any areas lacking stabilization and reseed as necessary. Remove any dead vegetation.
 - ii. For bioretention basins topped with grass and shallow rooted plantings, mowing should not be performed when the ground is soft to avoid the creation of ruts and compaction, which can reduce filtration of runoff. Grass should be watered as necessary during dry periods and during the first growing season.
 - b. Soil filter media for bioretention basins: Because the soil media filters contaminants from runoff, the cation exchange capacity of the media will eventually be exhausted. While infrequent, replacement of filter media should be done on an as-needed basis, when significant sediment accumulation has occurred on the floor of the basin (typically exceeding 1-inch), or when the drawdown capability of the basin has significantly decreased relative to its newly installed condition (typically drawdown periods exceeding 48 hours). The shallow-rooted vegetation proposed atop the filter media makes replacement of the media easier than when a top dressing of mulch or deeper-rooted vegetation is used. Replacement of the filter media is best performed in the late Spring or early Summer. Removal of the filter media should be performed carefully so as to avoid damage to the perforated underdrain pipes and the impermeable liner beneath the system. Replace the crushed stone bedding that the underdrains are located in on an as-needed basis when replacing the filter media. Reseed the replaced filter media and monitor continuously to ensure stabilization is accomplished.

Stormwater Management System Post-Construction Inspection Log

Proposed DPW Fleet Maintenance Facility
1421 Central Avenue
Needham, MA 02492

Inspector name:

Date:

Describe the condition of the features below (note presence of sediment, water levels, damage, etc.):

Catch Basins:

Discharge Points/ Flared End Sections / Rip Rap:

Bioretention basin & detention basin:

Outlet control structures, manholes, cleanouts, and piping:

Other:

Note any recommended repairs/maintenance to be performed on the following:

Catch Basins:

Discharge Points/ Flared End Sections / Rip Rap:

Bioretention basin & Detention basin:

Outlet control structures, manholes, cleanouts, and piping:

Other:

Comments:

[illegible]

Long-Term Pollution Prevention Plan

Proposed DPW Fleet Maintenance Facility
1421 Central Avenue
Needham, MA 02492

Responsible parties during construction:

Contractor - TBD

Hank Haff, Director
Needham Building Design & Construction Department
500 Dedham Ave.
Needham, MA 02492
781-455-7550 ext. 72347

Responsible parties post-construction:

Carys Lustig, Director of Public Works
500 Dedham Ave.
Needham, MA 02492
781-455-7550 ext. 72301

Long-Term Pollution Prevention Plan elements:

- The property owner shall be responsible for “good housekeeping” including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Appropriate storage and removal of solid waste facilities and/or containers.
- Commercial unit sweeping of driveways with a frequency as described above in this document. Collected sediment shall be disposed in accordance with any applicable requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the Operation and Maintenance plan.
- The Owner shall be responsible for snow removal. Snow shall not be piled on or directly near inlets, stormwater basins, or other stormwater controls. Sanding/salting of any paved areas and/or sidewalks during winter conditions shall only be done in accordance with all state/local requirements and approvals.
- The landscaped areas will be maintained by the owner. Fertilizers, if stored on site, will be stored under cover and no fertilizers will be stored within wetland resource area buffer zones. No fertilizer application will occur on the site.
- Sand/salt used in deicing (if applicable) shall be removed periodically during the winter and spring of each year. Records of cleaning shall be maintained on site and be processed in accordance with any relevant conditions associated with Conservation Commission approvals.
- Miscellaneous Maintenance
 - Trash and other debris shall be removed from all areas of the site at least twice yearly.
 - Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system.
 - Grass shall be maintained and clippings shall not be disposed of within stormwater management areas or adjacent resource areas.
 - Plants shall be pruned as necessary.
 - In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams or other water bodies), associated buffer zones, nor the stormwater management basins.

- If necessary, stockpiled snow will be removed from the Site and disposed of at an off-site location in accordance with all local, state and federal regulations.
- Deliveries shall be monitored by owner or owner's representative to ensure proper delivery and in the event that a spillage occurs it shall be contained and cleaned up immediately in accordance with the spill prevention program for the project.

Post Construction Spill Prevention and Response Procedures

To reduce the potential for a hazardous substance spill onsite, the Owner shall ensure that all hazardous substances be properly stored onsite, and any hazardous waste is disposed of properly by a licensed hazardous material disposal entity. Hazardous Waste storage requirements mandated by federal, state, and local authorities shall be followed; storage limits shall not be exceeded. All Hazardous Substances (pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure enclosed location, with their lids on when not in use. A spill control and containment kit shall be provided on site.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)
2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.
3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: 1-888-304-1133, the local fire department (9-1-1) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).
4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

Spill Prevention Control Form

Proposed DPW Fleet Maintenance Facility
1421 Central Avenue
Needham, MA 02492

Where a release containing a hazardous substance occurs, the Owner or his/her facility supervisor shall notify the local Fire Department immediately. Subsequent notifications to the local Board of Health and the Conservation Commission shall then be undertaken.

Contain the spill and the discharge of the pollutant(s) to off-site locations and receiving wetlands to the maximum extent practicable. Utilize any spill response kits present on-site. Gather documentation from a licensed contractor to verify spill control was performed and any cleanup procedures were undertaken. Provide a list to the Board of Health of any chemicals that were spilled.

Date of spill: _____ Time: _____

Material Spilled	Location	Approximate Quantity of Spill (in gallons)	Date of Notification

Cause of Spill:

Describe equipment used:

Location on-site:

Illicit Discharge Statement

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater, and any illicit discharge to the stormwater management system—as identified in the Massachusetts Stormwater Handbook and/or local bylaws and regulations—is prohibited. The stormwater management system conveys and treats on-site stormwater and includes stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

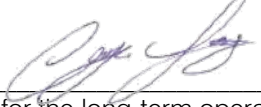
The control measures which have been outlined in the Long Term Pollution Prevention Plan included in this document will be strictly followed to ensure that no contamination of these illicit, non-stormwater discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

Carys Lustig, Director of Public Works, Town of Needham

Name & Title

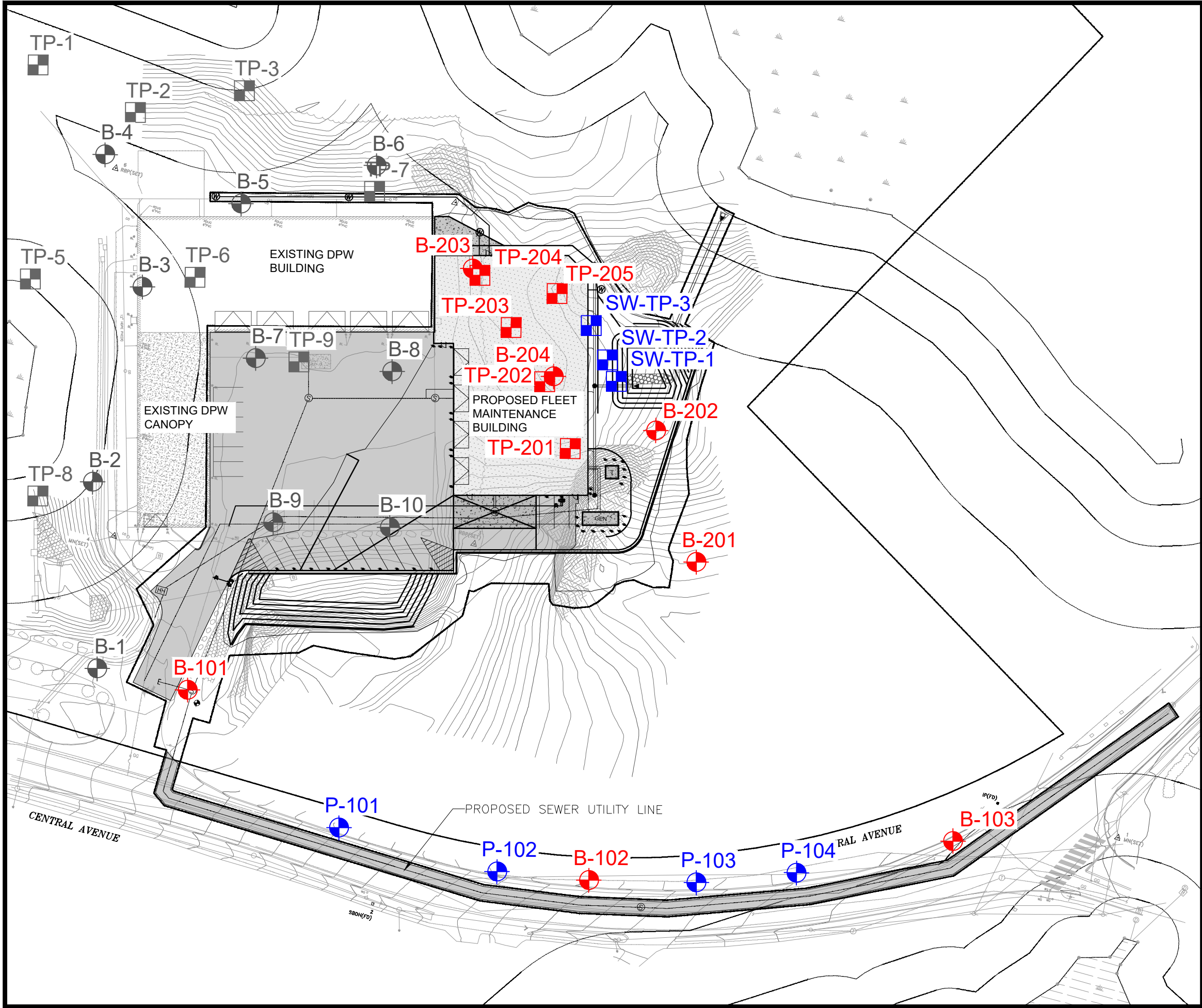
Owner O&M Responsibility Statement

I, (name/title)  _____, acknowledge my role as the party responsible for the long-term operation and maintenance of the stormwater management system on the site. Accordingly, I am responsible for emergency repairs and routine maintenance of the site's stormwater management features.

