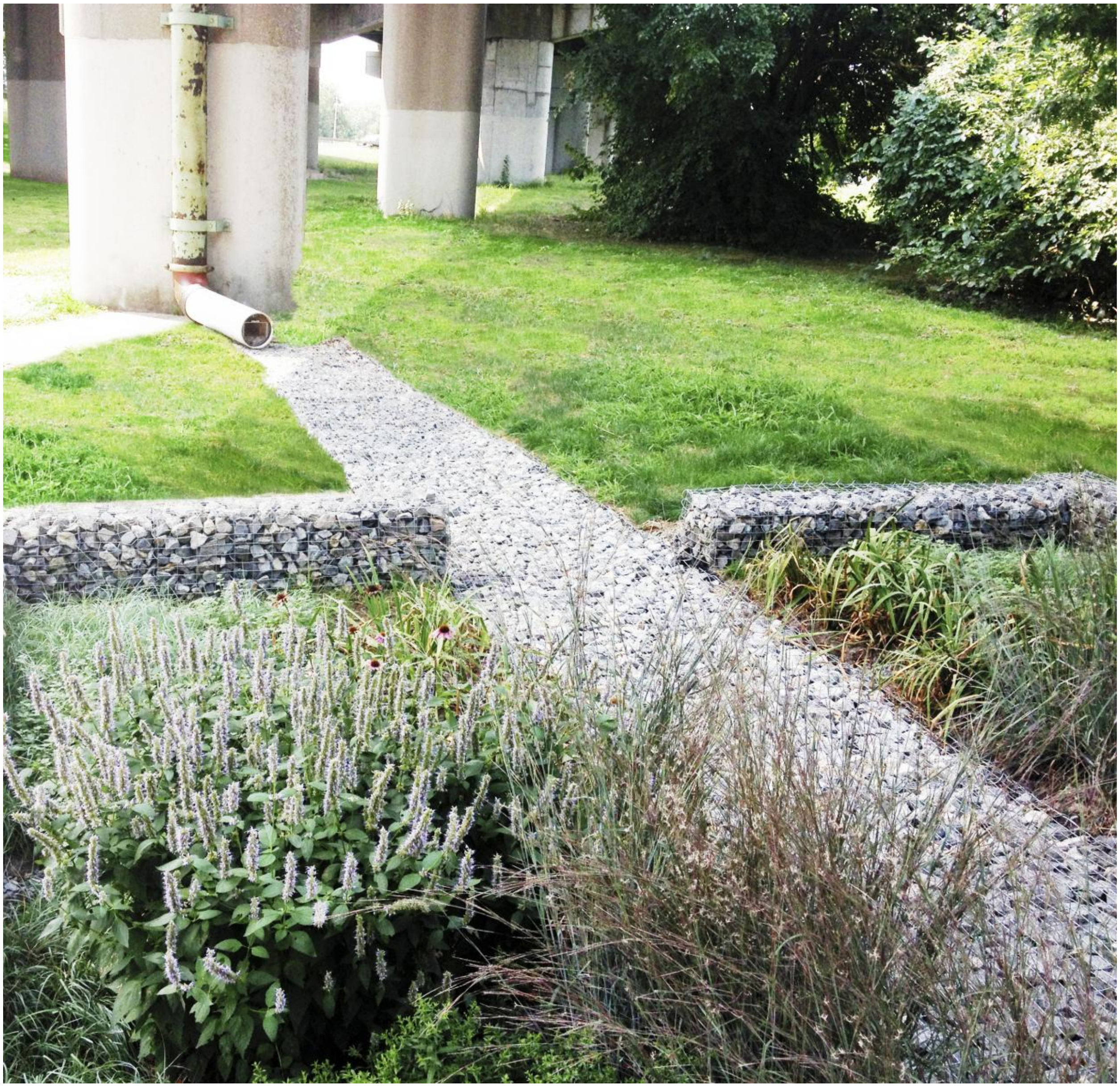
LI Sound Futures Fund 2011 - Planning - All Types - Submit Final Programmatic Report (Activities)
Grantee Organization: Regional Plan Association, Inc.
Project Title: Street Swale Infrastructure Initiative (NY)

Project Period	08/01/2011 - 07/31/2014
Award Amount	$59,935.00
Matching Contributions	$176,110.00
Project Location Description (from Proposal)	Flushing Creek in Queens, New York, where the Long Island Expressway and Van Wyck Expressway intersect in Flushing Meadows Corona Park. Latitude:N 40° 44' 34.3235" Longitude:W 73° 50' 14.8527"
Project Summary (from Proposal)	Planning and coordination required to install two bioretention basins that detain and filter 7,700 gallons of polluted stormwater annually flowing into Long Island Sound.
Summary of Accomplishments	RPA has worked with the consultant team to design the bioretention system to detain stormwater from the project site sub-watershed for the average 1.2” New York City storm. Construction and the planting of the bioremediative plants and soil media were completed in October of 2013. Concurrently, RPA and the consultant prepared a prospectus on the benefits of the bioretention system for use in approaching municipalities about opportunities for stormwater detention along the Long Island Sound shoreline, notably the renderings of the facility in Flushing Meadow Park. RPA developed a GIS model and conducted a preliminary assessment of the bioretention system’s applicability throughout the Long Island Sound shoreline, by considering publicly owned park lands with elevated highways and their proximity to impaired waterways, combined sewer outfalls, and priority ecological restoration sites. After completing the GIS analysis, RPA and the consultant contacted local partners in Bridgeport CT, Stamford CT, and NYC, as well as discussing the feasibility of the HOLD System at identified sites with representatives from ConnDOT and NYC Department of Parks and Recreation. RPA and the consultant visited seven potential sites in Connecticut and NYC with local partners, and summarized the GIS analysis and site visits in a final report.
Lessons Learned	Feasibility Assessment: The GIS methodology identified priority 58 areas to target green infrastructure projects located on public parkland, however we found that the methodology could be improved upon. Other publicly held lands (i.e. Department of Transportation right-of-ways) or other potential opportunities for future private developments could be included in the analysis in order to broaden the opportunities to roll out HOLD Systems at a larger scale. Monitoring and Maintenance: Unforeseen challenges with drainage monitoring equipment, and maintenance have taught it is critically important to budget a contingency of time and resources to account for unforeseen challenges. Also, long-term stewardship of the sites must be addressed. An additional assessment of potential stewardship entities and programs in the study area could help to advance the implementation at a larger scale. Implementation: Green infrastructure design must be flexible and able to be adapted to complex build environment. Challenges, including: permitting, existing drainage infrastructure, lighting, slope, water table, site ownership, etc., may detract from the cost/benefit and be a deterrent for municipalities or government agencies in choosing to implement

green infrastructure. In order to overcome these potential challenges, the responsible government agencies to need to adopt clean water and stormwater capture goals and prioritize green infrastructure as a tool in achieving those goals.

Conservation Activities Progress Measures activity Value at Grant Completion	Kick-off Meeting: Team Meeting and Site Visit # of workshops, webcasts, webinars, special events, meetings associated with 1
Conservation Activities Progress Measures Value at Grant Completion	Analysis/Schematic Design Other Activity Metric (# of Design Plans Created) 1
Conservation Activities Progress Measures Value at Grant Completion	Design Development: Monitoring Scheme/Quapp Preparation # of management plans created 1
Conservation Activities Progress Measures activity Value at Grant Completion	Design Development: Public Outreach # of workshops, webcasts, webinars, special events, meetings associated with 1
Conservation Activities Progress Measures Value at Grant Completion	Construction Documents and Cost Estimate # of management plans created 1
Conservation Activities Progress Measures Value at Grant Completion	Improve Road aesthetics Other Activity Metric (# of stakeholder groups who will benefit) 2
Conservation Activities significant quantities of street stormwater Progress Measures Value at Grant Completion	Develop new designs for bioretention basins that capture and remediate Other Activity Metric (# of approved new designs) 2
Conservation Activities Progress Measures stormwater bioretention basin) Value at Grant Completion	Monitoring Performance of Bioretention Basins Other Activity Metric (# of years of continuous performance data for 3
Conservation Activities Progress Measures identified) Value at Grant Completion	Long Island Sound Assessment Other Activity Metric (# of potential sites along Long Island Sound 12
Conservation Activities Progress Measures Value at Grant Completion	Preliminary Feasibility Assessment Other Activity Metric (# of potential sites) 3
Conservation Activities Progress Measures Value at Grant Completion	Meetings with local partners and landowners Other Activity Metric (# of meetings with local partners and landowners) 3
Conservation Activities applications Progress Measures Value at Grant Completion	Final report including pilot project design and Long Island Sound Other Activity Metric (# of reports published) 1




HOLD
SYSTEM
PROJECT TEAM
Regional Plan Association
dlandstudio architecture + landscape architecture, pllc
Weidlinger Associates
Manhattan College
F2 Environmental Design
PROJECT SUPPORT/FUNDING
New York City Department of Environmental Protection
New York City Department of Environmental Protection Gowanus Canal and Flushing
Bay and Creek Watershed Initiative Grant
Long Island Sound Futures Fund Grant
New York City Department of Parks and Recreation,
New York State Department of Transportation
WATERSHEDS + HIGHWAYS
IN URBAN AREAS
CURRENT CONDITION
HISTORIC CONDITIONS
SCUPPER 1
SCUPPER 2

Final Programmatic Report Narrative

Instructions: Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the on-line final programmatic report task as instructed.

1. Summary of Accomplishments
In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured.

RPA has worked with the consultant team to design the bioretention system to detain stormwater from the project site sub-watershed for the average 1.2" New York City storm. Construction and the planting of the bioremediative plants and soil media were completed in October of 2013. Concurrently, RPA and the consultant prepared a prospectus on the benefits of the bioretention system for use in approaching municipalities about opportunities for stormwater detention along the Long Island Sound shoreline, notably the renderings of the facility in Flushing Meadow Park. RPA developed a GIS model and conducted a preliminary assessment of the bioretention system's applicability throughout the Long Island Sound shoreline, by considering publicly owned park lands with elevated highways and their proximity to impaired waterways, combined sewer outfalls, and priority ecological restoration sites. After completing the GIS analysis, RPA and the consultant contacted local partners in Bridgeport CT, Stamford CT, and NYC, as well as discussing the feasibility of the HOLD System at identified sites with representatives from ConnDOT and NYC Department of Parks and Recreation. RPA and the consultant visited seven potential sites in Connecticut and NYC with local partners, and summarized the GIS analysis and site visits in a final report.

2. Project Activities & Outcomes

Activities -- *Note: Partially Completed tasks reflect the ongoing monitoring, which will run for a period of three years through October 2016.

Describe and quantify (using the approved metrics referenced in your grant agreement) the primary activities conducted during this grant.

- COMPLETED: RPA and the consultant team held a kick-off meeting, including a team meeting and site visit on May 6, 2011.

- COMPLETED: The consultant team completed the analysis of the existing site conditions and prepared a schematic design that would take water currently draining from the elevated section of the Long Island Expressway into the Flushing Creek at two points and instead direct it into bioretention basins that allow phytoremediation and soil filtration to cleanse the water before it ultimately is released for groundwater recharge. The consultant team's design considered findings from the survey, drainage assessment, soil analysis, and a review of existing data and studies on bioremediation. Using the above findings and plans, the consultant team completed layout, grading, and planting plans. All of these documents are found in **Appendix A: Flushing Pilot Sponge Swale Construction Documents**.

- *PARTIALLY COMPELETED: The consultant team collaborated to complete the monitoring scheme, as outlined in the United States Environmental Protection Agency Quality Assurance Project Plan (QAPP). The QAPP was submitted to Lynn Dwyer of National Fish and Wildlife Foundation on February 27, 2013. Monitoring will commence with construction completion in May 2013, and will run for a period of three years, through October 2016. The QAPP Submission is found in **Appendix B.**

- COMPLETED: Public outreach/part of "Design Development". The project team presented to the pilot project design to the Flushing Meadows Corona Park Coordinating Committee at a public meeting in Queens Borough Hall on June 10, 2011. The meeting was hosted by the office of the Queens Borough President.

- COMPLETED: Construction documents and cost estimate plans for the pilot project in Flushing Meadows Corona Park. Construction documents are found in **Appendix A**.

- COMPLETED: The project has successfully been constructed and planted, improving road aesthetics, specifically benefitting recreational users and visitors to the USTA Billie Jean King National Tennis Center and Hong Kong Dragon Boat Festival races on Meadow Lake in the park once the sites are planted this spring. Photographs of planted bioretention basins are found in **Appendix C.**

- COMPLETED: Develop new designs for bioretention basins that capture and remediate significant quantities of street stormwater. **See Appendix A.**

- *PARTIALLY COMPLETED: Monitoring performance of bioretention basins. RPA has developed the monitoring plan **(Appendix D)** and completed contracting with Manhattan College. Monitoring will run for a period of three years, through October 2016.

- COMPLETED: RPA has developed a GIS model and conducted an analysis identifying 58 potential sites along Long Island Sound where stormwater intervention are likely to succeed in mitigating stormwater runoff and combined sewer overflow (CSO) outfalls **(Appendix E).** The analysis:
    - Identifies public park lands with elevated highways
    - Assesses such lands for proximity to:
        - Impaired waterways
        - CSO outfalls
        - Priority ecological restoration sites

- COMPLETED: RPA, in collaboration with the consultant team, has created a prospectus for municipalities with potential sites along the Long Island Sound shoreline. This prospectus illustrates the design of the bioretention basins, explains the opportunities and challenges of such systems, and outlines the steps for beginning a project in their community. The prospectus was given to local partners in anticipation of phone calls and meetings to help guide the dialog about the feasibility of the bioretention basins **(Appendix F).**

- COMPLETED: Meeting with local partners and investigation/assessment of additional sites. RPA and the consultant had in-depth phone conversations regarding potential identified sites with Milton Puryear (Executive Director, Mill River Park Collaborative), Davey Ives (Environmental Projects Coordinator, City of Bridgeport CT), John Mattera (Senor Project Planner, NYC Department of Parks and Recreation), and Paul Corrente (Transportation Supervising Planner, ConnDOT). RPA and the consultant visited seven sites in Connecticut and NYC per the local partners advise. Davey Ives accompanied the team to various Bridgeport, CT sites.

- COMPLETED: Project and site analysis report. RPA and the consultant compiled a project overview, GIS analysis, and site visit findings into a final report **(Appendix E).**

Briefly explain discrepancies between the activities conducted during the grant and the activities agreed upon in your grant agreement.

- **Construction**: Because of site complications such as drainage and limited lighting, only two of the three planned bioretention basins in Flushing Meadows Corona Park were deemed to be feasible and constructed. The bioretention basins were constructed slightly behind schedule due to a variety of factors including delays in obtaining needed permissions from state and local authorities, inclement weather in the fall and winter that sidelined contractors and created difficulty in obtaining required soil.

- **Monitoring Challenges**: As a result of construction delays the monitoring and documentation of costs and benefits was also delayed. Monitoring began in May of 2014. However, because of challenges with the monitoring equipment the team has been able to only gauge initial precipitation and outflow rates from one of the basins. The inflow monitoring equipment has not been functioning properly and the other basin has not shown consistent outflow results due to drainage complications. The team is currently working to rectify these issues. In spite of these challenges the team is committed to completing 3 years of consistent monitoring, which are submitted in monthly and quarterly reports to NYCDEP.

- **Long Island Sound Feasibility Assessment:** RPA completed and ran the model to identify other feasible sites in winter of 2013-2014. The goal of the model was to identify three potential sites and begin conducting outreach with local partners. While the GIS and Google Earth analysis was able to identify target areas (58 potential sites total), the on-the-ground site visits (seven total) and discussions with local partners enabled us to observe site conditions critical to the feasibility of the HOLD System (i.e. slope, drainage, downspout quality, sun light, etc.). Further, local partners pointed out other potential siting opportunities, such as on-going local conservation initiatives, private developments and other publicly owned sites that were not identified in the GIS analysis.

Outcomes

Describe and quantify progress towards achieving the project outcomes described in your grant agreement. Briefly explain discrepancies between what actually happened compared to what was anticipated to happen. Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.

- **Construction, Monitoring and Results:** The consultant team successfully designed and constructed two bioretention basins in Flushing Meadows Park, which are currently being monitored per QAPP standards. The basins have been planted with resilient native plant communities that have increased the aesthetic value of this section of Flushing Meadows Corona Park under the elevated highway. The team is committed to monitoring the basins for a period of three years. To date, the team has collected reliable precipitation and outflow data from one basin for 5 months. Due to monitoring equipment and drainage issues that are currently be rectified, the team has not been able to accurately calculate levels of contamination being remediated by the basins. However, in one basin the team has been able to accurately observe that little (if any) water is flowing out of the basin. This finding implies that the basin's soil and plant life is capturing nearly all of the downspouts stormwater runoff.

  While the team has yet to analyze soil/sediment and water samples for contamination levels, we anticipate that roughly 11,400 square feet of impervious highway surfaces is being managed via bioretention systems. Once the inflow and outflow issues are addressed we will be able to accurately gauge the fiscal and environmental gains created by the bioretention basins.

- **Long Island Sound Feasibility Assessment:** RPA developed a methodology and conducted a GIS analysis of other potential feasible sites where the HOLD System could be implemented in the Long Island Sound. The analysis targets public parklands under elevated highway systems in critical areas for habitat restoration. The GIS analysis identified 58 potential sites, which were narrowed down using Google Earth, to 11 top sites. RPA reached out to several local partners and agency representatives to discuss the feasibility of these sites as well as other potential unidentified sites. RPA and the consultant team visited seven sites in Connecticut and New York City and deemed three sites to be feasible **(See Appendix F).**

  The process of engaging with local partners and public agency representatives reiterated the fact that managing overpass highway stormwater runoff is a pervasive issue throughout the Long Island Sound. Further, the broad implementation of green infrastructure in general, not only the HOLD Systems, could drastically help reduce water treatment costs, and improve habitat and water quality. However, each site is limited by a number of variables, including: Space, surrounding environment, land ownership, permitting, and entity responsible for long-term maintenance. The broad implementation of such projects will require substantial vision by property owners, political leaders, and responsible public entities.

Through our engagement process the consultant (dland Studio) made a valuable connection with Davey Ives, the Environmental Projects Coordinator, City of Bridgeport CT. Currently dland Studio and the City of Bridgeport are partnering to pursue bioretention green infrastructure projects in the City of Bridgeport.

3. Lessons Learned

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt their projects to build upon some of these key lessons about what worked best and what did not?

- **Long Island Sound Feasibility Assessment:** RPA conducted a GIS analysis that identified and 58 potentially feasible sites under elevated highways based on the sites' relationship to priority ecological areas, urban water quality issues, and public parkland (**Appendix-E**). The sites that met these criteria were then analyzed using Google Earth, and the top sites were visited to observe other constraints of implementation. While this methodology identified priority areas to target green infrastructure projects and is replicable, we found that the methodology could be improved upon.

  The analysis considered sites located on public parkland with the rationale that the maintenance of the bioretention basins at these sites could be included into the parks' operations and maintenance schedules. However, local partners pointed out a number of additional potential sites located on other public property, or that could be included as a part of private redevelopment. Other publicly held lands (i.e. Department of Transportation right-of-ways) or other potential opportunities for future private developments could be included in the analysis in order to broaden the opportunities to roll out HOLD Systems at a larger scale.

- **Monitoring and Maintenance:** Unforeseen challenges with drainage and monitoring equipment have arisen and delayed the collection of accurate results for the project. The team is currently working to address these issues in order to capture three years data and gauge the effectiveness of the basins. These challenges have taught us that in a pilot project it is critically important to budget a contingency of time and resources to account for unforeseen challenges, such as equipment malfunction, in order to meet monitoring requirements and deadlines. While the results are still inconclusive, our initial observations show that the bioretention basins capture a significant amount of stormwater runoff, which leads us to believe that the basins will be effective in capturing runoff from 11,400 square feet of impervious highway surfaces.

  Unforeseen maintenance challenges have also arisen including, the theft of some of the attractive native plants, and vermin issues. Currently the team is addressing these issues, but the pilot project assumes that the NYC Department of Parks and Recreation will be responsible for the long-term maintenance of the basins beyond the three-year monitoring period. If the other sites, beyond public parkland sites are to be considered, long-term stewardship must be addressed. An additional assessment of potential stewardship entities and programs in the study area could help to advance the implementation of HOLD Systems at a larger scale.

- **Implementation:** Green infrastructure is an effective tool for stormwater remediation. However, green infrastructure design must be flexible and able to be adapted to complex build environment. The HOLD System pilot project proposed three different designs to address a specific stormwater challenge of elevated highway runoff. Because our elevated roadways have been constructed through complex urban environments each site will pose it's own challenges, including: permitting, existing drainage infrastructure, lighting, slope, water table, site ownership, etc. For example, three sites where originally designed for the Flushing Meadows Pilot project, but one was ultimately deemed unfeasible due to drainage, lighting, and space issues.

  Further, during the site visits we observed that many highway drainage systems would require substantial improvements to the existing drainage infrastructure before implementing bioretention basins. These addition costs may detract from the cost/benefit and be a deterrent for municipalities or government agencies in choosing to implement green infrastructure. Additionally, the government agency representatives that we spoke to voiced concerns regarding the potential permitting required to implement HOLD Systems. In order to overcome these potential challenges, the responsible government agencies to need to adopt clean water and stormwater capture goals and prioritize green infrastructure as a tool in achieving those goals.

4. Dissemination

Briefly identify any dissemination of lessons learned or other project results to external audiences, such as the public or other conservation organizations.

- Over the next few months, RPA will work with Long Island Sound Futures Fund, NYC Department of Environmental Protection Water Infrastructure Steering Committee, and Harbor Estuary Program to disseminate the HOLD System Design Prospectus created by dland Studio and the Long Island Sound site feasibility assessment to their respective networks (Appendix F and G).

5. Project Documents

Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi and must be accompanied with a legend or caption describing the file name and content of the photos;
- report publications, GIS data, brochures, videos, outreach tools, press releases, media coverage;
- any project deliverables per the terms of your grant agreement.

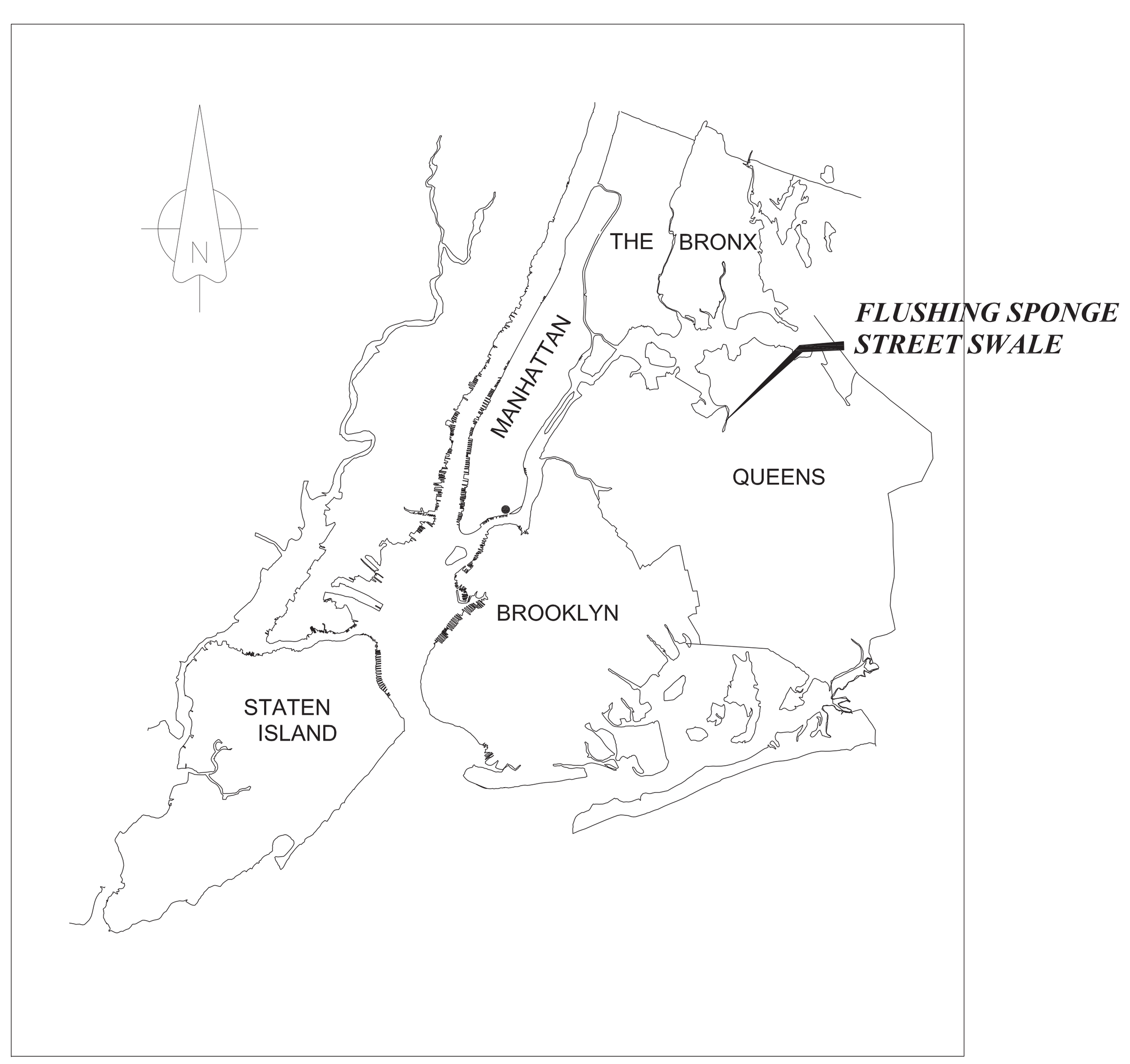
See Attached Appendices:

Appendix-A: Flushing Pilot Sponge Swale Drawings.pdf
Appendix-B: RPA WQ Monitoring QAPP.pdf
Appendix-C: CompletedHoldSystem_Photos.pdf
Appendix-D: HOLDSystem_MonitoringPlan.pdf
Appendix-E: Site Assessment-Report.pdf
Appendix-F: HOLD-System_Prospectus.pdf
Appendix-G: QueensChronicleArticle_07152010.pdf
Appendix-H: HOLDSystem_PhotosPackage.zip

CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENVIRONMENTAL ENGINEERING

FLUSHING PILOT SPONGE SWALE

BOROUGH OF QUEENS
APRIL 16, 2012



KEY PLAN

WARNING
CONTRACT DOCUMENTS NOT TO SCALE

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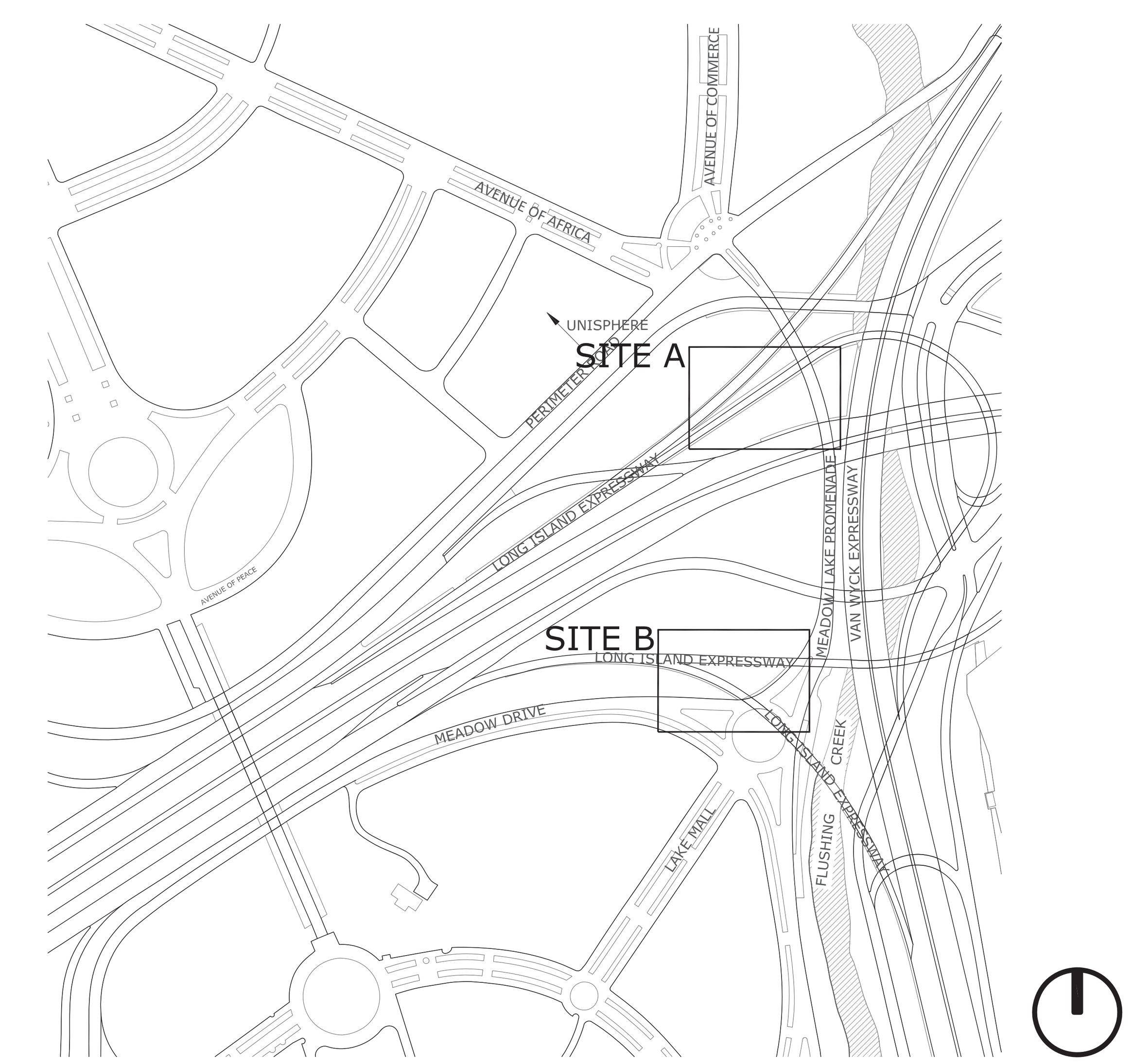

LOCATION PLAN

P.E.
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DIRECTOR, IN-HOUSE DESIGN
BUREAU OF ENVIRONMENTAL ENGINEERING

P.E.
MICHAEL BORSYKOWSKY, P.E.
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FIRST PUTY COMMISSIONER
DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT DRAWINGS

DRAWING INDEX - FLUSHING MEADOWS PILOT SPONGE SWALE

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L-101.1	SITE A SCUPPER 1 GRADING PLAN
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L-200.1	SITE A SCUPPER 1 SECTIONS
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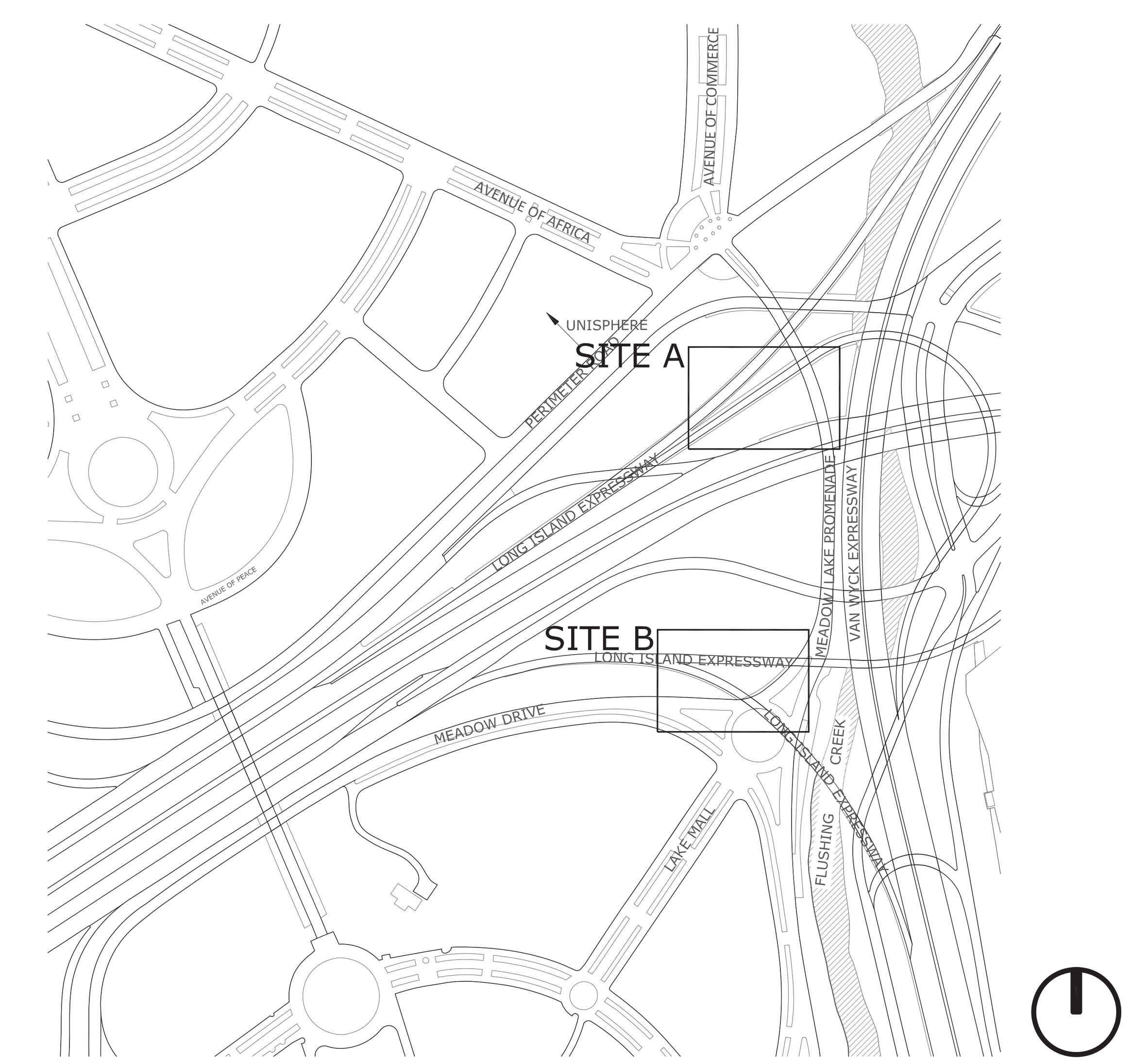
L-300.3	SITE B SCUPPER 3 DETAILS
L-301.1	MONITORING EQUIPMENT DETAILS

SHEET	TITLE
C-100	EXISTING SURVEY SITE A
C-200	EXISTING SURVEY SITE B
C-102.1	SITE A WATER CALCULATIONS & LOCATION PLAN
C-102.2	SITE B WATER CALCULATIONS & LOCATION PLAN



1 LOCATION PLAN
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NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: NA

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

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THE CITY OF NEW YORK
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE

INDEX

DATE: APRIL 16, 2012
DWG. NO.: 1 OF: 22
SHEET NO: G-000.2 OF:

CONTRACT DRAWINGS

GENERAL NOTES AND LEGEND

FLUSHING MEADOWS PILOT SPONGE SWALE

LEGEND

SYMBOLS AND ABBREVIATIONS

℄	CENTER LINE
Ø	DIAMETER
TYP	TYPICAL
VIF	CONTRACTOR SHALL VERIFY LOCATION IN FIELD
DWG	DRAWINGS
NIC	NOT IN CONTRACT
R	RADIUS
S.S.	STAINLESS STEEL
O.C.	ON CENTER
±	PLUS OR MINUS, APPROXIMATE DIMENSION
SIM	SIMILAR
O.D.	OUTSIDE DIAMETER

GRADING LEGEND

(X) XX X.XX	SPOT GRADE
X %	SLOPE

GRADING ABBREVIATIONS

TC	TOP OF CURB
BC	BOTTOM OF CURB
TW	TOP OF WALL
BW	BOTTOM OF WALL
GRT	ELEVATION OF GRATE
RIM	ELEVATION OF TOP OF RIM
W.L.	ELEVATION OF WATER IN PIPE
BOT	ELEVATION OF BOTTOM OF PIPE
INV	ELEVATION OF INVERT

GENERAL NOTES

1. The existing conditions were compiled from base plans of the site prepared for Weidlinger Associates, dated August 17, 2011, prepared by Control Point Associates, Inc. Although every effort has been made to accurately locate all conditions, actual conditions may vary from those shown. The Contractor shall make a full review of all existing conditions of the site and shall report discrepancies to the Landscape Architect before starting work. The Contractor shall assume responsibility for actual conditions as they exist on site.
2. The Contractor shall familiarize himself with all utilities above grade, at grade, and underground, including utility pipes and structures. The Contractor shall verify with the Utility Companies the locations of all utilities prior to the start of construction. The Contractor shall take sole responsibility for the cost incurred due to damage and replacement of all utilities on the site. The Contractor shall contact New York City One Call Center at 800-272-4480 to field locate all utilities before starting work.

SITE PREPARATION NOTES

1. The Landscape Architect and the Owner shall review the site and approve the extent of site preparation before any site preparation is started. Prior to construction the Contractor, Landscape Architect and Owner shall arrange a pre-construction meeting on site. The Contractor shall verify all items to be removed with the Landscape Architect and Owner prior to disposal. Existing materials designated for salvage by the Owner, Landscape Architect, or Contractor, shall be stockpiled or stored in locations approved by the Landscape Architect and the Owner. The Contractor shall protect all materials designated to remain and shall be solely responsible for replacement of any materials so designated that are damaged during construction. The extent of replacement and/or repair to damaged items or work shall be determined by the Landscape Architect and to the Owner's satisfaction.
2. The Contractor shall clear and remove all organic matter, debris and rubbish from the job site not designated for salvage or relocation. The removal of such items shall be done in a manner so as not to damage items and vegetation to remain. The Contractor shall dispose of said materials in a legal manner as approved by the Landscape Architect.
3. No paint shall be applied to site elements or vegetation designated to remain. The Contractor shall review the method of marking site elements and vegetation to remain with the Landscape Architect prior to beginning construction.
4. Impacts on vegetation to remain during construction are to be kept to a minimum. Tree protection fences shall be erected at the edge of the tree canopies in designated areas prior to the start of construction. The fences shall remain in place for the duration of construction. Use a standard 4' high orange reflective-type snow fence. Metal posts for supporting fence shall be driven a minimum of 2' into the ground. The tree protection fence should be a minimum of 8' away from the tree trunk. The Contractor shall review with the Owner and Landscape Architect the areas of construction operations, including proposed vehicular construction operations, stockpiling of materials, and areas of construction operations of associated contracts on the site prior to commencement of construction. All fences to protect vegetation, straw bales or other systems to protect wetland and salt marsh, are to be installed before construction and shall be maintained during construction.
5. The Contractor shall be responsible for visiting the site to determine the extent of demolition, preparation, and removals necessary (whether shown on the Drawings or not) to construct the proposed site improvements. The Contractor shall report, in writing, any discrepancies between the existing and proposed work to the Landscape Architect and Owner prior to proceeding with construction. Failure to inspect, notice, or report these discrepancies prior to construction shall not relieve the Contractor from his responsibility to perform the necessary operation for the successful completion of the proposed improvements.
6. All existing utilities shall remain and be protected.
7. Limits of the work area shall be identified and staked prior to the start of construction. Siltation fence and strawbales shall be installed around the perimeter of the wetland, salt marsh and work areas, as shown on the Drawing.
8. Siltation fence shall be AMOCO 1380 Siltation Fabric, or approved equivalent. Posts shall be 2 x 2 hardwood or metal. Wire fabric shall be 4" x 4" mesh, 12 gage minimum. Strawbales shall be clean, weed-free, seed-free straw or hay. Contractor shall confirm that materials conform to all applicable regulations of all agencies having jurisdiction over waterway protection. Siltation fence and strawbales shall remain in place during construction. Contractor shall review with landscape architect the layout of strawbales and siltation fence.