Appendix F

Geotechnical Information

P:\MA\Needham MA\24-0773 - Needham Fleet Maintenance\07-DesignMaterials\02-Geotechnical\3.1 CADD\Figure 2 - Site Plan.dwg



Weston & Sampson Engineers, Inc.
55 Walkers Brook Drive, Suite 100
Reading, MA 01867
978.532.1900 800.SAMPSON
www.westonandsampson.com

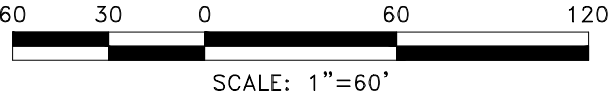
NOTES

1. THIS PLAN IS BASED ON AN EXISTING CONDITIONS SURVEY PLAN PREPARED BY WESTON & SAMPSON, ENGINEERS, INC. DATED OCTOBER 24, 2024. FLEET MAINTENANCE BUILDING AND SEWER LOCATION SHOWN IS AS PROPOSED ON OCTOBER 24 AND 25, 2024.
2. BORINGS WERE COMPLETED BY GEOSearch INC. OF STERLING, MA ON OCTOBER 21 AND NOVEMBER 4 AND 5, 2024.
3. TEST PITS WERE COMPLETED BY THE TOWN DEPARTMENT OF PUBLIC WORKS ON NOVEMBER 4, 2024.
4. ALL BORINGS AND TEST PITS WERE OBSERVED BY A WESTON & SAMPSON ENGINEER.
5. BORING AND TEST PIT LOCATIONS SHOWN ARE APPROXIMATE AND BASED ON FIELD COORDINATES OBTAINED USING A HANDHELD GPS.

LEGEND

- B-XXX DESIGNATION AND APPROXIMATE LOCATION OF BORING
- P-XXX DESIGNATION AND APPROXIMATE LOCATION OF PROBE
- TP-XXX DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT
- SW-TP-X DESIGNATION AND APPROXIMATE LOCATION OF STORMWATER TEST PIT
- B-X DESIGNATION AND APPROXIMATE LOCATION OF PREVIOUS BORING
- TP-X DESIGNATION AND APPROXIMATE LOCATION OF PREVIOUS TEST PIT

GRAPHIC SCALE



ORIENTATION



TITLE

SITE PLAN

PROJECT

NEEDHAM DPW FLEET
MAINTENANCE FACILITY
1407 CENTRAL AVE., NEEDHAM MA

FIGURE

FIGURE 2

DATE	11/2024
DRWN BY	KL/BWMS
CHKD BY	
PRJ. NO.	ENG24-0773
REV. NO.	-

CONTRACTOR: Excavated by Town DPW	TEST PIT LOCATION: See Attached Figure	DATE START: November 4, 2024
OPERATOR:	PLAN DIMENSIONS: Length: 6.0 ft. , Width: 2.5 ft.	DATE FINISH: November 4, 2024
LOGGED BY: Joseph Payson	SEEPAGE REMARKS: No Seepage Observed	GROUND EL: 172.0 ± (NAVD88)
CHECKED BY: Brett Grunert, PE	CAVING REMARKS: No Caving Observed	FINAL DEPTH: 4.0 ft. (Refusal)
EQUIPMENT: Hydraulic Excavator, Compact	BACKFILL MATERIAL: Excavated Soil	GRID COORDS: N:2925942 ± / E:721994 ±
BUCKET TYPE: Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS:	GRID SYSTEM: NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Topsoil- 4 inches thick. [TOPSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to medium SAND, little non plastic fines, trace fine gravel; common roots. [SUBSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to coarse SAND, some non plastic fines, few fine to coarse gravel; trace cobbles.		
5				167	Excavation refusal on boulder or bedrock at 4.0 ft. (exploration ended).
10				162	
15				157	



Test Pit Overview



Sidewall Profile

CONTRACTOR: Excavated by Town DPW	TEST PIT LOCATION: See Attached Figure	DATE START: November 4, 2024
OPERATOR: _____	PLAN DIMENSIONS: Length: 5.5 ft. , Width: 2.5 ft.	DATE FINISH: November 4, 2024
LOGGED BY: Joseph Payson	SEEPAGE REMARKS: No Seepage Observed	GROUND EL: 171.0 ± (NAVD88)
CHECKED BY: Brett Grunert, PE	CAVING REMARKS: No Caving Observed	FINAL DEPTH: 3.3 ft. (Refusal)
EQUIPMENT: Hydraulic Excavator, Compact	BACKFILL MATERIAL: Excavated Soil	GRID COORDS: N:2925953 ± / E:721985 ±
BUCKET TYPE: Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS: _____	GRID SYSTEM: NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Topsoil- 4 inches thick. [TOPSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to coarse SAND, little non plastic fines, trace fine to coarse gravel; occasional cobbles and boulders, occasional roots. [SUBSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to coarse SAND, little non plastic fines, few fine to coarse gravel; trace cobbles.		
5				166	Excavation refusal on boulder or bedrock at 3.3 ft. (exploration ended).
10				161	
15				156	



Sidewall Profile



Excavated Soil



Test Pit Overview

WSE Project: ENG24-0773

Central Ave., Needham, MA

Page 1 of 1

CONTRACTOR: <u>Excavated by Town DPW</u>	TEST PIT LOCATION: <u>See Attached Figure</u>	DATE START: <u>November 4, 2024</u>
OPERATOR: _____	PLAN DIMENSIONS: <u>Length: 4.8 ft. , Width: 2.5 ft.</u>	DATE FINISH: <u>November 4, 2024</u>
LOGGED BY: <u>Joseph Payson</u>	SEEPAGE REMARKS: <u>No Seepage Observed</u>	GROUND EL: <u>171.1 ± (NAVD88)</u>
CHECKED BY: <u>Brett Grunert, PE</u>	CAVING REMARKS: <u>No Caving Observed</u>	FINAL DEPTH: <u>2.5 ft. (Refusal)</u>
EQUIPMENT: <u>Hydraulic Excavator, Compact</u>	BACKFILL MATERIAL: <u>Excavated Soil</u>	GRID COORDS: <u>N:2925971 ± / E:721971 ±</u>
BUCKET TYPE: <u>Toothed, 24-in. (6.4 cubic-ft.)</u>	OTHER COMMENTS: _____	GRID SYSTEM: <u>NAD83 State Plane (MA)</u>

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Topsoil- 5 inches thick. [TOPSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to medium SAND, little non plastic fines, trace fine gravel; trace to common roots, trace cobbles and boulders. [SUBSOIL]		
5				167	
10				162	
15				157	Excavation refusal on boulder or bedrock at 2.5 ft. (exploration ended).