LAYOUT AND MATERIALS NOTES

1. Use dimensional information given. Do not scale Drawings.
2. The Contractor shall verify dimensions shown on the Drawings and notify the Landscape Architect of any discrepancies prior to the start of construction. The Contractor shall review and obtain the approval of the final layout with the Landscape Architect prior to starting construction. If requested by the Landscape Architect the Contractor shall stake out proposed tree locations to aid in the review of the final layout of site elements.
3. The Contractor shall refer any questions on materials, finishes, labor and/or products not specified herein to the Landscape Architect, prior to ordering materials or starting work.
4. All lines and dimensions are parallel or perpendicular to the lines from which they are measured unless otherwise shown.
5. Shop Drawings: Shop Drawings shall show all details including sizes, materials, quantities and manner of assembling the various members, properly coordinated with the related work. Shop Drawings shall show true profiles, methods of anchoring hardware, if any, and all other necessary information. Work includes stone walls, both types.
6. Field Measurements: Take accurate field measurement before preparation of Shop Drawings and fabrication. Do not delay job progress.

GRADING NOTES

1. The Contractor shall lay out and determine the elevations of all site elements for approval by the Landscape Architect prior to the start of construction.
2. The Contractor shall be responsible for positive surface drainage in all areas. All newly graded ground surfaces shall be finished to uniform grades and sloped in such a manner as to drain properly and be free of depressions which cause areas of standing water. The Contractor shall report any conflicts with this requirement to the Landscape Architect for resolution prior to final grading operations.
3. Where proposed grades meet existing, blend grades to provide a smooth transition between the new work and the existing work. Ponding at joints will not be accepted.
4. Grading within the drip lines of existing trees to remain shall be done by hand to avoid damage to tree roots.
5. The Contractor shall lay out and determine the elevations of all site elements and proposed utilities for approval by the Landscape Architect prior to the start of construction. The Contractor shall report any conflicts between surface utility structures and proposed improvements to the Landscape Architect.

LAWNS, AND FINE GRADING

1. Grass Sod: Provide strongly rooted, mature, vigorous, healthy, commercially grown grass sod not less than 2 years old and free of weeds, insects, diseases, stone, other grasses, and other deleterious matter.
2. Sod shall be harvested, delivered and installed within a period of 36 hours. Sod not transplanted within this period shall be inspected and approved by the Landscape Architect prior to its installation. Contractor shall be responsible for protection of unplanted sod from heat and wind. Soil on sod pads shall be kept moist at all times.
3. Disturbed existing lawn areas shall be loamed and sodded according to the details above and only after written approval of the finished grading or as directed by the Landscape Architect.
4. Planting season shall be from April 15 to June 1 and from September 1 to November 1. The actual planting of sod shall be done, however, only during periods within this season which are normal for such work as determined by weather conditions and by accepted practice in this locality. At his option and on his responsibility the Contractor may plant sod under unseasonable conditions without compensation but subject to Landscape Architect's approval as to time and methods.
5. The soil on which the sod is laid shall be reasonably moist and scarified with rakes, and shall be watered, if directed by the Landscape Architect. The sod shall be laid smoothly, edge to edge, and where continuous or solid sodding is called for on the plans sod shall be laid with the longest dimension parallel to the contours. Sodding shall start at the base of slopes and progress upward in continuous parallel rows. Vertical joints between sods shall be staggered. Immediately after laying, sod shall be pressed firmly into contact with the sod bed by tamping, rolling, or by other approved methods so as to eliminate all air pockets, provide true and even surfaces, insure knitting and protect all exposed sod edges, but without displacement of the sod or deformation of the sod surface. Sod surface shall be smooth and free of depressions or lumps, and without gaps, seams or bare patches. The sodded areas shall be watered evenly and at a rate of five gallons per square yard, unless otherwise directed by the Landscape Architect.
6. Do not handle loam or subsoil if it is wet or frozen.
7. Fine Grading: Set sufficient grade stakes for checking the finished grades. Stakes must be set at the bottom and top of slopes. Grades shall be established which are accurate to 1/10th of a foot either way. Connect contours and spot elevations with an even slope. All grading will insure drainage away from structures.
8. Fine grade lawn areas to smooth, free draining, even surfaces with fine texture. Roll, rake, and drag lawn areas to flatten ridges and fill depressions, except as select areas shown on the Drawings. Control moisture content to maintain optimum conditions, but do not create a muddy condition.
9. Watering: Water seed thoroughly at the rate of 5 gallons per square yard with a fine spray immediately after laying. Roll with light lawn roller to ensure contact with sub-grade.

PLANTING MATERIALS

1. Any proposed substitutions of plant species will be with plants with equivalent overall form, height, branching habit, flower color, leaf color, fruit color, and time of bloom, as approved by the Landscape Architect.
2. Soil Specifications: Provide soil according to the soil profile detailed in the specifications.
3. Bark Mulch: Provide partially decomposed minimum six month aged finely shredded pine bark mulch with dark brown color and free of excessive fine particles, stringy material, and chunks of wood thicker than 1/4".

PLANTING INSTALLATION

1. All plants will be tagged by the Landscape Architect in the nursery prior to digging, or otherwise approved by the Owner's Representative prior to arrival at the site. The Owner's Representative reserves the right to reject plant material at the nursery or at the site.
2. The Landscape Contractor shall stake the location of all proposed plant material for approval by the Landscape Architect prior to planting. No plants shall be planted before the acceptance of rough grading.
3. Keep root balls intact prior to and during planting operations. Plants with broken or damaged root balls shall be rejected and immediately removed from the site. Keep root balls damp and protected from damage due to sun and wind.
4. Container Stock Planting: Plant container grown stock the same as specified for balled and burlapped stock, but remove containers completely.
5. Obstructions: If obstructions or other conditions detrimental to healthy plant growth are encountered, notify Landscape Architect immediately and request additional instructions.
6. Watering and Drainage: Fill excavations with water and allow water to percolate out before planting. If planting pits do not percolate or drain properly, notify Landscape Architect and request additional instructions prior to planting. Do not plant into poorly draining planting pits; poorly draining planting pits may hold water and drown plants.
7. Watering: Flood all plants with water twice within the first 24 hours after planting.
8. All plant material shall be mulched after planting.
9. Pruning and Shaping: Prune, thin out and shape plants in compliance with American Association of Nurserymen, Horticultural Standards to preserve the natural character and only as approved by the Landscape Architect. Retain required height and spread. Do not alter shape and do not cut leaders. Remove all dead wood, suckers, broken or bruised branches, and crossing branches.

PLANTING MAINTENANCE AND WARRANTY

1. All plants shall be maintained by the Landscape Contractor from date of planting until date of acceptanc which is anticipated to be approximately six weeks from planting.This maintenance will involve watering as necessary to create a well developed root system throughout the soil.
2. Warranty: Provide written warranty agreeing to remove and replace plants and work which exhibits defects in materials or workmanship for one year from date of acceptance. "Defects" is defined to include, but is not limited to, death, unsatisfactory growth, disease, abnormal foliage density, abnormal size, abnormal color, failure to thrive, and other unsatisfactory characteristics. Replace each defective plant or work with new plants or work of same species, size, character, and quality of originally accepted work.
3. Maintenance period for plants and lawns, including watering, shall be as follows: 42 Days
4. Warrenty period for plants shall be as follows: Two (2) years from date of final acceptance.
5. Following the two year warranty period, the contractor will replace any failed plants with either a new plant of the same species or a new plant of a different species as directed by the Landscape Architect. The requirement of maintaining plants until acceptance will apply to these new plants.
6. Contractor will remove the monitoring equipment following the three year monitoring phase.

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio LLC
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: NA

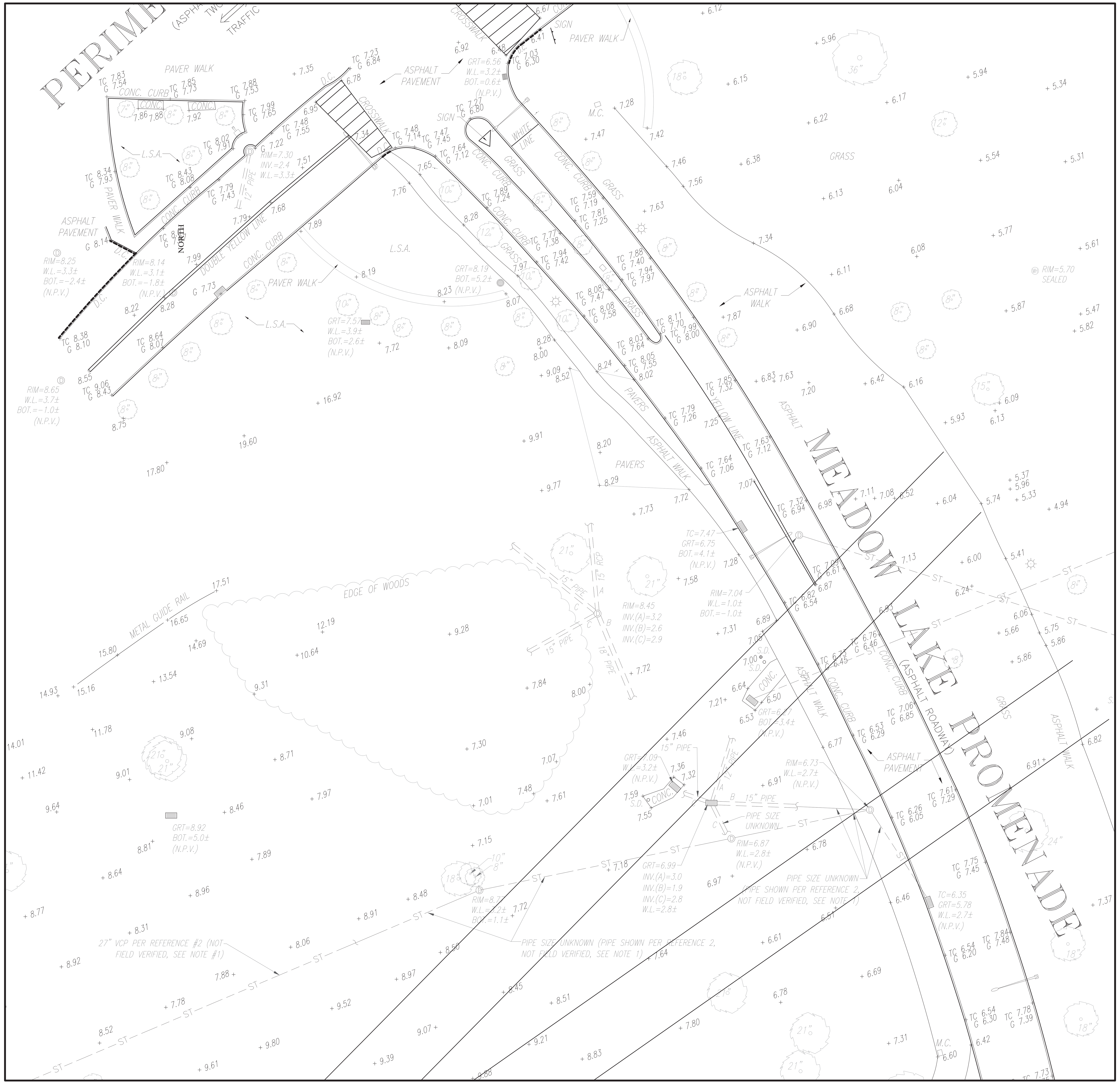
PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

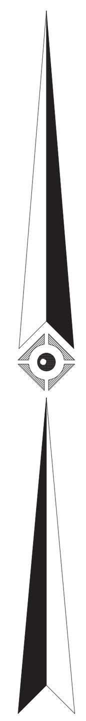
THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE

GENERAL NOTES AND LEGEND

DATE: APRIL 16, 2012
DWG. NO.: 2 OF: 22
SHEET NO.: G-000.3 OF:





NOTES:

1. LOCATION OF UNDERGROUND UTILITIES ARE APPROXIMATE. ALL LOCATIONS AND SIZES ARE BASED ON UTILITY MARK-OUTS, ABOVE GROUND STRUCTURES THAT WERE VISIBLE & ACCESSIBLE IN THE FIELD, AND THE MAPS AS LISTED IN THE REFERENCES AVAILABLE AT THE TIME OF THE SURVEY. AVAILABLE ASBUILT PLANS AND UTILITY MARKOUT DOES NOT ENSURE MAPPING OF ALL UNDERGROUND UTILITIES AND STRUCTURES. BEFORE ANY EXCAVATION IS TO BEGIN, ALL UNDERGROUND UTILITIES SHOULD BE VERIFIED AS TO THEIR LOCATION, SIZE AND TYPE BY THE PROPER UTILITY COMPANIES. CONTROL POINT ASSOCIATES, INC. DOES NOT GUARANTEE THE UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA EITHER IN SERVICE OR ABANDONED.
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3. THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND IS SUBJECT TO THE RESTRICTIONS, COVENANTS AND/OR EASEMENTS THAT MAY BE CONTAINED THEREIN.
4. BY GRAPHIC PLOTTING ONLY PROPERTY IS LOCATED IN FLOOD HAZARD ZONE AE (BAS FLOOD ELEVATIONS DETERMINED EL.=13) PER REF. 1
5. UNDERGROUND TANK SIZES WERE OBTAINED FROM INFORMATION RECEIVED FROM STATION MANAGER OR EMPLOYEE. ALL SIZES AND LOCATIONS ARE APPROXIMATE & ARE SUBJECT TO FIELD VERIFICATION
6. ELEVATIONS ARE BASED UPON GPS OBSERVATIONS DATUM IS N.A.V.D. 88.
7. THE OFFSETS SHOWN ARE NOT TO BE USED FOR THE CONSTRUCTION OF ANY STRUCTURE, FENCE, PERMANENT ADDITION, ETC.

REFERENCES:

1. MAP ENTITLED "NATIONAL FLOOD INSURANCE PROGRAM, FIRM, FLOOD INSURANCE RATE MAP, CITY OF NEW YORK, NEW YORK, BRONX RICHMOND, NEW YORK, QUEENS, AND KINGS COUNTIES, PANEL 227 OF 457". MAP NUMBER 3604970227F, MAP REVISED SEPTEMBER 5, 2007.
2. MAP ENTITLED "QUEENS SEWER MAP, NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION BUREAU OF WATER AND SEWER OPERATIONS", SHEETS 220Q, 221Q, 222Q, 228Q, & 260Q. PREPARED BY BAKER ENGINEERING NY, INC., MAP UPDATED 8/21/2008.

UTILITIES:

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SERIAL NUMBER: 111720331

UTILITY COMPANY	PHONE NUMBER
TIME WARNER NYC BROOKLYN	718-840-4252
TIME WARNER NYC QUEENS	718-888-4252

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

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NEW YORK CITY ONE CALL CENTER 1-800-272-4480 STOP-CALL-THEN Dig Safely

LEGEND

- - 123 - -	EXISTING CONTOUR
x 123.45	EXISTING SPOT ELEVATION
x TC 123.45	EXIST. TOP OF CURB ELEVATION
x G 123.45	EXIST. GUTTER ELEVATION
x TW 123.45	EXIST. TOP OF WALL ELEVATION
x BW 123.45	EXIST. BOTTOM OF WALL ELEVATION
WV	WATER VALVE
OH	OVERHEAD WIRES
— ST —	APPROX. LOC. UNDERGROUND STORM LINE PER REFERENCE #2 (NOT FIELD VERIFIED, SEE NOTE 1)
	SIGN
	BOLLARD
L.S.A.	LANDSCAPED AREA
	AREA LIGHT
	STREET LIGHT
	INLETS
	STORM MANHOLE
	WATER MANHOLE
	UNKNOWN MANHOLE
	FIRE HYDRANT
	PARKING SPACE COUNT
C.L.F.	CHAIN LINK FENCE
N.P.V.	NO PIPES VISIBLE
CONC.	CONCRETE
D.C.	DEPRESSED CURB
M.C.	METAL COVER
E.O.P.	EDGE OF PAVEMENT
F.W.D.	FILLED W/ DIRT/DEBRIS
W.L.	WATER LINE
S.D.	SCUPPER DRAIN
VCP	VITRIFIED CLAY PIPE
RCP	REINFORCED CONCRETE PIPE
DIP	DUCTILE IRON PIPE

PREPARED BY:

CONTROL POINT ASSOCIATES, INC.
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CHALFONT, PA 215.712.9800
SOUTHBOROUGH, MA 508.948.3000

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

PROJECT NAME

FLUSHING MEADOWS CORONA PARK

BOROUGH & COUNTY OF QUEENS
CITY & STATE OF NEW YORK

DRAWING TITLE

PARTIAL TOPOGRAPHIC SURVEY

SEAL & SIGNATURE

JAMES C. WEED
NEW YORK PROFESSIONAL LAND SURVEYOR

NOT VALID UNTIL SEALED

FIELD DATE:	8/17/2011
FIELD BK:	11-14
F. B. PAGE:	120-124
DATE:	9/7/2011
SCALE:	1"=30'
PROJECT No:	C11209
DRAWING BY:	INDO/C.R.
CHK BY:	J.R.
APPROVED BY:	J.C.W.
DWG No:	V-001.0
CAD FILE No: C11209ASB	PAGE No: 1 OF 2

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY:
DESIGNED BY:
CHECKED BY:
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 1"=30'-0"

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

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THE CITY OF NEW YORK
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