Sidewall Profile



Test Pit Overview



Excavated Soil

CONTRACTOR: Excavated by Town DPW	TEST PIT LOCATION: See Attached Figure	DATE START: November 4, 2024
OPERATOR:	PLAN DIMENSIONS: Length: 6.0 ft. , Width: 2.5 ft.	DATE FINISH: November 4, 2024
LOGGED BY: Joseph Payson	SEEPAGE REMARKS: No Seepage Observed	GROUND EL: 171.5 ± (NAVD88)
CHECKED BY: Brett Grunert, PE	CAVING REMARKS: No Caving Observed	FINAL DEPTH: 4.0 ft. (Refusal)
EQUIPMENT: Hydraulic Excavator, Compact	BACKFILL MATERIAL: Excavated Soil	GRID COORDS: N:2925895 ± / E:721978 ±
BUCKET TYPE: Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS:	GRID SYSTEM: NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Topsoil- 5 inches thick. [TOPSOIL]		
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, trace fine to coarse gravel; common roots, trace boulders. [SUBSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to coarse SAND, little non plastic fines, trace fine gravel; occasional roots.		
			Poorly graded sand with silt (SP-SM) - Mostly fine to coarse SAND, few non plastic fines, trace fine to coarse gravel; occasional cobbles, trace boulders.		
5				167	Excavation refusal on boulder or bedrock at 4.0 ft. (exploration ended).
10				162	
15				157	



Sidewall Profile



Test Pit Overview



Excavated Soil

CONTRACTOR: Excavated by Town DPW	TEST PIT LOCATION: See Attached Figure	DATE START: November 4, 2024
OPERATOR:	PLAN DIMENSIONS: Length: 12.0 ft. , Width: 3.5 ft.	DATE FINISH: November 4, 2024
LOGGED BY: Joseph Payson	SEEPAGE REMARKS: No Seepage Observed	GROUND EL: 169.0 ± (NAVD88)
CHECKED BY: Brett Grunert, PE	CAVING REMARKS: No Caving Observed	FINAL DEPTH: 10.2 ft. (Refusal)
EQUIPMENT: Hydraulic Excavator, Medium	BACKFILL MATERIAL: Excavated Soil	GRID COORDS: N:2925930 ± / E:721952 ±
BUCKET TYPE: Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS:	GRID SYSTEM: NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		
			Topsoil- 3 inches thick.		
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, few fine to coarse gravel; common roots, occasional cobbles, trace boulders. [SUBSOIL]		
			Poorly graded sand (SP) - Tan; moist; mostly fine to medium SAND, trace fine gravel, trace non plastic fines; occasional cobbles.		
			Poorly graded sand with silt (SP-SM) - Tan; moist; mostly fine to medium SAND, few non plastic fines, trace fine gravel; trace cobbles an boulder.		
5				164	
10				159	
15				154	
					<i>Excavation refusal on boulder or bedrock at 10.2 ft. (exploration ended).</i>



Test Pit Overview



Sidewall Profile



Excavated Soil

CONTRACTOR:	Excavated by Town DPW	TEST PIT LOCATION:	See Attached Figure	DATE START:	November 4, 2024
OPERATOR:		PLAN DIMENSIONS:	Length: 8.0 ft. , Width: 3.5 ft.	DATE FINISH:	November 4, 2024
LOGGED BY:	Joseph Payson	SEEPAGE REMARKS:	No Seepage Observed	GROUND EL:	168.8 ± (NAVD88)
CHECKED BY:	Brett Grunert, PE	CAVING REMARKS:	No Caving Observed	FINAL DEPTH:	6.5 ft. (Refusal)
EQUIPMENT:	Hydraulic Excavator, Compact	BACKFILL MATERIAL:	Excavated Soil	GRID COORDS:	N:2925956 ± / E:721924 ±
BUCKET TYPE:	Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS:		GRID SYSTEM:	NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark. Excavation refusal on boulder or bedrock at 6.5 ft. (exploration ended).
			Topsoil- 5 inches thick. [TOPSOIL]		
			Silty sand (SM) - Light gray; moist; mostly fine to medium SAND, little non plastic fines; occasional roots, trace cobble. [SUBSOIL]		
			Silty sand (SM) - Tan with orange; moist; mostly fine to coarse SAND, little non plastic fines, few fine to coarse gravel; occasional cobbles.		
5			Poorly graded sand with silt (SP-SM) - Light tan; mostly fine to coarse SAND, few non plastic fines, trace fine to coarse gravel; trace cobbles and boulders.	164	
10				159	
15				154	



Excavated Soil



Sidewall Profile



Test Pit Overview

CONTRACTOR: Excavated by Town DPW	TEST PIT LOCATION: See Attached Figure	DATE START: November 4, 2024
OPERATOR: _____	PLAN DIMENSIONS: Length: 4.8 ft. , Width: 2.5 ft.	DATE FINISH: November 4, 2024
LOGGED BY: Joseph Payson	SEEPAGE REMARKS: No Seepage Observed	GROUND EL: 169.1 ± (NAVD88)
CHECKED BY: Brett Grunert, PE	CAVING REMARKS: No Caving Observed	FINAL DEPTH: 2.5 ft. (Refusal)
EQUIPMENT: Hydraulic Excavator, Compact	BACKFILL MATERIAL: Excavated Soil	GRID COORDS: N:2925982 ± / E:721898 ±
BUCKET TYPE: Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS: _____	GRID SYSTEM: NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Topsoil- 3 inches thick. [TOPSOIL]		
			Silty sand (SM) - Light brown; moist; mostly fine to medium SAND, little non plastic fines, trace fine gravel; occasional roots. [SUBSOIL]		
			Silty sand (SM) - Tan; moist; mostly fine to coarse SAND, some non plastic fines, trace fine gravel; trace cobbles and boulders.		
5				165	
10				160	
15				155	
					Excavation refusal on boulder or bedrock at 2.5 ft. (exploration ended).



Sidewall Profile



Test Pit Overview



Excavated Soil

CONTRACTOR: Excavated by Town DPW	TEST PIT LOCATION: See Attached Figure	DATE START: November 4, 2024
OPERATOR: _____	PLAN DIMENSIONS: Length: 1.0 ft. , Width: 1.0 ft.	DATE FINISH: November 4, 2024
LOGGED BY: Joseph Payson	SEEPAGE REMARKS: No Seepage Observed	GROUND EL: 170.1 ± (NAVD88)
CHECKED BY: Brett Grunert, PE	CAVING REMARKS: No Caving Observed	FINAL DEPTH: 0.2 ft. (Refusal)
EQUIPMENT: Hydraulic Excavator, Compact	BACKFILL MATERIAL: Excavated Soil	GRID COORDS: N:2925984 ± / E:721946 ±
BUCKET TYPE: Toothed, 24-in. (6.4 cubic-ft.)	OTHER COMMENTS: _____	GRID SYSTEM: NAD83 State Plane (MA)

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Forest debris.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Topsoil- 2 inches of topsoil above rock. [TOPSOIL]		Excavation refusal on boulder or bedrock at 0.2 ft. (exploration ended).
5				166	
10				161	
15				156	



Test Pit Overview



**Department of Public Works
Engineering Division**
500 Dedham Avenue
Needham, MA 02492
781-455-7550
www.needhamma.gov

June 11, 2025

Needham Planning Board
Public Service Administration Building
Needham, MA 02492

RE: Major Project Special Permit No. 2013-02
1407 Central Avenue- Central Avenue DPW Fleet

Dear Members of the Board:

The Department of Public Works has completed its review of the DPW Fleet facility at the Jack Cogswell Building. The applicant has submitted responses to the comments from the Planning Board review.

The additional documents submitted for review are as follows:

1. Cover Letter from Tyler J. Cofelice, PE and Jesse O'Donnell, Weston and Sampson, dated June 3, 2025.
2. Response Letter from Tyler J. Cofelice, PE, Weston and Sampson, dated June 3, 2025 with attachments including Photometric Plan, Traffic Impact Assessment, updated traffic report that also includes excerpts from a 2014 study from Pare Corporation, and Stormwater Report

Our comments and recommendations are as follows:

- We have no additional comments or objections

If you have any questions regarding the above, please contact our office at 781-455-7550.

Truly yours,

Thomas A Ryder
Town Engineer

From: [David G. Lazarus](#)
To: [Planning](#)
Subject: Comment for 6/17/25 Public Hearing re: Central Avenue Agenda Item/Cogswell
Date: Tuesday, June 17, 2025 1:11:50 PM

Good afternoon -

Traffic is out of control on Central Avenue between Marked Tree Road and Charles River Road. My understanding is that the Town is considering sending trucks to the Cogswell Garage via South Street and Charles River Road. Please do not do this. If you must do this, please consider the following:

1. conduct a single comprehensive traffic study including the impact of 1688 Central Avenue daycare, potential skatepark and pickleball at Claxton, new building at Cogswell, Temple Aliyah, and the extended duration of the South Street construction shutdown. The town should not rely on piecemeal traffic studies for individual projects -- sturdy it all at once. I have recently sat in traffic, twice, for example, from the dump to the light at Charles River at 3:15 PM.
2. limit the time for trucks to use this road to non-school commuting hours, such as trucks only from 10 am -2 pm. Do not allow trucks at anytime if there is a scheduled sporting event at the always over-flowing Walker-Gordon field on Charles River Road. Whenever there is an event at this field the road essentially becomes one dangerous lane due to illegal parking along the sides of the street.
3. add a crosswalk at the corner of Central and Charles River. The neighbors have been requesting one for years and have been informed at various times that it 1) is on the capital plan and 2) it is not, and cannot be, on the plan. In addition, we have been told there cannot be a crosswalk because there is no sidewalk. Add one. This intersection is incredibly dangerous and adding heavy trucks heading to and from Cogswell, particularly making the right turn onto Central, will compound these dangers.
4. make the right turn from Charles River onto Central a "No Turn on Red" intersection.
5. add pedestrian crossing lights at the rail trail on Charles River Street. Currently, there are blue posts and a crosswalk but if you are sending heavy trucks across this street you should strongly consider expanding pedestrian safety there. This crosswalk is at the base of a blind hill.
6. make Central Avenue a no parking zone from Charles River to Marked Tree, and
7. I urge the Planning Board to provide notice to the residents of Charles River and Central who may be impacted by these significant and permanent changes. These projects are self-inflicted and the Town should send more than the minimum required abutter notice. For example, when the town shut down Central Avenue this week to complete the Walker Pond project, we received a flyer. The Town can and should do this for all residents that may be effected by this decision. There is no down side to over-inclusive notices to the residents of the Town - particularly since these are Town projects. There is no urgency to complete this garage project -- do this as openly and collaboratively as possible please.