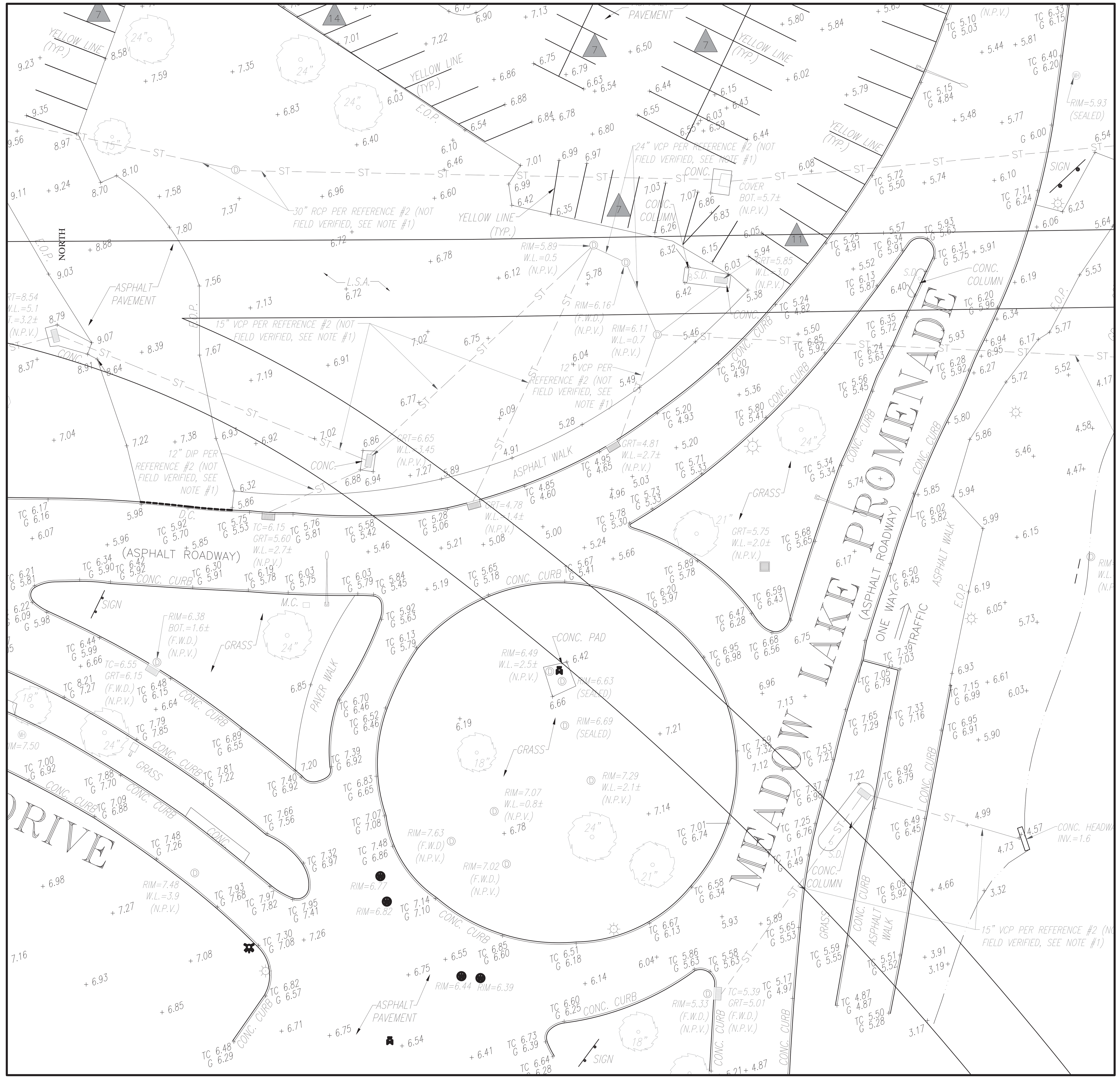
FLUSHING MEADOWS PILOT SPONGE SWALE

EXISTING SURVEY SITE A

DRAFT NOT FOR CONSTRUCTION

DATE: APRIL 16, 2012

DWG. NO.: 3	SHEET NO: C-100.1
OF: 22	OF:



LEGEND

- EXISTING CONTOUR
- EXISTING SPOT ELEVATION
- EXIST. TOP OF CURB ELEVATION
- EXIST. GUTTER ELEVATION
- EXIST. TOP OF WALL ELEVATION
- EXIST. BOTTOM OF WALL ELEVATION
- WATER VALVE
- OVERHEAD WIRES
- APPROX. LOC. UNDERGROUND STORM LINE PER REFERENCE #2 (NOT FIELD VERIFIED, SEE NOTE 1)
- SIGN
- BOLLARD
- L.S.A. LANDSCAPED AREA
- AREA LIGHT
- STREET LIGHT
- INLETS
- STORM MANHOLE
- WATER MANHOLE
- UNKNOWN MANHOLE
- FIRE HYDRANT
- PARKING SPACE COUNT
- C.L.F. CHAIN LINK FENCE
- N.P.V. NO PIPES VISIBLE
- CONC. CONCRETE
- D.C. DEPRESSED CURB
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- W.L. WATER LINE
- S.D. SCUPPER DRAIN
- VCP VITRIFIED CLAY PIPE
- RCP REINFORCED CONCRETE PIPE
- DIP DUCTILE IRON PIPE

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SERIAL NUMBER: 111720331

UTILITY COMPANY	PHONE NUMBER
TIME WARNER NYC BROOKLYN	718-840-4252
TIME WARNER NYC QUEENS	718-888-4252

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

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PREPARED BY:

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CHALFONT, PA 215.712.9800
SOUTHBOROUGH, MA 508.948.3000

NO.	DATE	BY	DESCRIPTION	APPROVED

REVISIONS

PROJECT NAME

FLUSHING MEADOWS CORONA PARK

BOROUGH & COUNTY OF QUEENS
CITY & STATE OF NEW YORK

DRAWING TITLE

PARTIAL TOPOGRAPHIC SURVEY

SEAL & SIGNATURE

JAMES C. WEED
NEW YORK PROFESSIONAL LAND SURVEYOR

NOT VALID UNTIL SEALED

FIELD DATE:	8/17/2011
FIELD BK:	11-14
F. B. PAGE:	120-124
DATE:	9/7/2011
SCALE:	1"=30'
PROJECT No:	C11209
DRAWING BY:	INDO/C.R.
CHK BY:	J.R.
APPROVED BY:	J.C.W.
DWG No:	V-001.0
CAD FILE No:	C11209ASB
PAGE No:	2 OF 2

DRAFT NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY:
DESIGNED BY:
CHECKED BY:
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 1"=30'-0"

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

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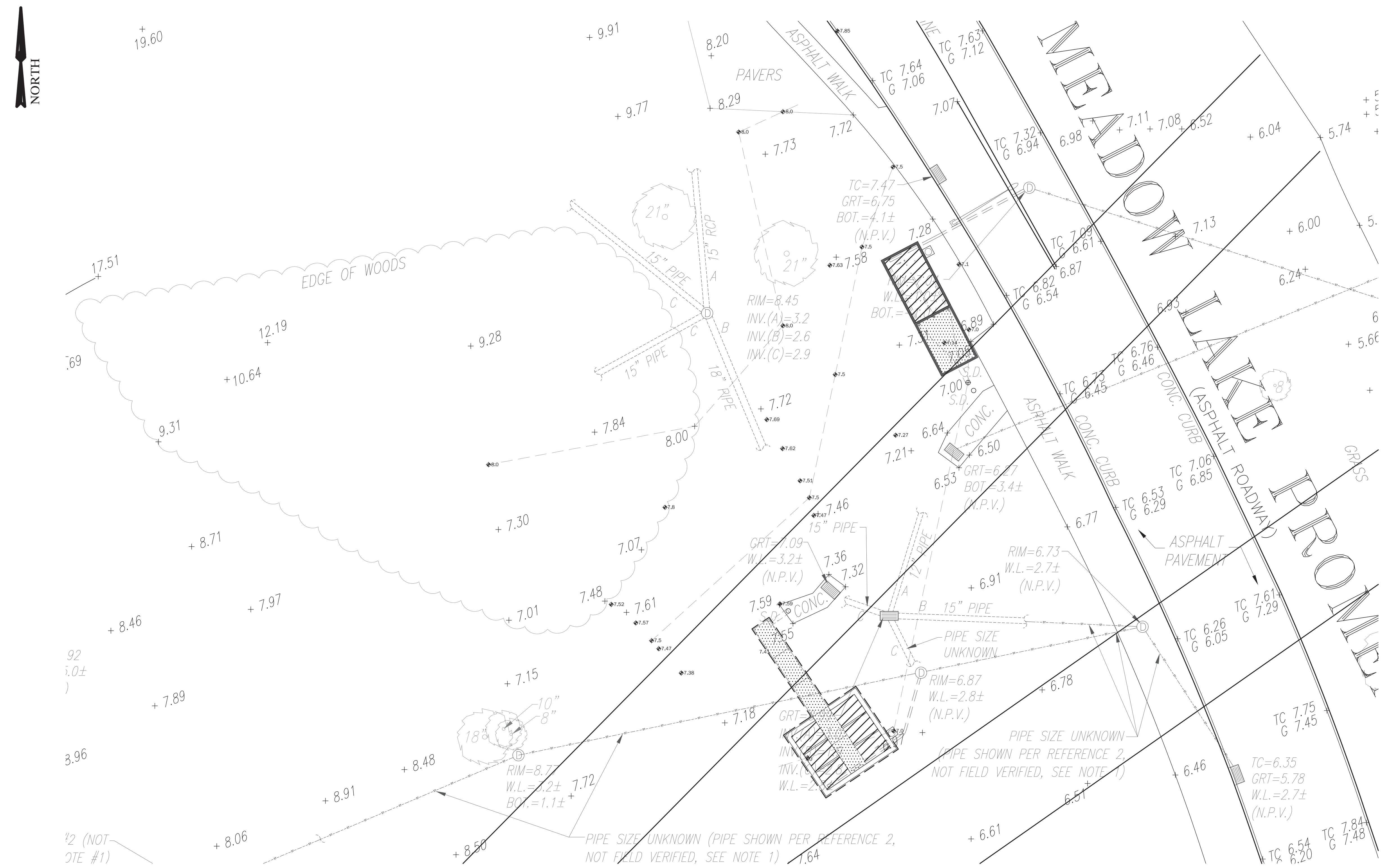
THE CITY OF NEW YORK
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
EXISTING SURVEY SITE B

DATE: APRIL 16, 2012

DWG. NO.: 4 OF: 22
SHEET NO: C-100.2 OF:



GRAPHIC SCALE

0 20 10 20 40 80

(IN FEET)
1 inch = 20 ft.

LEGEND

FILTRATION SYSTEM

PEA GRAVEL PRETREATMENT AREA

ELEVATED HIGHWAY

SCUPPER 1

TOTAL AREA = (66'*24') + Af + As = 1800 SF = 0.0413 ACRES

P = 1.2 (FIGURE 4.1 90% RAINFALL IN NYS)
I = 100% (PERCENT IMPERVIOUS COVER)
Rv = 0.05 + 0.009 * I = 0.95
WQv = (P*Rv*A)/12 = 0.00393 ACRE–FT = 171.00 CF

REQUIRED PEA GRAVEL PRETREATMENT SURFACE AREA
(NYS STORMWATER MANAGEMENT DESIGN MANUAL – 8–40)
Pv = PRETREATMENT VOLUME [CF]
d = DEPTH OF PRETREATMENT [FT]
= 0.75 FT
As = DESIGNED SURFACE AREA [SF]
= 96 SF

Pv = (0.30)*(d)*($\frac{1}{12}$)*(As)
Pv = (0.30)*(9)*($\frac{1}{12}$)*(96)
Pv = 21.6 CF

DESIGNED PEA GRAVEL PRETREATMENT AREA:
Vs = 72 CF > 21.6 CF (42.10% WQv)
As = 96.00 SF
ds = 0.75 FT

TABLE C.2 MATERIAL SPECIFICATIONS FOR BIORETENTION
(NYS STORMWATER MANAGEMENT DESIGN MANUAL C–10)
PEA GRAVEL: ASTM D 448, NO. 6
STONE: 2"–5"

REQUIRED FILTER BED AREA:
Af = [WQv*df]/[k*(hf+df)*tf]
Af = SURFACE AREA OF FILTER BED [SF]
WQv = WATER QUALITY VOLUME [CF]
df = FILTER BED DEPTH [FT]
= 4 FT
k = COEFFICIENT OF PERMEABILITY OF FILTER MEDIA [FT/DAY]
= 6 FT/DAY FOR ENGINEERED SOIL = 3 IN/HR
hf = AVERAGE HEIGHT OF WATER ABOVE FILTER BED [FT]
= 0.5 FT
tf = DESIGN FILTER BED DRAIN TIME [DAYS]
= 2 DAYS FOR BIORETENTION SOILS

Af = 12.67 SF

Vf = 85.50 CF (50% OF WQv)
Af = 21.38 SF
df = 4 FT

DESIGNED FILTER BED AREA:
Vf = 280.70% OF WQv
Af = 120 SF > 12.67 SF
df = 4 FT

TOTAL Vf = 322.80% OF WQv > 75%

SCUPPER 2

TOTAL AREA = (130.61'*24') + Af + As = 3465.64 SF = 0.0796 ACRES

P = 1.2 (FIGURE 4.1 90% RAINFALL IN NYS)
I = 100% (PERCENT IMPERVIOUS COVER)
Rv = 0.05 + 0.009 * I = 0.95
WQv = (P*Rv*A)/12 = 0.01 ACRE–FT = 329.24 CF

REQUIRED PEA GRAVEL PRETREATMENT SURFACE AREA
(NYS STORMWATER MANAGEMENT DESIGN MANUAL – 8–40)
Pv = PRETREATMENT VOLUME [CF]
d = DEPTH OF PRETREATMENT [FT]
= 0.5 FT
As = DESIGNED SURFACE AREA [SF]
= 156 SF

Pv = (0.30)*(d)*($\frac{1}{12}$)*(As)
Pv = (0.30)*(6)*($\frac{1}{12}$)*(96)
Pv = 23.4 CF

DESIGNED PEA GRAVEL PRETREATMENT AREA:
Vs = 78 CF > 23.4 CF (23.69% WQv)
As = 156.0 SF > 23.4 SF
ds = 0.5 FT

TABLE C.2 MATERIAL SPECIFICATIONS FOR BIORETENTION
(NYS STORMWATER MANAGEMENT DESIGN MANUAL C–10)
PEA GRAVEL: ASTM D 448, NO. 6
STONE: 2"–5"

REQUIRED FILTER BED AREA:
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WQv = WATER QUALITY VOLUME [CF]
df = FILTER BED DEPTH [FT]
= 2 FT
k = COEFFICIENT OF PERMEABILITY OF FILTER MEDIA [FT/DAY]
= 6 FT/DAY FOR ENGINEERED SOIL = 3 IN/HR
hf = AVERAGE HEIGHT OF WATER ABOVE FILTER BED [FT]
= 0.5 FT
tf = DESIGN FILTER BED DRAIN TIME [DAYS]
= 2 DAYS FOR BIORETENTION SOILS

Af = 21.95 SF

Vf = 164.62 CF (50% OF WQv)
Af = 82.31 SF
df = 2 FT

DESIGNED FILTER BED AREA:
Vf = 106.31% OF WQv
Af = 175 SF > 21.95 SF
df = 2 FT

TOTAL Vf = 130.00% OF WQv > 75%

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: MARIA HATGIPETROS
DESIGNED BY: MARIA HATGIPETROS
CHECKED BY: PETER BAKARICH
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 1"=20'-0"

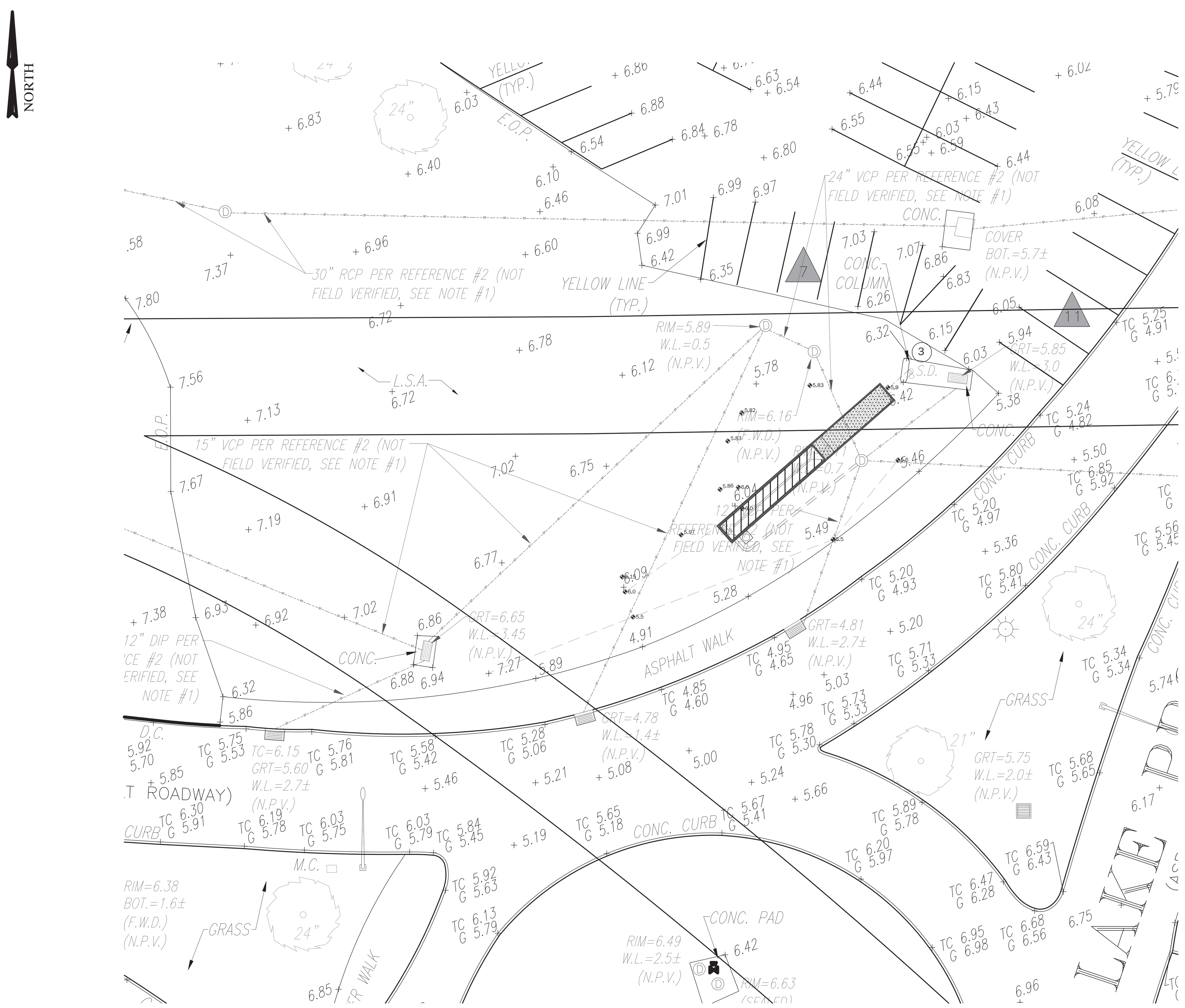
PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE

SITE A WATER CALCULATIONS & LOCATION PLAN

DATE: APRIL 16, 2012
DWG. NO.: 5 OF: 22
SHEET NO: C-102.1 OF:



GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

LEGEND

- FILTRATION SYSTEM
- PEA GRAVEL PRETREATMENT AREA
- ELEVATED HIGHWAY

SCUPPER 3

TOTAL AREA = (66'*24') + Af + As = 1867.87 SF = 0.0429 ACRES

P = 1.2 (FIGURE 4.1 90% RAINFALL IN NYS)
I = 100% (PERCENT IMPERVIOUS COVER)
Rv = 0.05 + 0.009 * I = 0.95
WQv = (P*Rv*A)/12 = 0.00407 ACRE-FT = 177.45 CF