Thank you.

Sincerely,
David Lazarus
115 Oxbow Road



CHARLES RIVER
HEIGHTS

Charles River Heights

Perspective View - Arrival Aerial



Charles River Autism- Supportive Housing
Needham, MA | 88 June 2020 | #00000 | © The Architectural Firm, Inc.



Mission: To provide inclusive housing and a full spectrum of supportive services that empower individuals with disabilities to live independently, achieve their personal goals, and actively participate in their communities.

Current Challenges: A considerable percentage of adults with ASD face challenges in achieving independent living. Studies indicate that only about 5% of autistic adults live independently, while 37% require overnight care. This underscores a significant gap of **58%** of individuals who need support services necessary to foster autonomy among this population.

Proposed Solution: By offering inclusive housing and flexible, integrated support services—including assistance with daily living activities, vocational training, and social skills development—we can empower adults with ASD to access their communities, gain employment and live more independently.

This impacts not only benefits individuals but also enhances the broader community by fostering diversity and inclusion.

Project Team Members



Developer:

Planning Office for Urban Affairs

Project team members:

Anne-Marie Bajwa, President and CEO, Charles River Center

William Grogan, President, Planning Office for Urban Affairs

Phil Crean, Project Manager, Planning Office for Urban Affairs

Architect: The Architectural Team (TAT)

Civil and Traffic Engineer: VHB

Landscape Architect: RBLA Design

Owner's Representative: Waypoint KLA

Land Use Attorney: Goulston and Storrs

Attorney: Nolan Sheehan Patten

Project Timeline



- June 2025- Project Eligibility Letter (PEL) application submission
- September 2025- PEL issuance
- October 2025- Comprehensive Permit Application
- Nov. 2025- Executive Office of Housing and Livable Communities pre-application due
- Feb. 2026- Executive Office of Housing and Livable Communities application due
- July 2026- Anticipated funding application award
- Mar. 2027- Construction Start
- Oct. 2028- Construction End/ Certificate of Occupancy

Charles River Heights

Creating **86** new affordable housing units to attract and retain households earning at or below 30% to 80% of the Area Median Income (AMI), including elderly residents, individuals with disabilities, young professionals, and public/private employees essential to the town's services.

43 handicapped-accessible units with integrated supportive services, including:

- Remote monitoring for overnight support Clinical services
- Health and safety monitoring
- College navigation
- Career exploration
- Job support
- Adult companion
- Peer support services
- Transportation assistance

Five affordable apartments for Charles River Center staff to provide emergency support after hours.

Community Center: 4,400 sf- to bring the community to us

- Commercial grade kitchen and dining space (events)
- Office space
- Recreation Room
- Computer stations
- Gym

Green space with walking trails
Covered outdoor space

Model Community: Establishing a creative, inclusive model that other municipalities across the state and beyond can replicate.

Project Design

Building A

- 3 story
- 67,000 gsf
- (15) CRC studios with common area
- (10) CRC 1 bedrooms with common area
- (33) 1-bedroom units
- (10) 2- bedroom units
- **68 units total**
- 4,400 sf Community Space
- 1,900 sf Lobby / Amenity

Building B, C, D

- 1 story
- 4,000 gsf
- (6) CRC studios with common area

Other Features

- 61 Parking Space
 - 1:1 spaces per affordable unit
 - 0.4:1 spaces per CRC unit
- CRC wrap around services
- Community Room available to town
- Passive House Design for all 4 buildings
- Onsite Renewable Energy Creation
- Connections to outdoor walking trails

Site Plan | Proposed Conditions





Building A | Ground Floor Plan



- Studio
- 1 bedroom
- 2 bedroom

CRC units
5 - studio
5 - 1 bedroom

Non CRC units
5 - 1 bedroom
2 - 2 bedroom

Total
5 - studio
10 - 1 bedroom
2 - 2 bedroom
17 units



Studio
1 bedroom
2 bedroom

CRC units
5 - studio
5 - 1 bedroom

Non CRC units
11 - 1 bedroom
4 - 2 bedroom

Total
5 - studio
16 - 1 bedroom
4 - 2 bedroom
25 units



Studio
1 bedroom
2 bedroom

CRC units
5 - studio

Non CRC units
17 - 1 bedroom
4 - 2 bedroom

Total
5 - studio
17 - 1 bedroom
4 - 2 bedroom
26 units



(5) CRC studio units with shared community room









Charles River Autism- Supportive Housing

Needham, MA | 06 June, 2025 | #23032 | © The Architectural Team, Inc.

Perspective View - Main Building South Entry





Charles River Autism- Supportive Housing

Needham, MA | 05 June, 2025 | #250352 | © The Architectural Team, Inc.





Questions & Comments

Perspective View - Arrival Aerial





Office of the Town Manager
1471 Highland Avenue
Needham, MA 02492
781-455-7500
www.needhamma.gov

June 3, 2025

Edward Augustus, Secretary
Executive Office of Housing and Livable Communities
100 Cambridge Street, Suite 300
Boston, MA 02114

Re: Letter of Support from the Town of Needham/Charles River Heights Project, 59 East
Militia Heights Road

Dear Secretary Augustus:

At its meeting on May 27, 2025, the Needham Select Board voted to support the Charles River Center's Charles River Heights project at 59 East Militia Heights Road as a "friendly 40B."

For this project, the Charles River Center (CRC) is partnering with the nonprofit developer Planning Office for Urban Affairs (POUA). POUA has a strong track record, having developed over 3,000 units of affordable, workforce, and mixed-income housing in the greater Boston area.

Charles River Heights will include 86 units of housing for households earning at or below 30% to 80% of Area Median Income (AMI). Approximately half of these units will be available through a closed referral system for people with autism or intellectual and developmental disabilities, as well as CRC staff. CRC will provide a comprehensive network of support and services to these residents, alongside educational opportunities. Programming will include remote support for overnight monitoring, clinical support (including medical, health and safety), college navigation, employment and career exploration, training and job support, adult companion and peer support, and transportation services.

The remainder of the units in the project will be available to households earning at or below 30% to 80% of AMI but will not be restricted to individuals with autism or intellectual and developmental disabilities. The integration of adults with autism and intellectual and developmental disabilities alongside adults without disabilities is a critical component of the CRC model. When complete, the project will provide a creative model of an inclusive community for other communities across the Commonwealth and beyond.

Public benefits of the project include:

- a community center and green outdoor space that is accessible to the surrounding neighborhood and open to the greater Needham community;
- an increase in affordable housing units in Needham, including those for individuals with disabilities – a goal articulated in the Town’s Housing Plan; and
- preference to Needham residents at initial lease-up, to the extent permitted by EOHL.

The 2025 Annual Town Meeting voted to appropriate \$2,840,223 from Community Preservation Act funds to support the funding strategy for this project. Based on the foregoing, the Town believes that this project will be beneficial both to current Needham residents and those who will move to Needham to live in this truly inclusive community.

If you have any questions or need additional information, please feel free to contact me.

Very truly yours,

A handwritten signature in cursive script, appearing to read "Kate Fitzpatrick".

Kate Fitzpatrick
Town Manager

cc: Select Board
 Zoning Board of Appeals
 Anne-Marie Bajwa, Charles River Center
 Chris Heep, Town Counsel
 Katie King, Deputy Town Manager
 Lee Newman, Director of Planning & Community Development
 Alison Steinfeld, Community Housing Specialist



1 EXISTING PARCELS - PRESENT DAY LAYOUTS
SCALE: 1" = 10'-0"

SCALE: 1" = 10'-0"



(52) TOTAL PARKING SPACES:

(39) FULL SIZE: 8'-0" x 17'-0"

(13) COMPACT: 8'-0" x 16'-0"

2 EXISTING PARCELS - RECONFIGURED TO ACCOMMODATE ADD'L SPACES (REV4)
SCALE: 1" = 10'-0"

DATE: 06.10.2025

Planning Board
Planning Project Schedule and Goals 2025-2026

	June	July	August	September	October	November	December	January	February	March	April	May	June	NOTES
PROJECT / GOAL														

Existing / Ongoing
Projects

ADU per new state law		review language	finalize language	Statutory Hearing	Special Town Meeting									
Large House Review (LHR)	Community Mtg			Community Mtg		Community Mtg			Statutory Hearing			Town Meeting		
Parking bylaw		RFP for consultant	hire consultant		workshop				workshop		Report from consultant			**zoning will go to Oct STM
Stephen Palmer		hire consultant		Committee work initiates										

Goals / Desired Projects

Inclusionary zoning														
"Unlocking the Charles"														
Customary home occupations														
Great Plain (Pickering to Warren)														
Design Guidelines for MBTA zoning														
Multifamily housing at Hersey station NB district														
DEI related goals														

ADDITIONAL ZONING RECOMMENDATIONS

There were two items that the Housing Needham Advisory Group voted to recommend to the Planning Board, during the Board's deliberations on the MBTA Communities Act zoning, once the Town hears back from the Executive Office of Housing and Livable Communities (EOHLC) on their preliminary review:

1. In the Avery Square Business subdistrict (which applies to the parcel at 100 West Street only), within the Neighborhood Housing Plan, consider allowing 4 stories and an FAR of 1.4 as of right if the applicant chooses to provide 7.5% of units as workforce housing for households with incomes between 80% – 120% AMI.
2. Under both the Base Compliance Plan and the Neighborhood Housing Plan, in the Avery Square Business subdistrict, consider exempting structured parking from the calculation of floor area ratio to be consistent with the underlying zoning on that parcel. All other areas proposed for multi-family zoning count structured parking towards the FAR calculation, consistent with the underlying zoning in those subdistricts. This deliberation should be informed by any comments received by EOHLC on Needham's existing zoning as it relates to structured parking.

Over the course of HONE's deliberations, there were some matters that the members chose to exclude from their recommendations for compliance with the MBTA Communities Act, but voted to recommend further action by the Planning Board.

The Housing Needham Advisory Group recommends that the Planning Board:

1. Review zoning in the Hersey Station area, encompassing at least the area, that is now commercially zoned and the Hersey MBTA lots, for multi-family housing, with or without mixed use.
2. Review the General Residence district to consider: (1) allowing 3 or 4 units per 10,000 square foot lot in the General Residence district, (2) whether the 10,000 square foot threshold should be reduced, and (3) any implications of our current inclusionary zoning, which does not apply to buildings with fewer than 6 housing units. Current zoning has a 2-unit per parcel restriction.
3. Consider ways of making mixed-use development in the Center Business District more likely, where stand-alone multi-family should be considered, and what incentives could be used.
4. Consider rezoning the south side of Great Plain Avenue between Pickering Street and Warren Street for multi-family housing.
5. Review and update existing parking requirements for commercial uses.
6. Review whether to reduce lot size from 10,000 square feet to something less in the Chestnut Street District, the Industrial District, and the Hillside Avenue Business District.
7. Review zoning and financial strategies to incentivize workforce housing and consider developing a Town program for workforce housing.
8. Review the Planning Board's existing site plan review process under Section 7.4 of the Zoning Bylaw.

NEEDHAM PLANNING BOARD MINUTES

May 5, 2025

The Needham Planning Board meeting, held in the Highland Room at Needham Town Hall, and virtually using Zoom, was called to order by Natasha Espada, Chairman, on Monday, May 5, 2025, at 7:00 p.m. with Messrs. Block, McCullen, Crocker and Greenberg, Planner, Ms. Newman and Assistant Planner, Ms. Clee.

Ms. Espada noted this is an open meeting that is being held in a hybrid manner per state guidelines. She reviewed the rules of conduct for all meetings. This meeting does not include any public hearings and no public comment will be allowed. If any votes are taken at the meeting the vote will be conducted by roll call.

Discussion of Town Meeting warrant articles.

Ms. Espada noted this meeting is prior to Town Meeting and will be kept open in case questions come up. There were no changes but updates to the fiscal impact. There is one grammar change and no substantial changes.

Upon a motion made by Mr. McCullen, and seconded by Mr. Block, it was by a vote of the five members present unanimously:

VOTED: to amend the Zoning By-Law to create a Multi-Family Overlay District in compliance with the MBTA Communities Act, the so-called Base Compliance Plan, and if the main motion under Article 18 passes to implement a Map Change consistent with the amendments to the zoning by-law made under Article 18.

Board of Appeals – May 15, 2025.

6 Brook Road – Advanced Softball Training, LLC

Upon a motion made by Mr. McCullen, and seconded by Mr. Block, it was by a vote of the five members present unanimously:

VOTED: “No comment.”

Minutes

There were no minutes.

Correspondence

There was no correspondence.

Report from Planning Director and Board members

Ms. Newman stated she received a \$45,000 grant for a parking study she had applied for back in the Fall. She did not hear anything but heard last week. The scope is to review the parking standard across the commercial district using Stan Tec. They are trying to determine if the standards are still accurate and if there are any changes that need to be identified. She will have to do a Request for Proposals (RFP) to give the framework and modify the zoning to implement those standards. Mr. McCullen stated there have been a number of complaints from downtown businesses that they have seen CVS, Beth Israel Deaconess (BID) - Needham, and other business employees parking in the municipal lots well beyond what was allotted. This needs to be evaluated and looked at to see what the initial expectations were.

Ms. Clee stated the BID Needham Decision required it to represent where their employees were parking, including how many municipal parking permits they were using, but there was no maximum number set. Mr. McCullen noted the Ambulatory Care Center. Rumor has it they have purchased 6 parcels and will expand the ambulatory care center and parking will be a piece of that. Ms. Espada stated the recent parking study showed excess parking. This needs to be revisited. Mr. McCullen noted the parking study was based on one day. A multi-day study needs to be done. Ms. Espada asked Ms. Newman for an update on anything pertaining to Stephen Palmer at the next meeting. Ms. Newman noted an RFP is supposed to go out next week.

Upon a motion made by Mr. McCullen, and seconded by Mr. Block, it was by a vote of the five members present unanimously:

VOTED: to continue the meeting until the end of Town Meeting.

Respectfully submitted,
Donna J. Kalinowski, Notetaker

Artie Crocker, Vice-Chairman and Clerk

NEEDHAM PLANNING BOARD MINUTES

May 12, 2025

The Needham Planning Board meeting, held in the Highland Room at Needham Town Hall was called to order by Artie Crocker, Vice Chairperson, on Monday, May 12, 2025, at 7:00 p.m. with Messrs. Block and McCullen and Planner, Ms. Newman.

Discussion of Town Meeting warrant articles.

Board Members briefly discussed the flood plain zoning, which was Articles 5 and 6 of the Special Town Meeting.

Minutes

There were no minutes.

Correspondence

There was no correspondence.

Report from Planning Director and Board members

There was nothing to report.

Upon a motion made by Mr. McCullen, and seconded by Mr. Block, it was by a vote of the three members present unanimously:

VOTED: to continue the meeting until the end of Town Meeting.

Respectfully submitted,
Alexandra Clee, Notetaker

Artie Crocker, Vice-Chairman and Clerk

NEEDHAM PLANNING BOARD MINUTES

May 20, 2025

The Needham Planning Board meeting, held in the Highland Room at Needham Town Hall, and virtually using Zoom, was called to order by Natasha Espada, Chairman, on Monday, May 20, 2025, at 7:00 p.m. with Messrs. Block, McCullen, Crocker and Greenberg, Planner, Ms. Newman and Assistant Planner, Ms. Clee.

Ms. Espada noted this is an open meeting that is being held in a hybrid manner per state guidelines. She reviewed the rules of conduct for all meetings. This meeting includes two public hearings and public comment will be allowed. If any votes are taken at the meeting the vote will be conducted by roll call.

Reorganization and Committee Appointments

Upon a motion made by Mr. Block, and seconded by Mr. Greenberg, it was by a vote of the five members present unanimously:

VOTED: to nominate Mr. Crocker as Chairman and Mr. McCullen as Vice-Chairman.

Mr. Crocker took over as the Chairman of the meeting.

Public Hearing:

7:00 p.m. – Scenic Road Act: Peter Giannacopoulos, 11 Edgewater Drive, Needham, MA, Petitioner (Property located at the corner of Edgewater and South Street (11 Edgewater Drive, Assessor's Map 201, Parcel 48). Regarding request to remove four (4) existing trees along South Street at the corner of Edgewater and South Street, and to replace them with six (6) new trees.

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of the five members present unanimously:

VOTED: to waive the reading of the public hearing notice.