REQUIRED PEA GRAVEL PRETREATMENT SURFACE AREA
(NYS STORMWATER MANAGEMENT DESIGN MANUAL – 8-40)
Pv = PRETREATMENT VOLUME [CF]
d = DEPTH OF PRETREATMENT [FT]
= 0.5 FT
As = DESIGNED SURFACE AREA [SF]
= 67.5 SF

$Pv = (0.30)*(d)*(\frac{1}{12})*(As)$
$Pv = (0.30)*(6)*(\frac{1}{12})*(96)$
Pv = 10.125 CF

DESIGNED PEA GRAVEL PRETREATMENT AREA:
Vs = 33.75 CF > 10.125 CF (19.02% WQv)
As = 67.5 SF
ds = 0.5 FT

TABLE C.2 MATERIAL SPECIFICATIONS FOR BIORETENTION
(NYS STORMWATER MANAGEMENT DESIGN MANUAL C-10)
PEA GRAVEL: ASTM D 448, NO. 6
STONE: 2"-5"

REQUIRED FILTER BED AREA:
Af = [WQv*df]/[k*(hf+df)*tf]
Af = SURFACE AREA OF FILTER BED [SF]
WQv = WATER QUALITY VOLUME [CF]
df = FILTER BED DEPTH [FT]
= 2 FT
k = COEFFICIENT OF PERMEABILITY OF FILTER MEDIA [FT/DAY]
= 6 FT/DAY FOR ENGINEERED SOIL = 3 IN/HR
hf = AVERAGE HEIGHT OF WATER ABOVE FILTER BED [FT]
= 0.5 FT
tf = DESIGN FILTER BED DRAIN TIME [DAYS]
= 2 DAYS FOR BIORETENTION SOILS

Af = 11.83 SF

Vf = 88.72 CF (50% OF WQv)
Af = 44.36 SF
df = 2 FT

DESIGNED FILTER BED AREA:
Vf = 95.09% OF WQv
Af = 84.37 SF >11.83 SF
df = 2 FT

TOTAL Vf = 114.11% OF WQv > 75%

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: MARIA HATGIPETROS
DESIGNED BY: MARIA HATGIPETROS
CHECKED BY: PETER BAKARICH
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 1"=20'-0"

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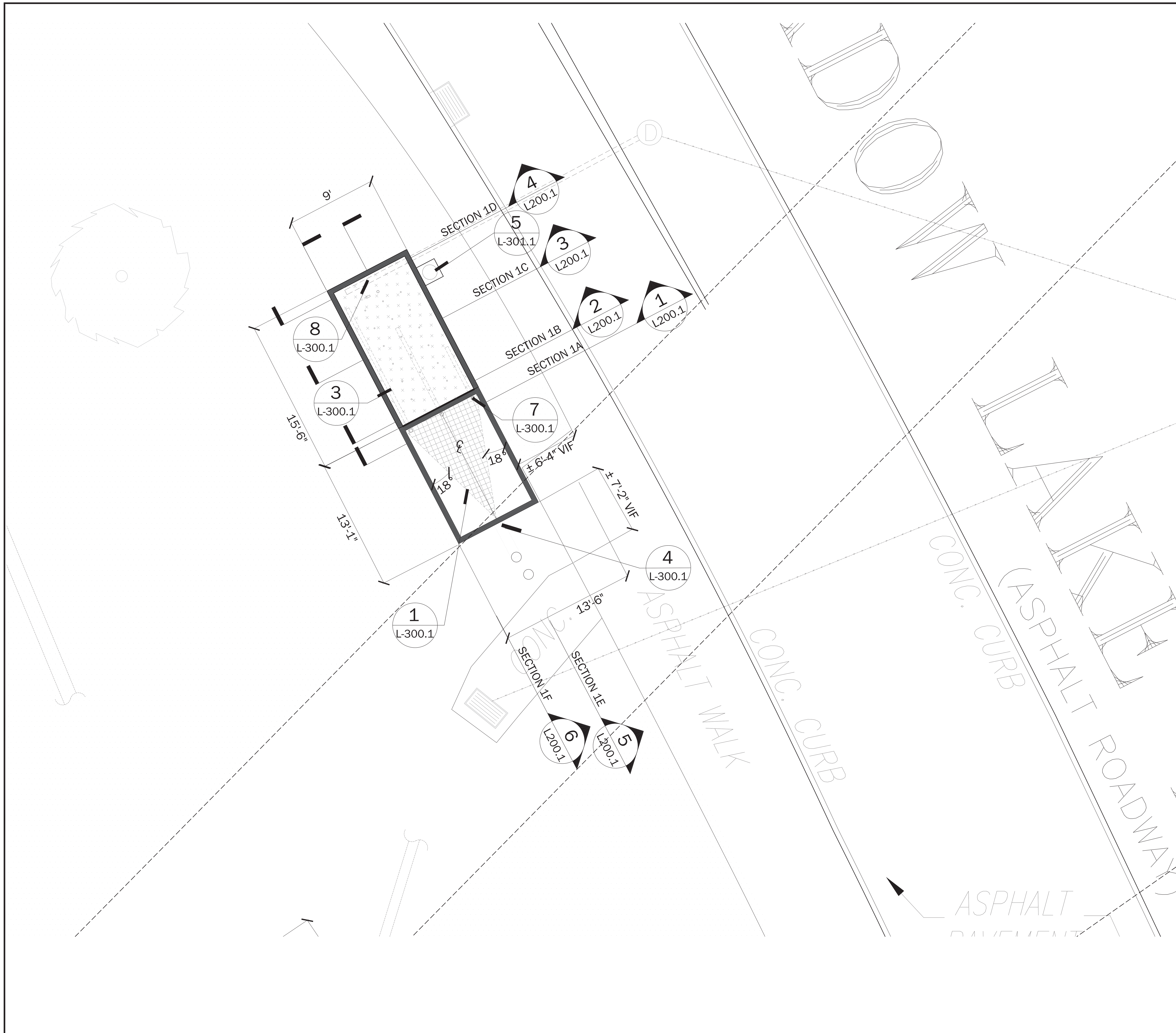
FLUSHING MEADOWS PILOT SPONGE SWALE

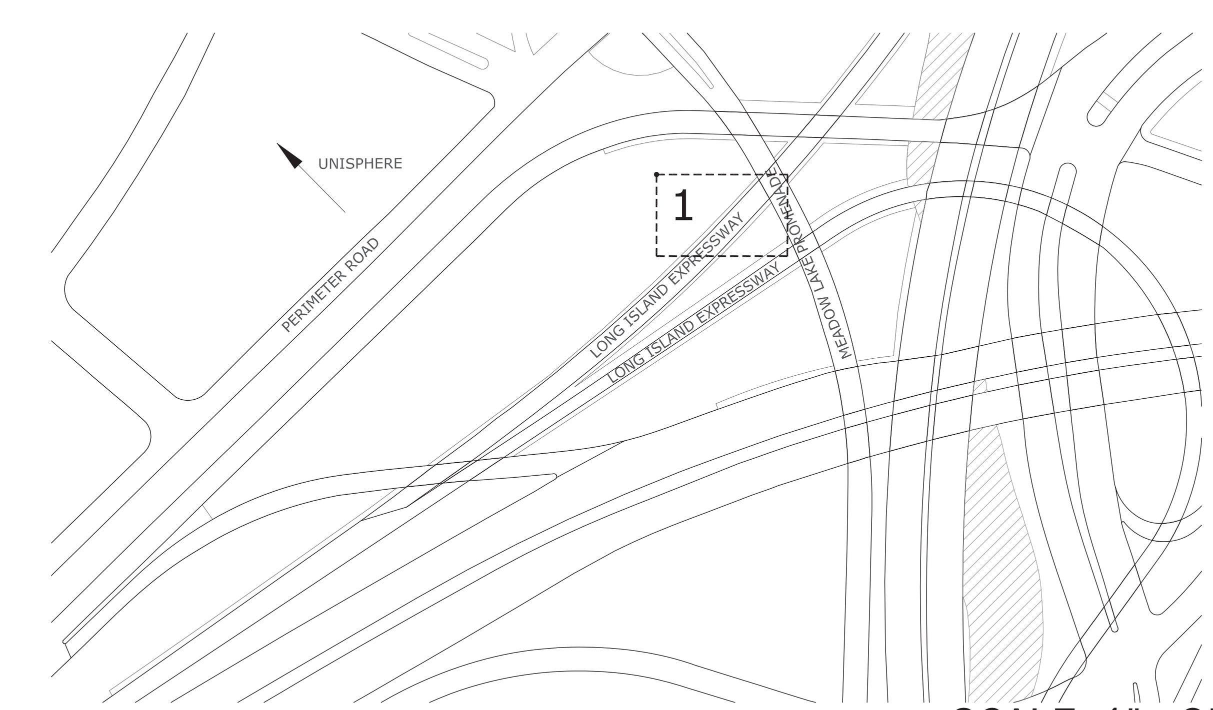
SITE B WATER CALCULATIONS & LOCATION PLAN

DATE: APRIL 16, 2012
DWG. NO.: 6 OF: 22
SHEET NO: C-102.2 OF:



LEGEND

S.D.	EXISTING SPLASH PAD W/ EXISTING SCUPPER DRAIN		SCUPPER EXTENSION
			MOISTURE LEVEL GAUGE
	DATA COLLECTING EQUIPMENT		CONCRETE CURB
	STORM MANHOLE		GRAVEL
	STORM DRAIN WITH ADJACENT PIPES		PLANTING BED
	EXISTING CURB		STONE FILLED WIRE MESH
	ELEVATED HIGHWAY		OVERFLOW STORMWATER CONNECTION
	EXISTING LAWN		



LOCATION PLAN SCALE: 1" =250'

KEY PLAN SCALE: 1" =500'

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NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 3/16"=1'-0"

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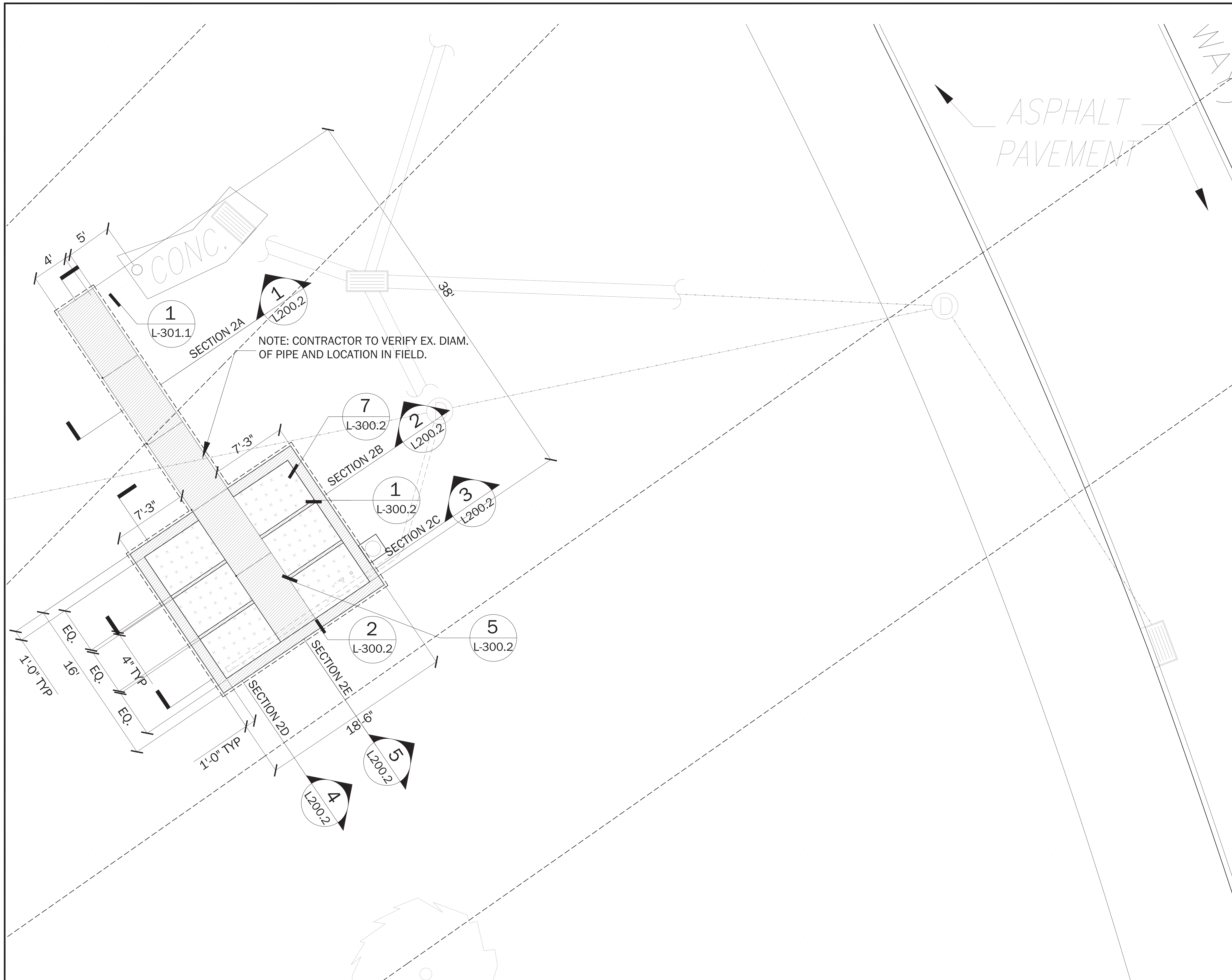
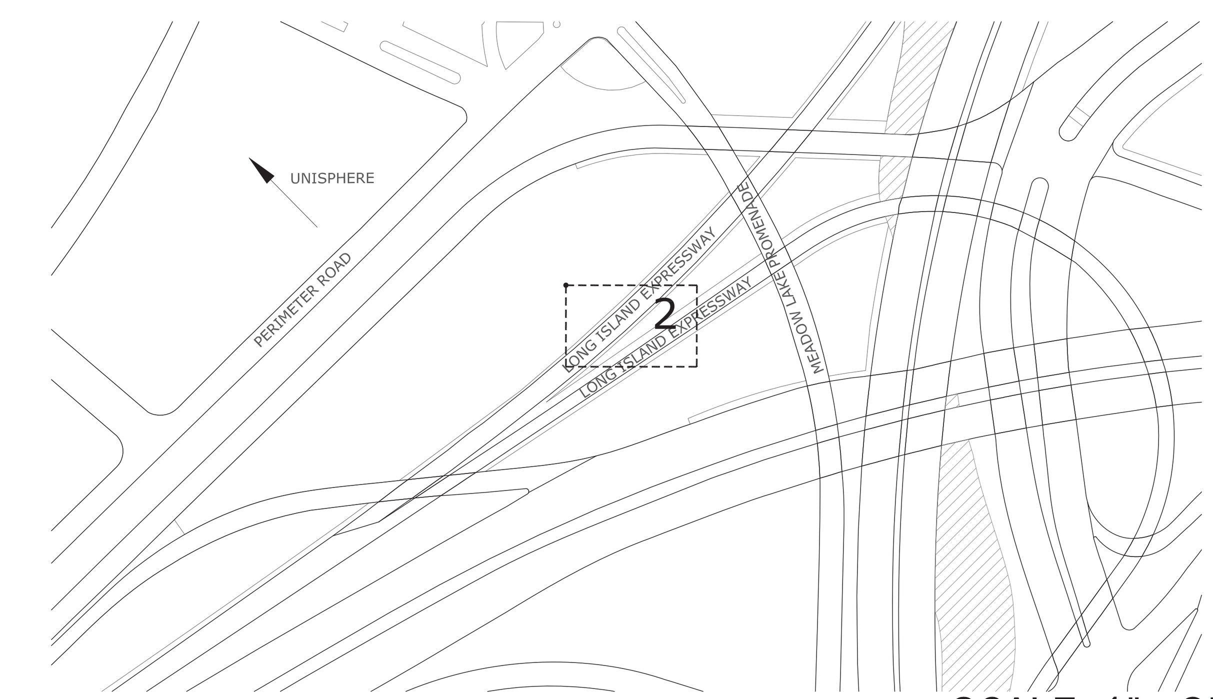
FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 1
LAYOUT & MATERIALS PLAN

DATE: APRIL 16, 2012
DWG. NO.: 7
OF: 22
SHEET NO: L-100.1



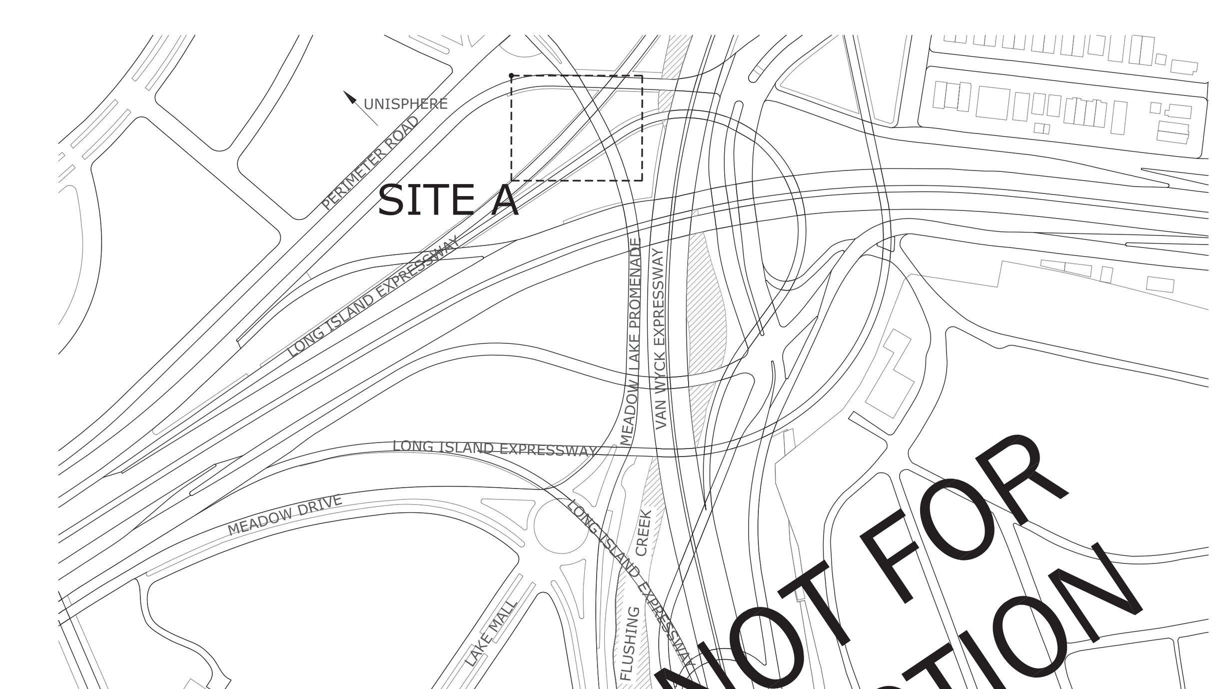
LEGEND

EXISTING SPLASH PAD W/ EXISTING SCUPPER DRAIN (S.D.)	SCUPPER EXTENSION
DATA COLLECTING EQUIPMENT	MOISTURE LEVEL GAUGE
STORM MANHOLE	CONCRETE CURB
STORM DRAIN WITH ADJACENT PIPES	GRAVEL
EXISTING CURB	PLANTING BED
ELEVATED HIGHWAY	STONE FILLED WIRE MESH
EXISTING LAWN	OVERFLOW STORMWATER CONNECTION