Peter Giannacopoulos, owner, worked with Tree Warden Ed Olsen and Arborist Michael Logan to see what the town would like to see. The town proposed 6 trees and he added another 20 arborvitae so his house and the scenic road are an improvement. Ms. Newman noted the Tree Warden approved the plan and recommended certain species. Mr. Crocker stated Building Commissioner Joseph Prondak had no comment, Police Chief John Schlittler had no comment and Engineering had no comment.

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of the five members present unanimously:

VOTED: to close the hearing.

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of the five members present unanimously:

VOTED: to approve the plan as submitted tonight.

Mr. Crocker asked the Board members about their committee assignments and if they intend to stay on the committees. Mr. Block will stay on the Council of Economic Advisors and the Community Preservation Committee. Mr. McCullen is on the Mobility and Planning Coordination Committee, Mr. Crocker is on Envision and the Tree Committee, Ms. Espada is on the Stephen Palmer Committee and Mr. Crocker is on the Large House Committee along with Planning Board designee

Jeanne McKnight. Mr. Crocker noted the first Large House meeting is 6/9/25 with a public hearing with questions and answers.

Minutes

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of four of the five members present (Mr. Greenberg abstained):

VOTED: to move passage and adoption of the minutes of 3/27/25, 4/1/25 and 4/15/25 as drafted and presented in the packet tonight.

Public Hearing:

7:15 p.m. – Amendment to Major Project Site Plan Review No. 2013-02: Town of Needham, 1471 Highland Avenue, Needham, Massachusetts, Petitioner (Property located at 1407 Central Avenue, Needham, Massachusetts). Regarding proposal for a new building addition of approximately 12,400 square feet, as well as the renovation of roughly 1,800 square feet within the existing storage garage to create a dedicated tire maintenance bay.

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of the five members present unanimously:

VOTED: to waive the reading of the public hearing notice.

Tyler Cofelice, Senior Project Manager with Weston & Sampson Engineering, Inc., gave the project background. They were hired to do an existing conditions and master plan for 470 Dedham Avenue. Several deficiencies were identified such as no sprinklers and poor ventilation and it is undersized for storage area requirements. The site is plagued with flooding. There is a phased renovation plan with the first phase relocating from 470 Dedham Avenue to the Jack Cogswell site. The wetlands have been reflagged. The proposal is to renovate the far east bay to a tire maintenance bay and just off that bay they will add a 12,000 square foot pre-engineered metal building with storage, maintenance garages and supporting offices, a break room and parts room. A covered exterior wash pad will be off the southern end. There will be pretty significant ledge removal. There is a large swathe of natural and forested trees between Central Avenue and the building to be kept in place. The proposed dumpster location is in the rear.

Mr. Cofelice noted there is a proposed generator and sound wall. One goal is to have a fully electric net zero building. There will be ground source heat pumps. A maximum of 4 wells with a test well done this summer are being proposed. Proposed roof top solar will be on the addition and the existing building. There will be a sewer line extension with a gravity drain to the corner of Central Avenue to the entry to a pump station. The grade comes up from Central Avenue to the building so the building will not be able to be seen from the intersection. There will be 4 bay doors with one being a drive through. Stormwater management is being proposed and has been reviewed with the Conservation Commission. There will be 2 systems – one on the left and the existing basin is being expanded. Eleven trees will be removed with the wetland buffer area and will be replaced 2 to one with 22 additional trees in the wetland buffer zone.

Mr. Cofelice noted there will be 6 full-time employees and 3 divisional vehicles. There are 12 parking spaces planned and some spaces have been set aside for temporary parking for a total of 18 spaces for the facility. He noted a traffic study has been submitted along with a sound study on the noise from the proposed generator. The building will act as a buffer as well as the sound wall. Mr. Crocker asked how the sound study was performed. Mr. Cofelice noted the sound engineer put sensors out in the field to get the background noise then modeled the site building and topography. Sound levels were established at these locations. Mr. Crocker asked what the wall was going to be made from. Mr. Cofelice noted it will be a simple sound wall, 10 feet high, supported by vertical high beams with sound attenuating panels in between. Mr. Crocker asked the height of the generator and was informed 8 feet. He asked if there was going to be anything on the building to attenuate the sound reflection. There will be nothing above the standard building materials. Fencing is being proposed along the top of the ledge wall and sound attenuating panels could be added. Mr. McCullen asked if the generator was for emergency power only with monthly testing. He wants to make sure the testing happens during the daytime. Mr. Sargent stated the testing will be done during the daytime, once a week for 15 or 20 minutes.

Mr. Colefice stated there is a drive through bay to prevent the noise from trucks backing up. He showed the photometric plan. There will be no pole mounted light but only wall mounted lights pointed straight down with 0 candle at the property line. There were updated traffic counts done in February. There are 14,000 cars per day with 1,300 peak per hour. He anticipates 32 trips added daily. The employees will work 7:00 a.m. to 3:30 p.m. Mr. Greenberg asked, with increased operations, did the applicant consider additional vendors or third parking trips. Mr. Colefice stated he did not increase vendor trips but believes they would be relatively rare. Mr. Sargent noted there are tire deliveries once per month. The Recycling Transfer Station (RTS) is a major user of the mechanics. They will not be making trips to Dedham Avenue but would be crossing from lot to lot. This will take traffic off of Central Avenue. Mr. McCullen noted the estimated trips to the current facility is 32. He asked where that number comes from and if it was from other parts of Needham. Mr. Colefice stated the fleet managers provided a total number of repair trips so they counted each coming and going from this facility. Trips were included in the traffic counts. He noted this is all off season storage and will be adding 32 trips to the existing. Mr. Block asked what the total was and was informed that was not estimated but employees may go get a piece of equipment there.

Mr. McCullen commented this is a highly trafficked area. He has some concerns, which is why he is nitpicking. Mr. Sargent noted the idea is to get employees and vehicles to be repaired in early by around 7:00 a.m. Mr. McCullen asked if there could be an agreement no vehicles during the day and if they are not there by 7:00 a.m. it would be the next day. Mr. Sargent noted it would be ok for the vehicles to be dropped off the night before. Mr. McCullen stated the Newman School drop off is 8:30 a.m. to 8:45 a.m. and pick up is 3:10 p.m. to 3:25 p.m. Mr. Colefice stated there are zoning regulations. The proposed site is in the Single-Family Resident A District, the Wireless Communication Facility Towers Overlay District, Photovoltaic District and the Temporary Towers Overlay District. Municipal use is permitted by right and this meets all dimensional requirements. He reviewed the requested relief. Of the 4 waivers requested 2 were previously approved for the Cogswell Building – minimum parking and bike racks. They are requesting relief from the landscape requirement for trees and trees for parking. Ms. Espada asked if the trees had gone through the town arborist. Mr. Sargent noted they went through the Conservation Commission, but he believes the Tree Warden was consulted.

Mr. Colefice noted the comments from the Health and Human Services Department and the Engineering Department. He brought the written comments and reviewed the comments and responses regarding sound, the water separator, lighting, dumpster permit, dust control and pest control. They are finalizing the permit for geothermal wells through the Department of Health. There is a question about the Town doing public outreach for educational purposes. Mr. Crocker asked what is being done in the wash bay to maintain it. Mr. Colefice stated the wash bay is under a cantilevered roof to prevent stormwater and rainwater going into a sump that will collect and treat, then to a catch basin that is hooded with the overflow going into the building to a floor drain system that goes out to the sewer. Mr. Crocker asked if there will be any demolition or construction on Central Avenue. There will be a low-pressure storm main routed down Central Avenue. Mr. Crocker asked what time of day the construction is and how much of the road is being dug up. Mr. Sargent stated this will be coordinated with the DPW to be done outside of rush hours. Mr. Colefice stated there was a water main extension done recently. He feels it will be the same.

Mr. Block stated he wants to be clear on the environmental mitigations. In terms of conditions there should be sound attenuation, a finding and representation on traffic and additional mitigation if needed. The facility will handle all the town's vehicles and there will be an oil and gasoline separator. He asked what other environmental mitigations are being proposed. Mr. Colefice noted the project is meeting all Massachusetts stormwater regulations. Motor oil is stored within the facility in a fluid storage room. Double walled tanks provide secondary containment and any 55-gallon drums will be on spill pallets. Mr. Sargent noted it will be similar to what is being done now at 470 Dedham Avenue. Mr. Block would like the applicants to email the Planning Director with a list of all environmental mitigations. He feels he would like to include in the list of conditions stormwater and non-stormwater, like oil changes or antifreeze spills.

Mr. Crocker asked what is being allowed to flow back into the wetlands and was informed treated stormwater, roof runoff and parking lot runoff. Mr. Greenberg asked who would pump it out. Mr. Sargent does not know who the Town contracts with. Mr. Colefice noted there is regular maintenance for the water separators. Mr. McCullen noted the Claxton Field tennis courts and skate park and commented traffic growth should be expected. The applicant said the traffic counts are

less than in 2016. The tennis courts and field use will increase that. He feels that statement should not be made as they do not know the impact of Claxton and the field use. They need to make sure holistically this does not create a burden on the residents, employees and all who travel through the town. Mr. Sargent will go back to the traffic engineer and flesh it out. Ms. Espada asked the applicant to clarify where vehicles enter and where the main entrance is now. Mr. Sargent noted there really is not one as the building is not currently staffed.

Ms. Espada noted there is a connector between the 2 buildings and she wondered if the connector could be eliminated and the building moved in so there is more of a buffer between residential. It sounds like there is an 85-foot buffer now. Mr. Sargent stated services are in the connector and it cannot be eliminated. Ms. Espada asked if the color of the building would be the same as the rest of the building and was informed it would be. She noted the color is aged and will not be able to be matched. She suggested making it a shade different. Mr. Crocker stated he would like to see where the trees are going. Mr. Colefice showed the landscape plan. Mr. Crocker asked if it was possible to add trees as a buffer for the closest house. Mr. Colefice noted there are trees and the wall that acts as a screen. The buffer area is maybe 25 feet.

The meeting was opened for public comment. Walter Hollop, of 301 Marked Tree Road, asked if trucks would go exclusively down Central Avenue or Marked Tree Road. Mr. Sargent noted that is a question for the Fleet Maintenance. He sees a lot of trucks coming down Marked Tree. He leaves for work at 7:00 a.m. and he has a hard time getting out onto Central Avenue due to traffic from Dover. He asked how long construction would be and was informed 19 months. Mr. Hollop asked how loud the construction would be and what the workday would be. Mr. Sargent stated the work cannot begin before 7:00 a.m. Work will be from 7:00 a.m. and stop at 3:30 p.m. Mr. Colefice noted there will be some ledge blasting and some hammering. There will be a survey of existing houses prior to blasting. Mr. Hollop asked if there would be any work on weekends and was informed that was very unlikely but there may be a rare Saturday if they are expecting snow or something like that. The town has a policy that work cannot begin before 7:00 a.m. Yuangang Gu, of 309 Marked Tree Road, asked if this facility was for tires only or for general maintenance and if it was for all vehicles. He was informed it will be general maintenance for all town vehicles. Mr. Gu stated the report has no traffic for Marked Tree Road. Mr. Crocker asked where the report was done. Mr. Colefice noted the estimate is around 12 heavy trucks per day. Mr. Sargent noted the majority of vehicles are RTS and will not go on Central Avenue. Mr. Gu would like the traffic to be split so it does not all come from one direction. He commented that big trucks make a lot of noise. Mr. Sargent will look into this. Mr. Gu noted they did not talk about the generator last time and he wanted to make sure it was only for backup. Mr. Crocker stated it is only for backup and will be tested once per week. Mr. Gu would not be able to hear it at 33 decibals. Mr. Gu stated there is a site next to this building and he asked why not use that area. Mr. Sargent stated the DPW Master Plan is online. This is a phased project that is explained online.

Holly Clarke, of 1652 Central Avenue, appreciates that the Board has talked about Central Avenue as it exists now. It is satiated now, and it is fair to say trucks are not the same as cars. She stated there were promises from the Town when the Jack Cogswell building was put there that it would only be for storage and there would not be any people or any more traffic. It is hard to see that promise changed or reneged on. That is what happened. When the master plan was done in 2014 there was a traffic study done of what would happen if the DPW was put here. She was surprised that was not built on. She appreciates the need for a fuller traffic study done now. The site line distances were discussed but never changed because it was only supposed to be storage. It would be prudent to build on that. Mr. Sargent stated cars cannot pull out onto Central Avenue from the Cogswell building. Cars must turn and go to the RTS. Ms. Clarke stated the RTS driveway is the driveway they said does not have the site distance. This was written into the reports the experts hired by the Town did. Mr. Sargent stated if it was that big of a problem they would be talking about the RTS entrance.

Ms. Clarke noted an accident study done back then talked about Central and Marked Tree. At 7:00 a.m. traffic is already backed up on Central Avenue. Rush hours in the afternoon begin when Newman School lets out and does not stop. The traffic study done talked about the RTS busy hours as being right at 7:30 a.m. and the end of the day. She feels there should be a condition requiring when trucks can come and go. They need to look at what could be done at Marked Tree. This area is just saturated and they need to see what can be done. More study needs to be done before going forward. She appreciates the environmental study that was done. She wants the construction management plan to be explicit in when construction can happen. She feels 32 vehicles is optimistic.

Ken Buckley, of 221 Warren Street, noted this was a great presentation. He stated the Town is here for approval of a variance to the rules. Approval of the site should have been done before the whole plan was done. He understands another location was possible or available. There will be new traffic with pickle ball, ball fields and a skate park. It will be worse once the ball fields are open. He heard 32 vehicles is the increase. Trucks are slower and he feels there will be a lot of safety issues. He noted there is another exit trucks can use with better site line. He asked if there was the possibility of another site. Mr. Crocker stated not for this Board. Mr. Block noted the process is for the Town or developer to decide which site is the best then come to the Planning Board. Mr. Buckley stated this is a single-family residence zone if you take away the overlay. He feels there should have been more consideration given to the other site.

Mr. Gu asked how he can follow this. Mr. Crocker stated there would be another meeting where the Board would approve an order of conditions. Mr. Gu asked if there is detail for the 32 number of large or small trucks. He asked if they could get this number for the previous year or 3 years on how many fixes the town has done per year and how many trucks are coming from the RTS directly. Ms. Espada asked if the detail traffic report study and application additional information is in the detail and application online in the agenda. Mr. Colefice stated of the 32 additional trips 10 would be large trucks. Mr. Sargent can supplement the information from the maintenance loop. Mr. Gu asked if there is a lot of sound who do they complain to. Mr. Crocker stated the Building Department who will then come to the Planning Board. Mr. Gu commented that would be too late. Mr. Block feels the hearing may need to be continued for additional information.

Mr. Sargent stated part of the study process was to do disparate sites or one main campus site. They determined no site was big enough to handle all of DPW which is why it is split up the way it is. Ms. Espada feels there needs to be additional information about operations and how trucks move around the site and around the town and construction with drilling and how houses adjacent will be monitored. Mr. Sargent stated that is similar to what they did with the Cogswell Building. Ms. Espada wants to make sure the team reviews the 2014 study to look at Holly Clarke's concerns. Mr. McCullen is very concerned with the ingress and egress and what it does with Claxton and the skate park at 7:30 a.m. when people are doing RTS runs and afternoons. When sports teams start there will be a lot of parent traffic there and he has concerns. He would like that followed up. Ms. Espada asked, when doing the study, did the applicant take into account the changes at Claxton and the new day care center at 1688 Central Avenue and was informed they did not.

Mr. Block stated he would like the specific information the Board is looking at. Ms. Espada would like information on traffic impacts with the projects. Mr. Crocker would like to see the paths the vehicles are taking, what size vehicles, if they take different routes and how the trucks move around town. Mr. Colefice can show detail. Mr. Greenburg would like them to look at vendor trips also.

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of the five members present unanimously:

VOTED: to continue the hearing to 6/17/25 at 7:45 p.m.

Ms. Newman would need the information by 6/3/25 in order to do an internal review if necessary.

Discussion: Beth Israel Deaconess Hospital-Needham (BIDN) to discuss the possibility of a revision to the Hospital's approved parking plan through the addition of a valet-only parking lot on property located at 14 and 20 Oak Street.

John Fogerty, President of Beth Israel Deaconess (BID) Hospital, noted many hospitals have closed in the last 5 years since Covid, which has had significant impacts on BID Needham. They are growing vibrant and parking is more of a challenge. This is a short term strategy so patients can find a parking spot. Two buildings will be demolished and the valet parking spots will be expanded. He feels this will provide minimum traffic disruption. Evans Huber, Attorney for the applicant, noted the proposed lot is on the other side of Chestnut Street. There are 2 residential structures not being used. Those will be demolished and replaced with a valet parking lot between Oak Street and Freeman Place. Freeman Place dead ends at the railroad so there is no through traffic. Nathan Turner, of Margulies Peruzzi, Architects, stated there is limited ability to park at 14 and 20 Oak Street. The project is using best practices for drive aisles and clearances. It would be a valet lot and not patients accessing their vehicles. This is only for patients and visitors.