LOCATION PLAN

SCALE: 1" =250'



KEY PLAN

SCALE: 1" =500'

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REVISIONS

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GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

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THE CITY OF NEW YORK
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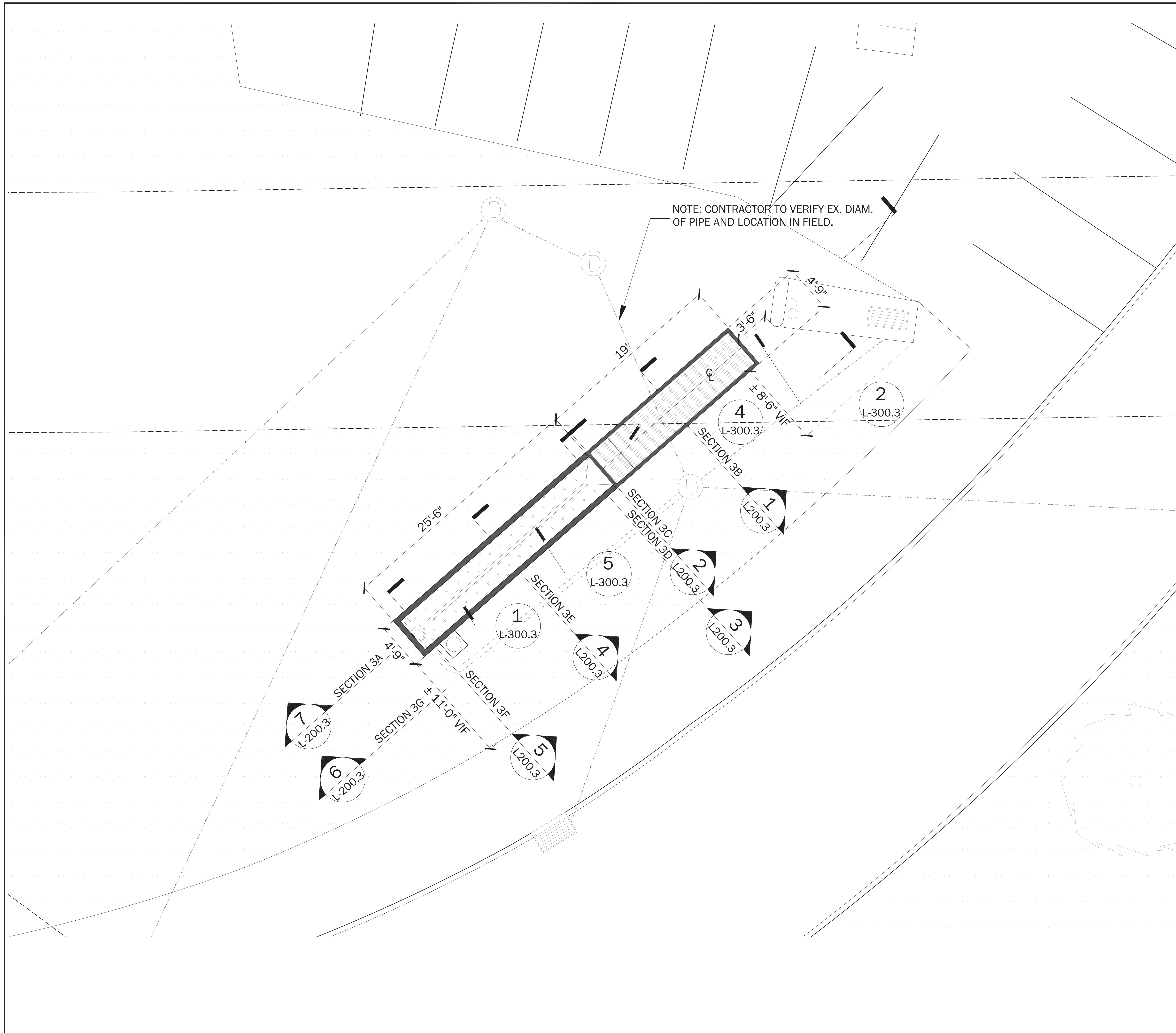
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE

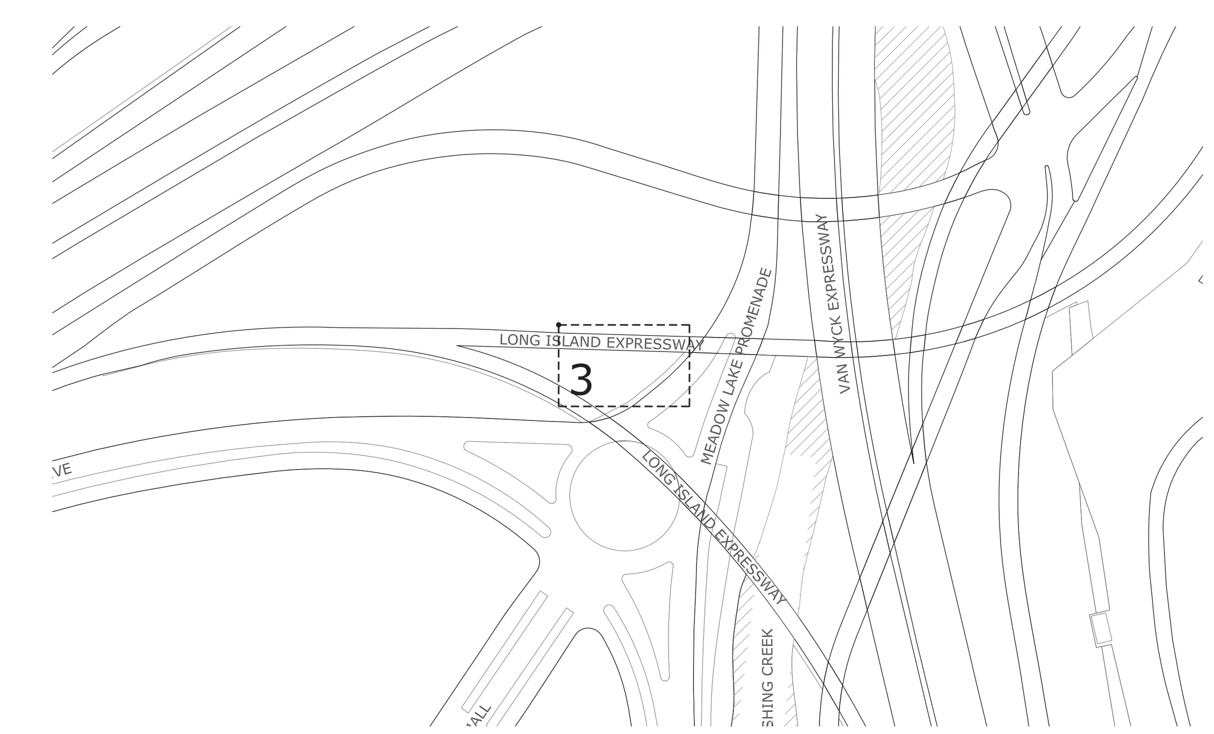
SITE A SCUPPER 2
LAYOUT & MATERIALS PLAN

DATE: APRIL 16, 2012
DWG. NO.: 8 OF: 22
SHEET NO.: L-100.2 OF:



LEGEND

S.D.	EXISTING SPLASH PAD W/ EXISTING SCUPPER DRAIN		SCUPPER EXTENSION
	DATA COLLECTING EQUIPMENT		MOISTURE LEVEL GAUGE
	STORM MANHOLE		CONCRETE CURB
	STORM DRAIN WITH ADJACENT PIPES		PLANTING BED
	EXISTING CURB		S.S. GRATE OVER SEDIMENTATION BASIN
	ELEVATED HIGHWAY		OVERFLOW STORMWATER CONNECTION
	EXISTING LAWN		



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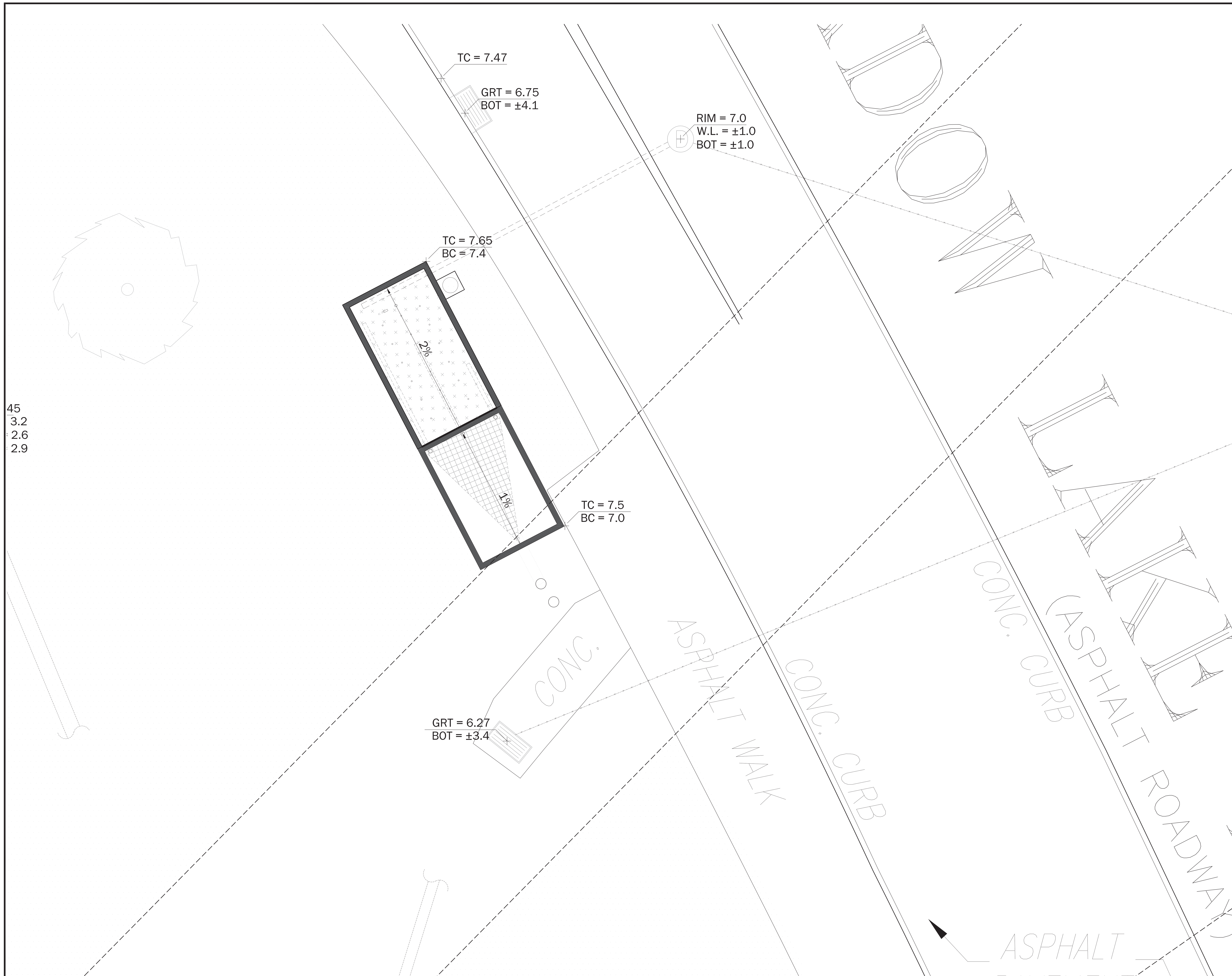
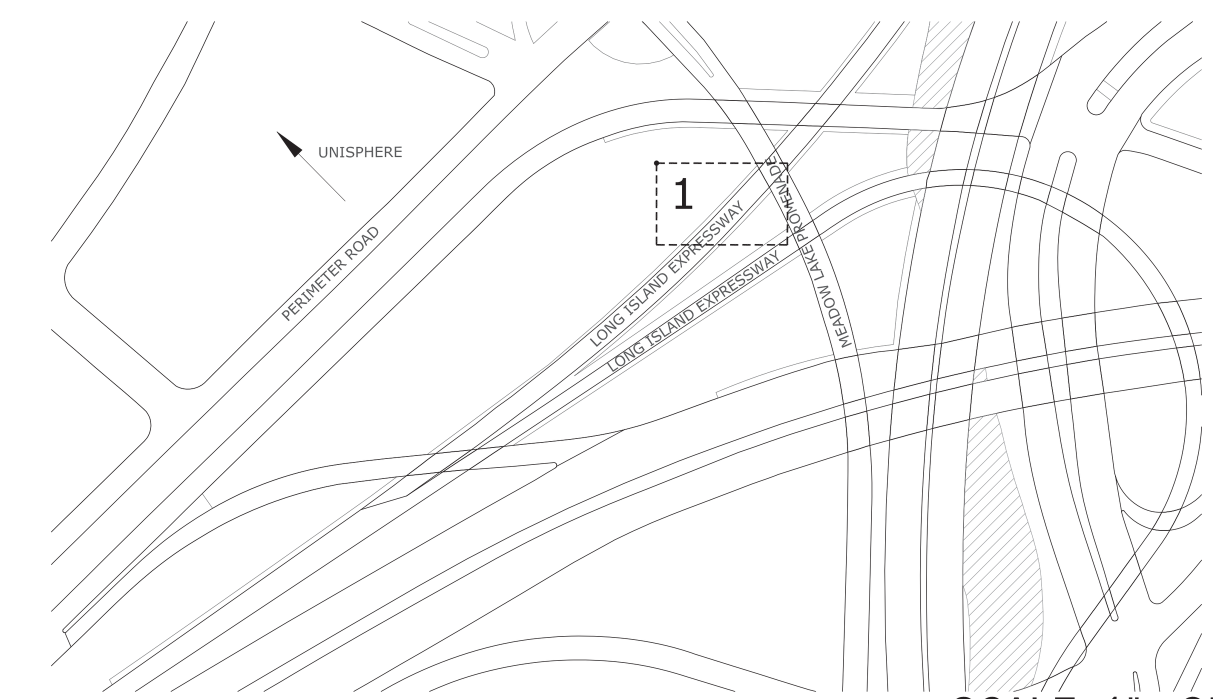
FLUSHING MEADOWS PILOT SPONGE SWALE
SITE B SCUPPER 3
LAYOUT & MATERIAL PLAN

DATE: APRIL 16, 2012
DWG. NO.: 9 OF: 22
SHEET NO: L-100.3 OF:



LEGEND

S.D.	EXISTING SPLASH PAD W/ EXISTING SCUPPER DRAIN		SCUPPER EXTENSION
			MOISTURE LEVEL GAUGE
	DATA COLLECTING EQUIPMENT		CONCRETE CURB
	STORM MANHOLE		GRAVEL
	STORM DRAIN WITH ADJACENT PIPES		PLANTING BED
	EXISTING CURB		STONE FILLED WIRE MESH
	ELEVATED HIGHWAY		OVERFLOW STORMWATER CONNECTION
	EXISTING LAWN		



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KEY PLAN SCALE: 1" =500'

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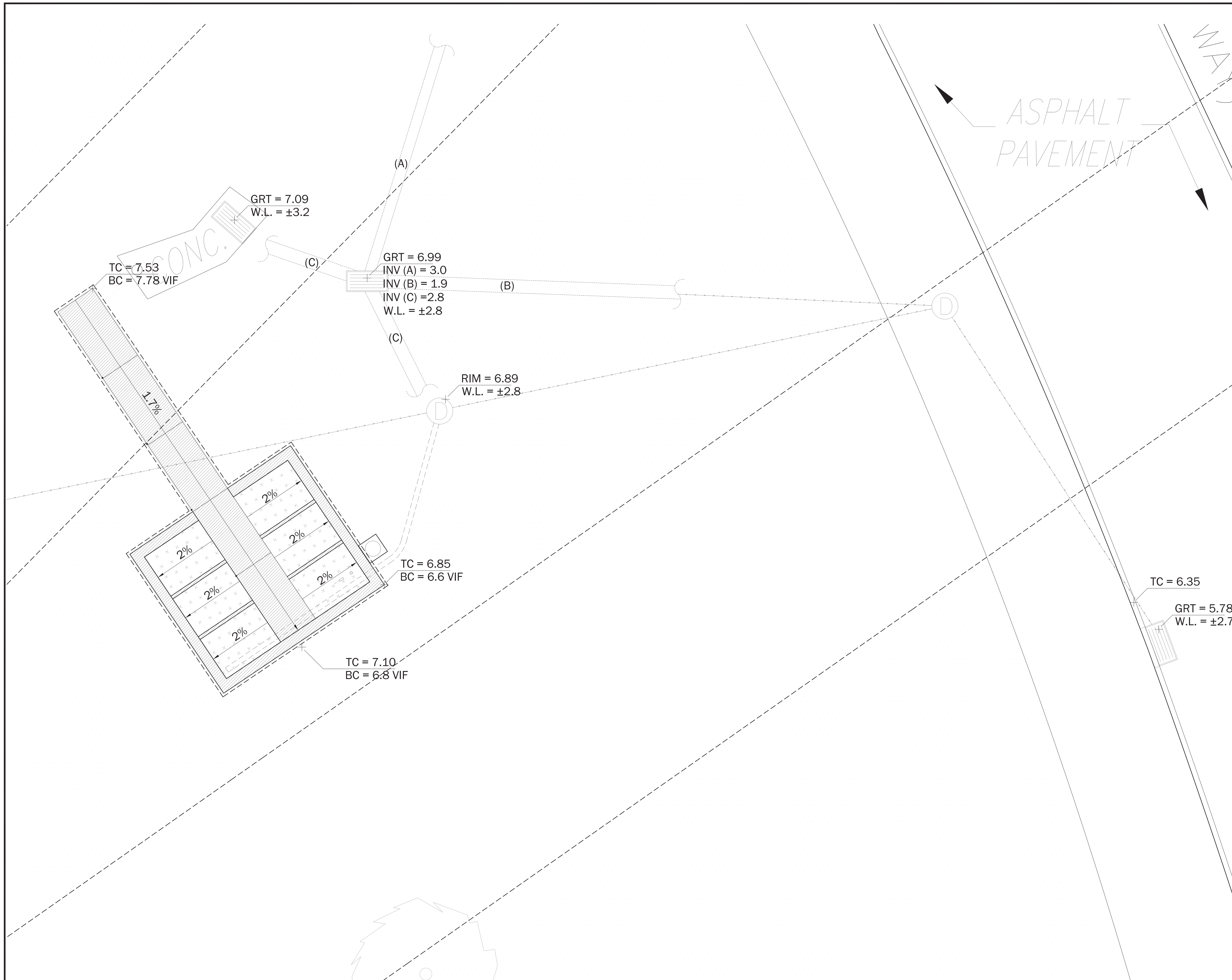
FLUSHING MEADOWS PILOT SPONGE SWALE