Peter Dane, of Dane & Company, Inc., noted the front door is manned now by a parking company that assists patients. This lot will be adjunct. When the main lot fills, they will ferry cars over with professional attendants. Mr. Turner feels this could improve the Oak Street sidewalk conditions. Mr. Crocker clarified there is no entrance from Oak Street to the lot and was told there is no entrance. Mr. Block recognizes the important role the hospital plays as a community asset in town and the growth. There are 152 parking spaces on site and the hospital is looking to add 52 new spaces. He asked what the actual demand for parking is. Mr. Fogerty stated he has no figure. He just knows by sight that parking is incredibly tight. He feels the hospital would need to do more down the road. The demand is on the higher range of what he quoted. Mr. Block asked if the site is large enough to be future proofed by creating a second story. Mr. Dane stated the site is too small. He feels the demand currently is about 200. The 154 spaces are adequate on some days.

Mr. McCullen asked where people currently park if over capacity. Mr. Dane noted there are 3 spaces in the lot they can overload. Mr. Fogerty noted the volunteers can park on site and some OR staff. Employees park post site. Most are shuttled from Dedham or the church down the street. There is also another lot in Westwood. The employee parking is ok. They police the lots to make sure no one is parking there. Ms. Espada noted the 2 lots the hospital owns and commented people walk down the street to the center of town. What is the thought on the pedestrian experience if removing those houses? Mr. Huber stated this was designed so there is no entrance on Oak Street. Ms. Espada asked what the buffer is between the parking and the sidewalk. Mr. Huber stated the applicant is asking for substantial relief. This has been designed to maximize the number of cars. Mr. Dane noted it is important to remember that 100% of that stretch of Oak Street has cars parking along the perimeter of the street.

Mr. Crocker asked what width would be needed to add a vegetative buffer. Mr. Huber noted the applicant has come to the Board for comments. He asked how strict is the Board going to hold to the drive aisles? If double parking is not needed vegetation could be added. Ms. Espada understands the need for parking, but they do not need to make that street a parking lot. There needs to be the pedestrian experience and there needs to be a planting buffer to the sidewalk like at Sudbury Farms. Mr. Huber noted there are a row of spaces perpendicular to Oak Street and then dotted lines for parallel parking. There could be 8 feet of buffer but those spaces would be lost. The hospital does not see this as a long-term permanent solution. Mr. Fogerty stated the hospital is trying to maximize the parking they can get. There is a cost to use this lot in this way. If you take out spaces it impacts their ability to do this. They are trying to balance patient care with access. It is not a perfect solution but would help with pain points. Mr. McCullen appreciates with BID does for the town and they need to find a solution. The town needs to look at parking in general holistically. He asked if BID pays for permits in the municipal lots and how many. Mr. Fogerty stated they do have some spaces in the town lot. He does not know the number but it is not significant. He has a good relationship with the town and does not believe there is a problem.

Mr. Crocker commented if this is not permanent, he feels a buffer should be put between the parking and Oak Street. Mr. Fogerty stated they may do more back there some day but this lot would not be part of it. Eventually they will need a much more substantial parking area. The hospital is continuing to grow. The plan is to not have an acre of flat parking. Ms. Espada understands why they want to do this but they need to take into account the people walking. Mr. McCullen noted, for full disclosure, he lives near here and his kids walk down there. Mr. Block feels this is a reasonable use with a number of parking spaces. Mr. Huber noted it was designed to meet requirements for a drive aisle width. If spaces are moved away from Oak Street a waiver would probably be needed from drive aisle width. He asked if the Board would have flexibility from the width? Mr. Crocker has no problem if there are no safety issues. All agreed. Mr. Block asked what other relief is being requested. Mr. Huber noted handicap, bike racks, setback on the Freeman Street side and landscaping. Mr. Block does not have a problem with that relief. Mr. Crocker agreed.

Report from Planning Director and Board members

Ms. Newman noted the Large House Study Committee meets tomorrow night. They did a review of a number of houses on conforming lots. They will be reviewing that and planning the agenda for the 6/9/25 community meeting. That will involve a presentation of what the committee has done so far and will have an open microphone and a questionnaire. She has put together requests for proposal quotes to assist the Committee with modeling. She expects to get those back by the end of the month. She discussed the scope and adding the analysis of what the fiscal impact to the Town's revenue side would be. She is going to set up a meeting to discuss that scope. There will be a Chair and Vice-Chair meeting at Town Hall for the

Large House Committee that will include the Finance Committee and Planning Board to review the scope. Mr. Crocker noted the Tree Committee is having a public hearing on 6/4/25. Ms. Newman noted the MBTA Communities Act. She is filing the documents with the state so they are in compliance. She has reached out to DCR to get the Flood Plain Certification done and is closing out the grant under HONE.

Mr. McCullen commented on Envision. The Select Board had decided to hold a public hearing but put a hold on it prior to the meeting. Over 300 people were there and over 85 online. The majority opined about the feeling of the process and where they were. Envision met yesterday and went over the download of the hearing, where they want to go and to look at objectives. The Select Board has opinions and Business owners have opinions. They have a full committee now. They will meet again to see where the objectives are and move on from there. It will be a pilot and no one knows how big or small that would be. There will be a significant amount of engagement with a reboot.

Correspondence

Mr. Crocker noted an email from Chris Deleo, dated 4/30/25, with his opinion regarding the audit.

Upon a motion made by Mr. Block, and seconded by Mr. McCullen, it was by a vote of the five members present unanimously:

VOTED: to adjourn at 9:40 p.m.

Respectfully submitted,
Donna J. Kalinowski, Notetaker

Justin McCullen, Vice-Chairman and Clerk

Alexandra Clee

From: noreply@civicplus.com
Sent: Tuesday, June 3, 2025 7:55 PM
To: Alexandra Clee; Lee Newman; Elisa Litchman
Subject: Online Form Submittal: Contact Planning Board

Follow Up Flag: Follow up
Flag Status: Flagged

Contact Planning Board

Please use this form to contact the Planning Board. Thank you.

Contact Information

Full Name: Emily Pick

Email Address: Emilyrpick@msn.com

Address: 12 Mills Rd

City/Town: Needham

State: MA

Zip Code: 02494

Telephone Number: 617-784-2796

Comments / Questions

I'm infuriated by the fact that Bullfinch is coming before the planning board once again to change their plans. I was heavily involved and opposed to the construction of residential housing a few years ago, and I remain opposed to residential construction on the property today.

Furthermore, I'm mortified by the fact that the planning board continues to ignore local residential concerns about traffic mitigation on Highland Avenue. Furthermore I'm opposed to any retail development on that site that will draw more traffic on nights and weekends destroying what's left of quiet quality of life Needham Heights.

Furthermore, I need to ask what's in it for the resident of Needham Heights? Our taxes were just raised by 30% or more. Is this development going to compensate and offset my personal tax burden? Not only this year, but in future years or like typical cities and towns all over the country will my taxes

continue to increase exponentially.? There needs to be gives and gets.

To this day, it remains a challenge, crossing Highland Ave by foot anytime of day. This has been exacerbated by high-speed drivers merging off of 95 and even worse when those drivers need to shift lanes to the left. There is insufficient police to monitor the heavy traffic and the aggressive drivers who use Highland Avenue as a speedway..

Make no mistake. A large healthcare facility is being built within a few hundred feet of my home, and having another massive structure on the opposite corner will only reduce quality of life, but also make traffic congestion worse.

I'd like to remind the planning board that I raised the point years ago that there is no cohesive plan for Highland Avenue , and this piecemeal approach is destroying our quality of life.

Finally, our concerns typically get heavily ignored when we raise the red flag that our residential streets are becoming cut throughs for frustrated drivers.

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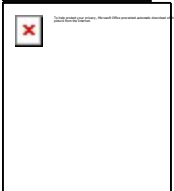
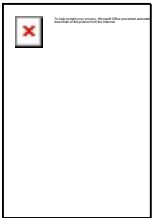
Alexandra Clee

From: Robin Zucker <kaszuckerdesign@gmail.com>
Sent: Wednesday, June 4, 2025 8:19 AM
To: Planning
Subject: Muzi website - pertinent information

1. There are already 2 hotels less than one mile away. Is a third needed or even sustainable? Consider the Indigo Hotel in Newton, now deserted and decaying.

2. I urge you to develop and design structures in proportion to the space and consider landscape design. We want to improve Needham, not just build huge buildings and become a 2nd Waltham.

All the best,
Robin Zucker



Kas Zucker Design + Marketing
339-225-1397

Alexandra Clee

From: BARBARA MCDONALD <oaklangley@gmail.com>
Sent: Friday, June 13, 2025 8:47 AM
To: Planning
Subject: Working Group Breakout Session

Dear Planning Board:

I would like to let you know that during my tables breakout session there were several of us in the group that do not want any significant changes made to the existing zoning at this time, without presenting hard data, and concrete examples detailing the specific issues.

We also recommend that the three groups tree committee, water mitigation committee, and large house review committee merge and form one group to review large houses as a whole, going forward.

Data and facts should be provided, as to what exactly the issues are that this group is trying to resolve. Specific examples of the complaints will help define the committees mission.

Regards,

Barbara McDonald

Sent from my iPhone