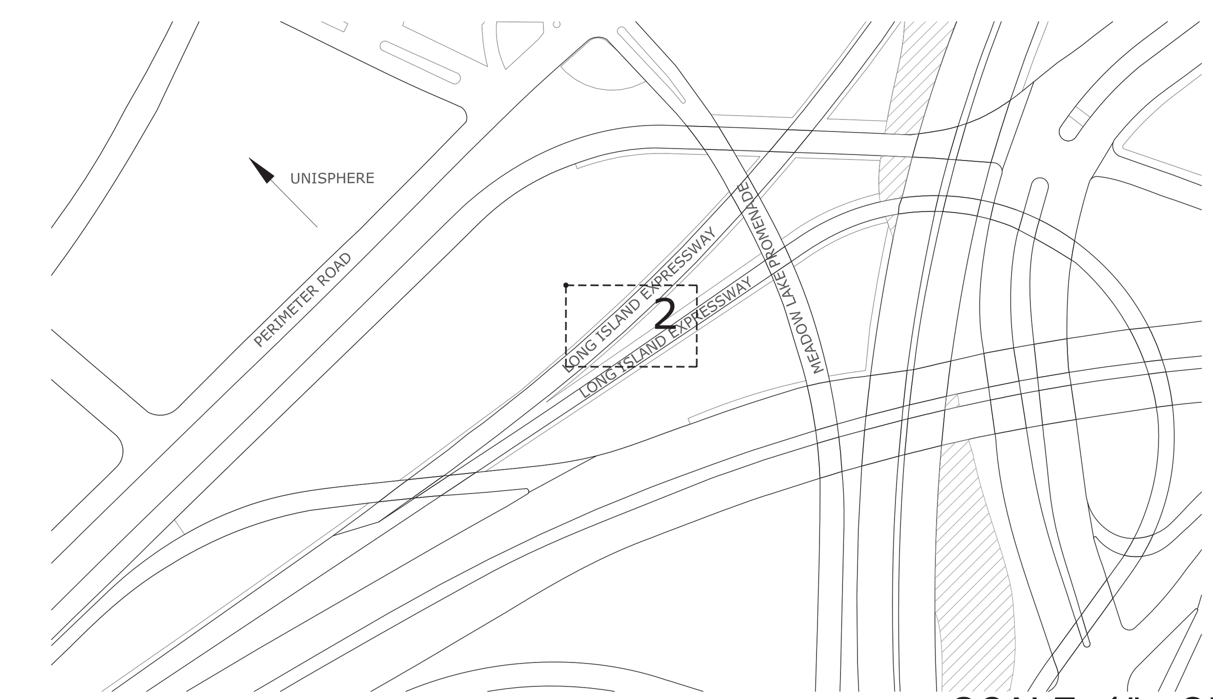
SITE A SCUPPER 1
GRADING PLAN

DATE: APRIL 16, 2012
DWG. NO.: 10 OF: 22
SHEET NO: L-101.1 OF:

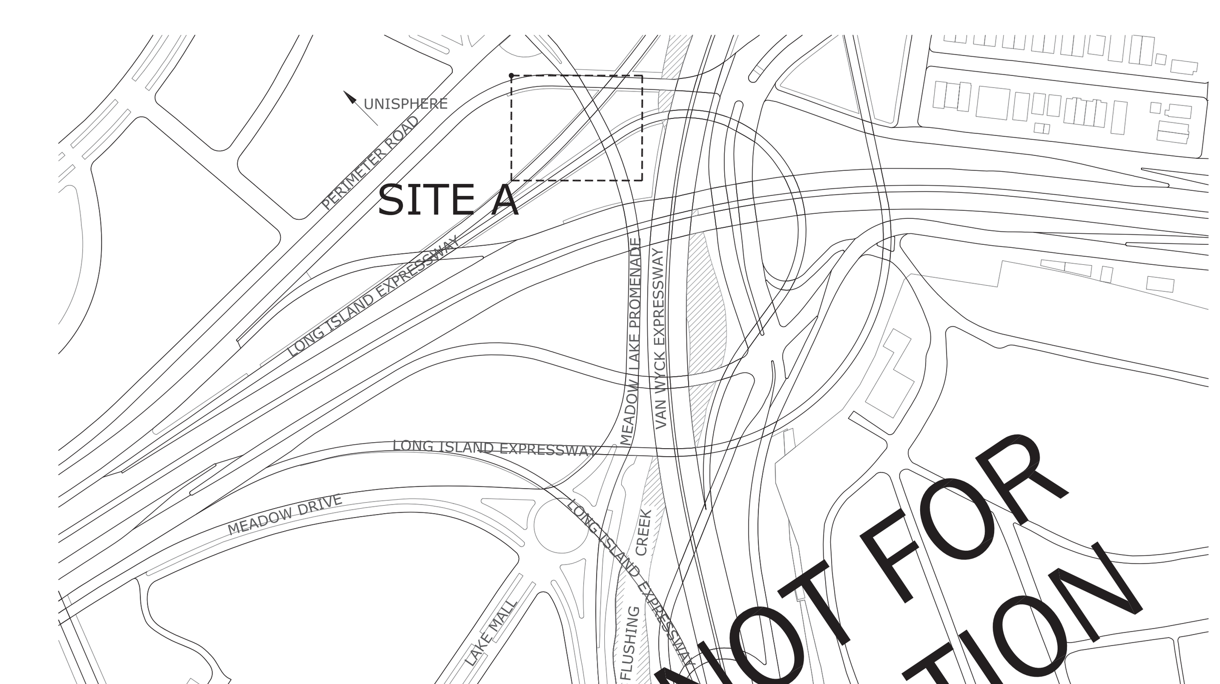


LEGEND

S.D.	EXISTING SPLASH PAD W/ EXISTING SCUPPER DRAIN		SCUPPER EXTENSION
			MOISTURE LEVEL GAUGE
	DATA COLLECTING EQUIPMENT		CONCRETE CURB
	STORM MANHOLE		GRAVEL
	STORM DRAIN WITH ADJACENT PIPES		PLANTING BED
	EXISTING CURB		STONE FILLED WIRE MESH
	ELEVATED HIGHWAY		OVERFLOW STORMWATER CONNECTION
	EXISTING LAWN		



LOCATION PLAN SCALE: 1" =250'



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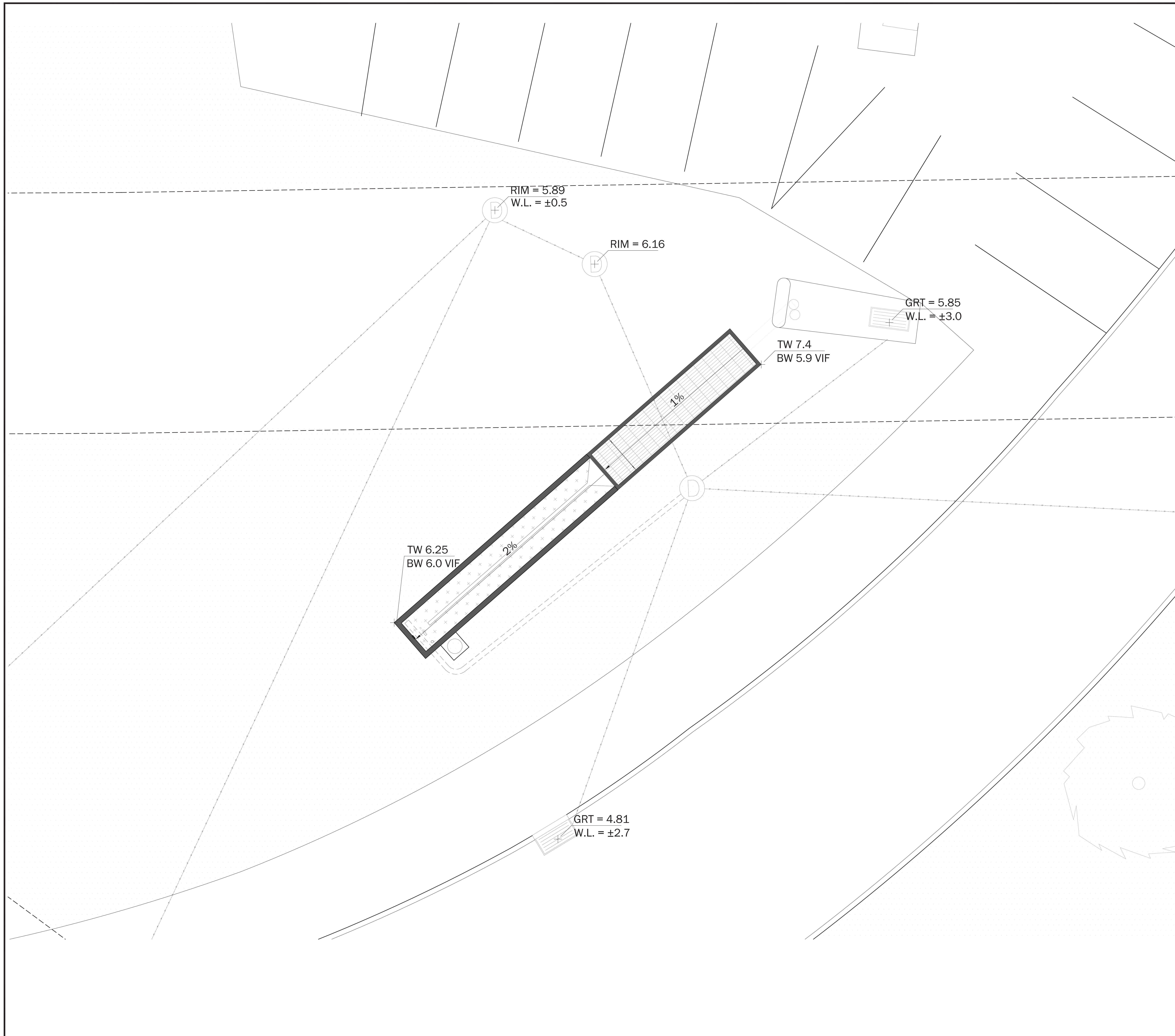
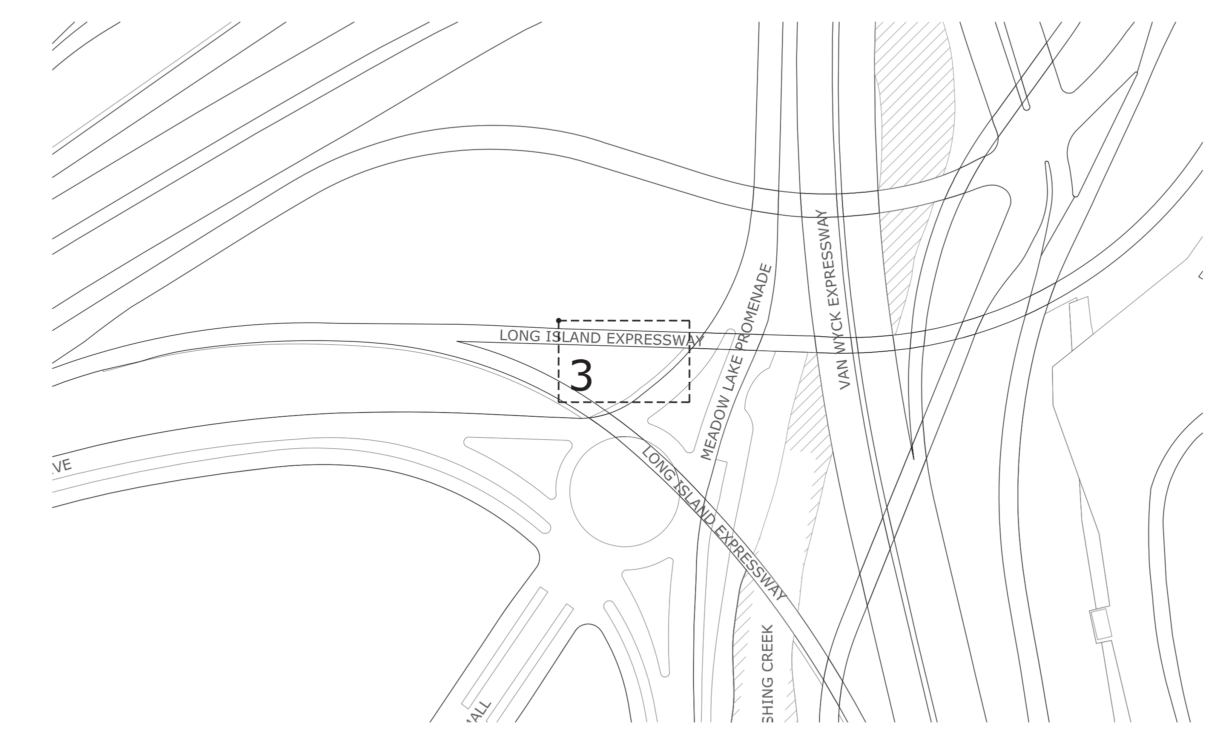
FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 2
GRADING PLAN

DATE: APRIL 16, 2012
DWG. NO.: 11 OF: 22
SHEET NO: L-101.2 OF:



LEGEND

EXISTING SPLASH PAD W/ EXISTING SCUPPER DRAIN (S.D.)	SCUPPER EXTENSION
DATA COLLECTING EQUIPMENT	MOISTURE LEVEL GAUGE
STORM MANHOLE	CONCRETE CURB
STORM DRAIN WITH ADJACENT PIPES	GRAVEL
EXISTING CURB	PLANTING BED
ELEVATED HIGHWAY	STONE FILLED WIRE MESH
EXISTING LAWN	OVERFLOW STORMWATER CONNECTION



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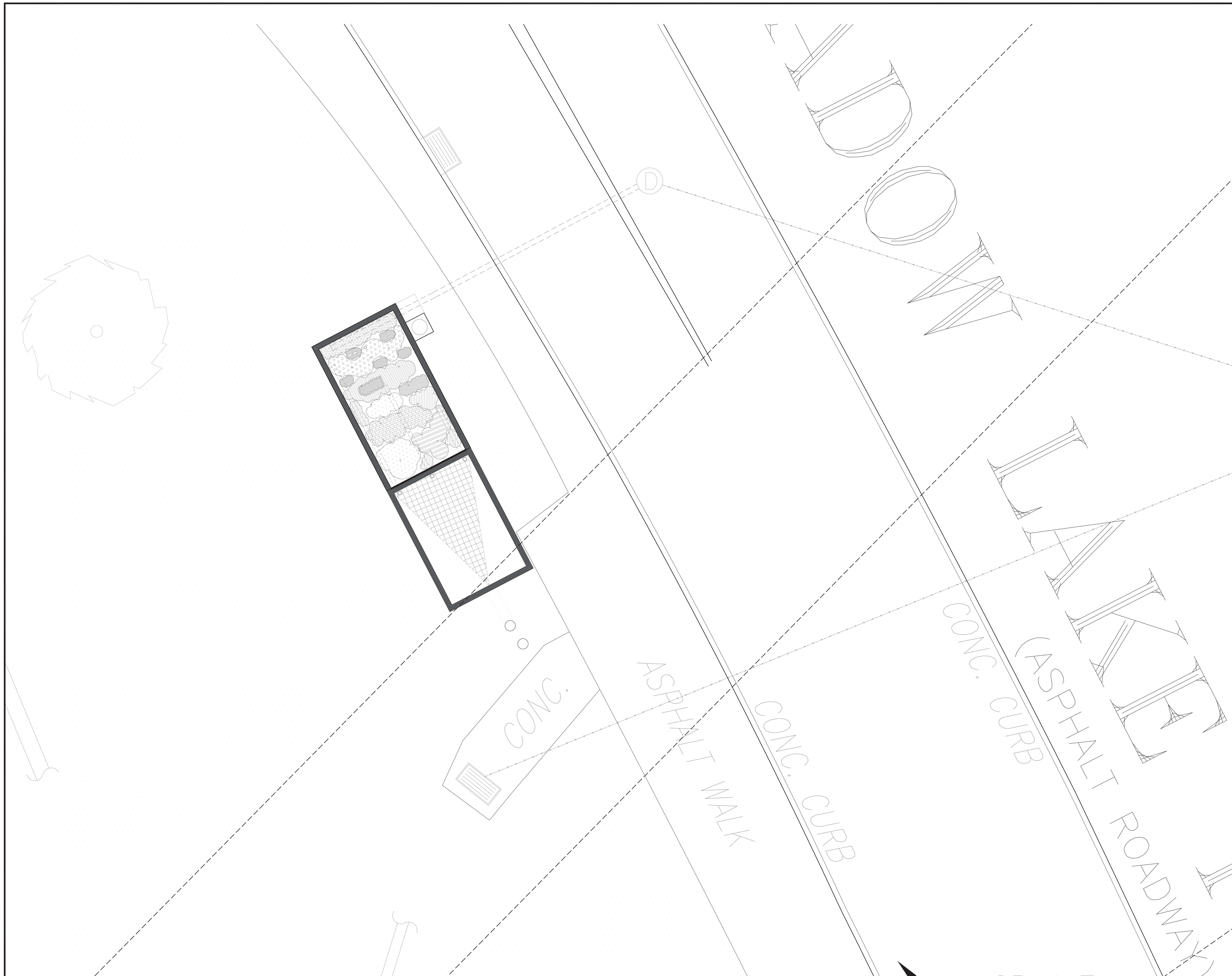
FLUSHING MEADOWS PILOT SPONGE SWALE
SITE B SCUPPER 3
GRADING PLAN

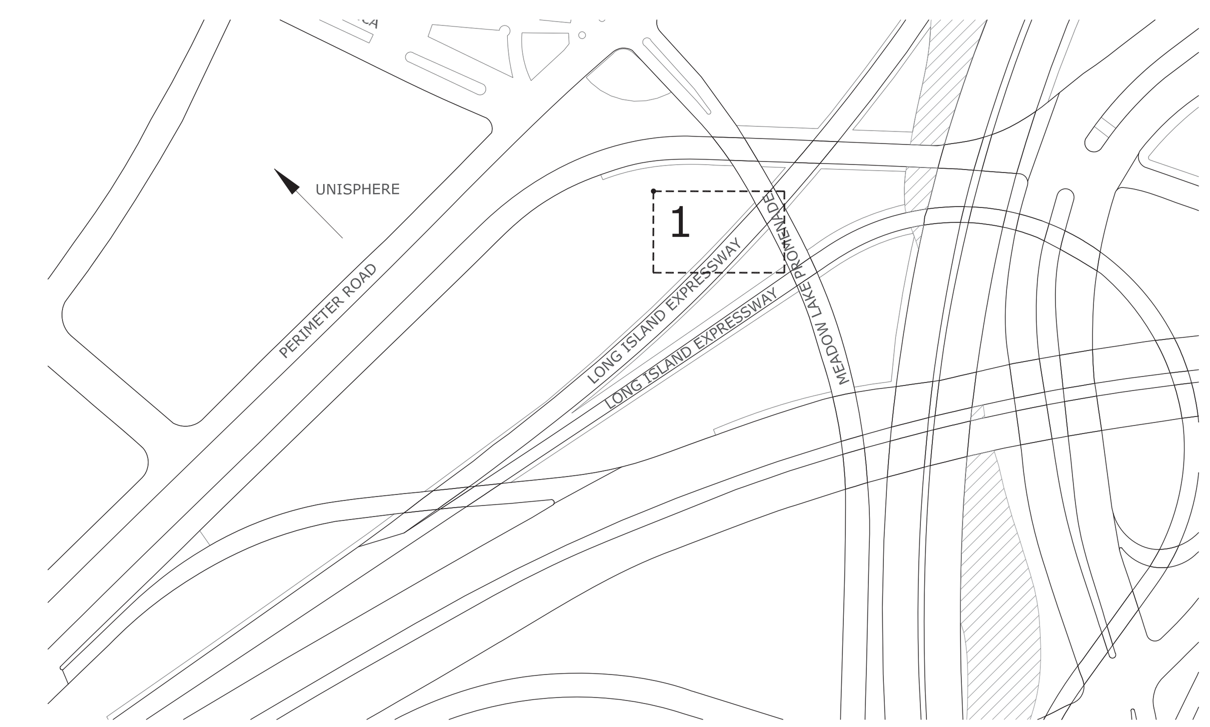
DATE: APRIL 16, 2012
DWG. NO.: 12 OF: 22
SHEET NO: L-101.3 OF:



PLANTING SCHEDULE

ABBR.	LATIN NAME	COMMON NAME	SIZE	SQFT	SPACING
Am	*Achillea millefolium*	Yarrow	1 gal.	11	1.5'
Ag	*Acorus gramineus*	Grassleaf Sweet Flag	1 gal.	18	0.5'-1'
As	*Allium stellatum*	Wild Onion	1 gal.	10	0.5'
Cp	*Carex flacca*	Blue Sedge	1 gal.	15	8"
Iv	Iris versicolor	Northern Blueflag Iris	1 gal.	12	1'
Pv	*Panicum virgatum*	Switchgrass	1 gal.	16	20"
Ss	*Schizachyrium scoparium*	Little Blue Stem	1 gal.	12	18"
So	*Solidago sempervirens*	Seaside Goldenrod	2 gal.	14	18"

NOTE: Contractor to layout plants in field in the presence of Landscape Architect.



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REVISIONS

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FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 1
PLANTING PLAN

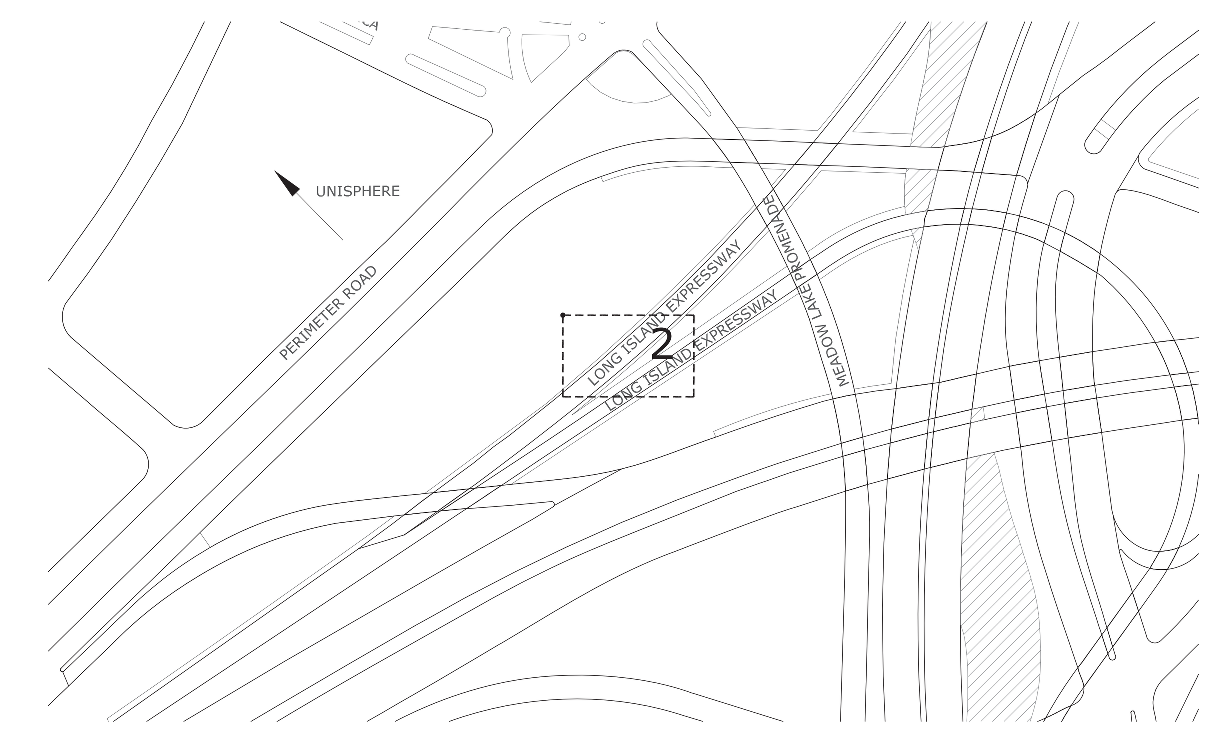
DRAFT NOT FOR CONSTRUCTION

DATE: APRIL 16, 2012
DWG. NO.: 13 OF: 22
SHEET NO.: L-102.1

PLANTING SCHEDULE

	ABBR.	LATIN NAME	COMMON NAME	SIZE	SQFT	SPACING
	Am	*Achillea millefolium*	Yarrow	1 gal.	33	1.5'
	Cp	*Carex flacca*	Blue Sedge	1 gal.	36	8"
	Pv	*Panicum virgatum*	Switchgrass	1 gal.	36	20"
	So	*Solidago sempervirens*	Seaside Goldenrod	2 gal.	31	18"

NOTE: Contractor to layout plants in field in the presence of Landscape Architect.



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FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 2
PLANTING PLAN

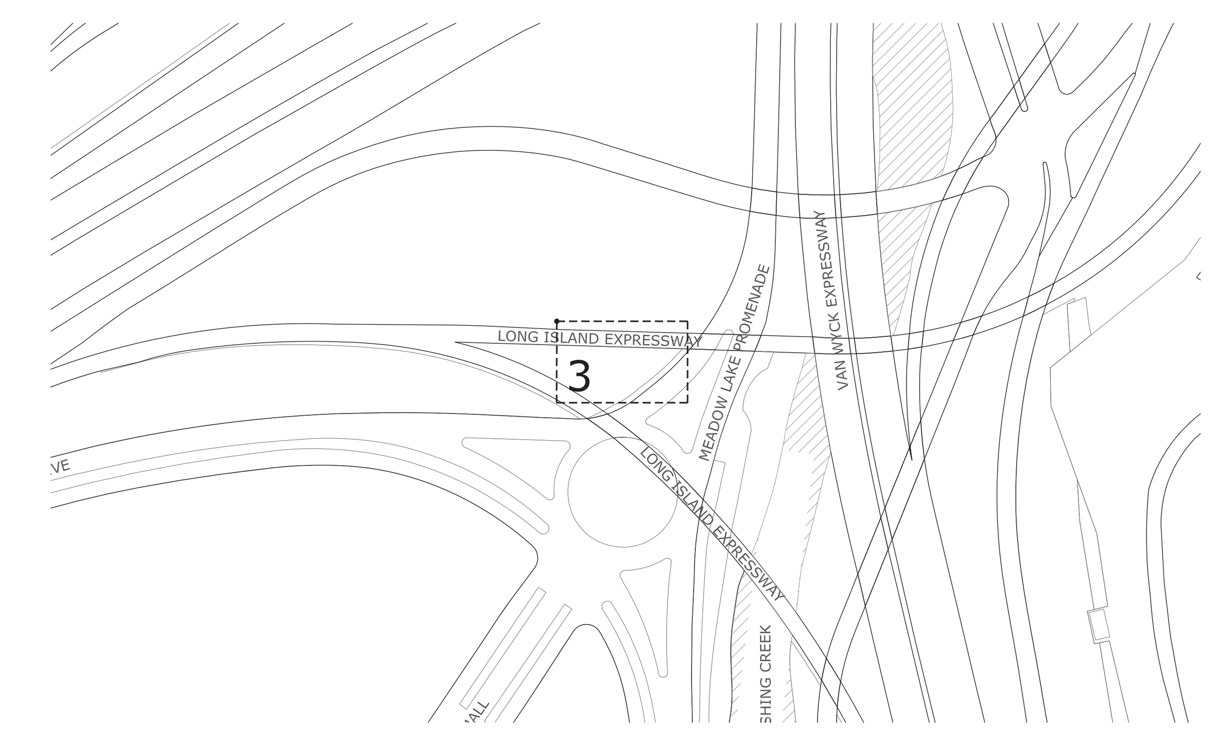
DRAFT NOT FOR CONSTRUCTION

DATE: APRIL 16, 2012
DWG. NO.: 14 OF: 22
SHEET NO.: L-102.2 OF:

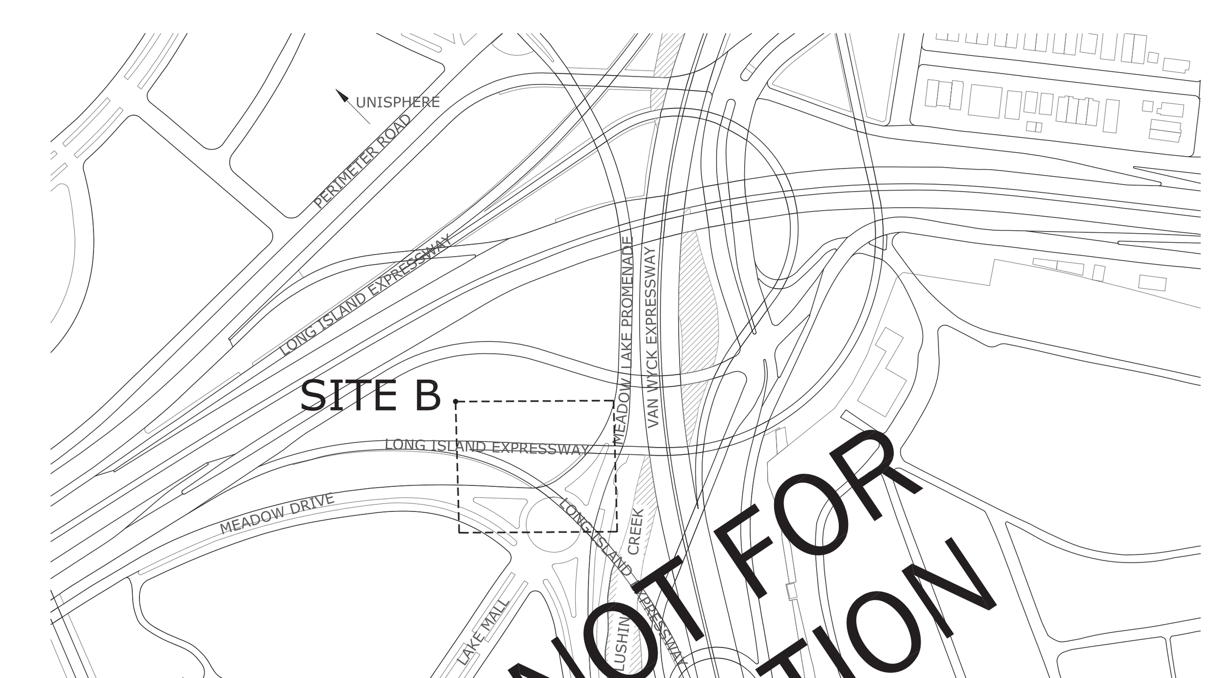
PLANTING SCHEDULE

ABBR.	LATIN NAME	COMMON NAME	SIZE	SQFT	SPACING
Ag	*Acorus gramineus*	Grassleaf Sweet Flag	1 gal.	18	6"
Ca	*Calamagrostis x acutiflora 'Overdam'*	Feather Reed Grass	1 gal.	11	16"
Ci	*Carex Ice Dance*	Ice Dance Sedge	1 gal.	15	1'
Iv	Iris versicolor	Northern Blueflag Iris	1 gal.	2	1'
Pv	*Panicum virgatum*	Switchgrass	1 gal.	14	20"
So	*Solidago sempervirens*	Seaside Goldenrod	2 gal.	9	18"
Vh	Verbena hastata	Swamp Verbena	1 gal.	3	18"

NOTE: Contractor to layout plants in field in the presence of Landscape Architect.



LOCATION PLAN SCALE: 1" =250'



KEY PLAN SCALE: 1" =500'

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REVISIONS

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DEPARTMENT OF
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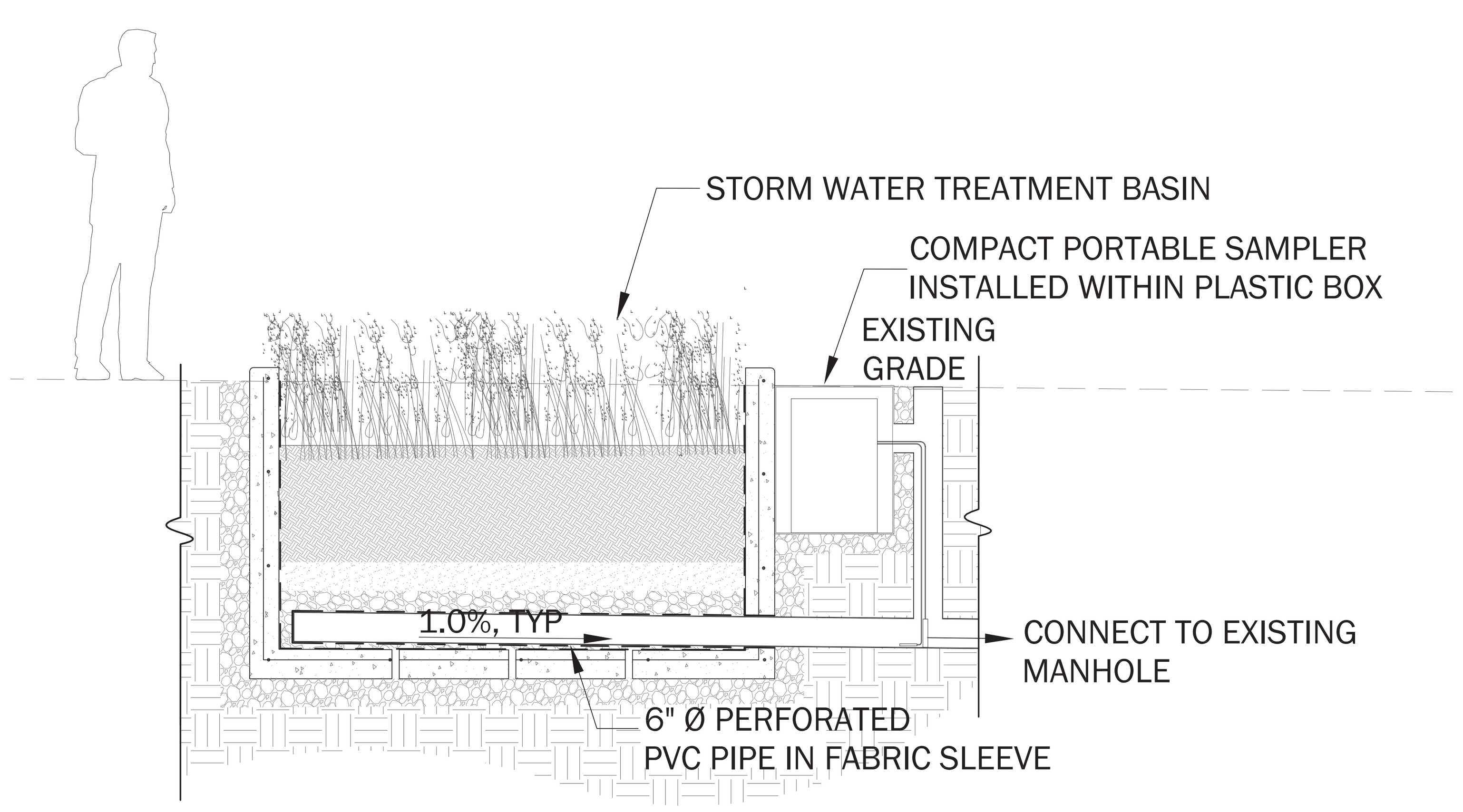
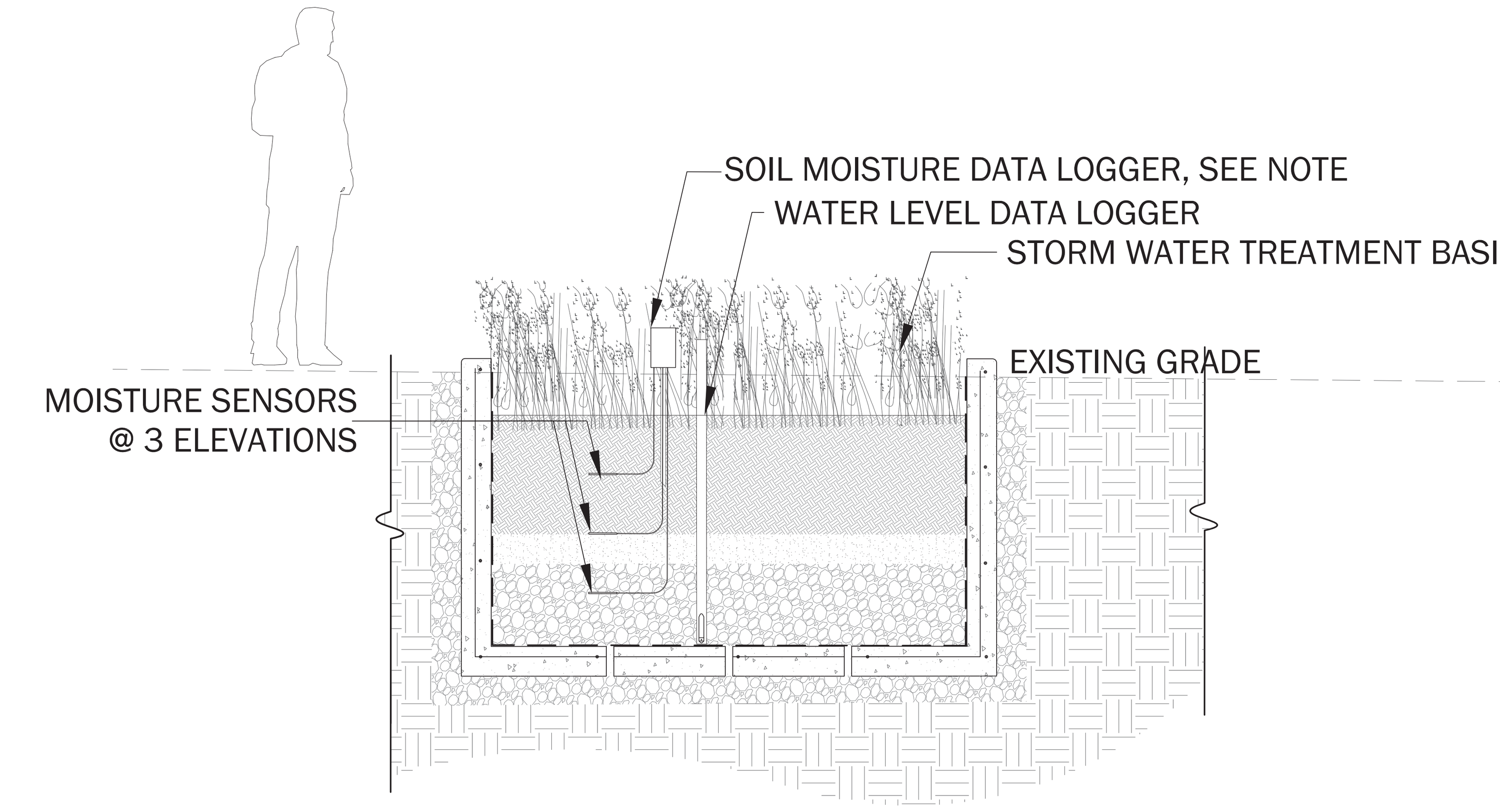
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
SITE B SCUPPER 3
PLANTING PLAN

DATE: APRIL 16, 2012
DWG. NO.: 15 OF: 22
SHEET NO: L-102.3 OF:



4 SECTION 1D
SECTION



3 SECTION 1C
SECTION

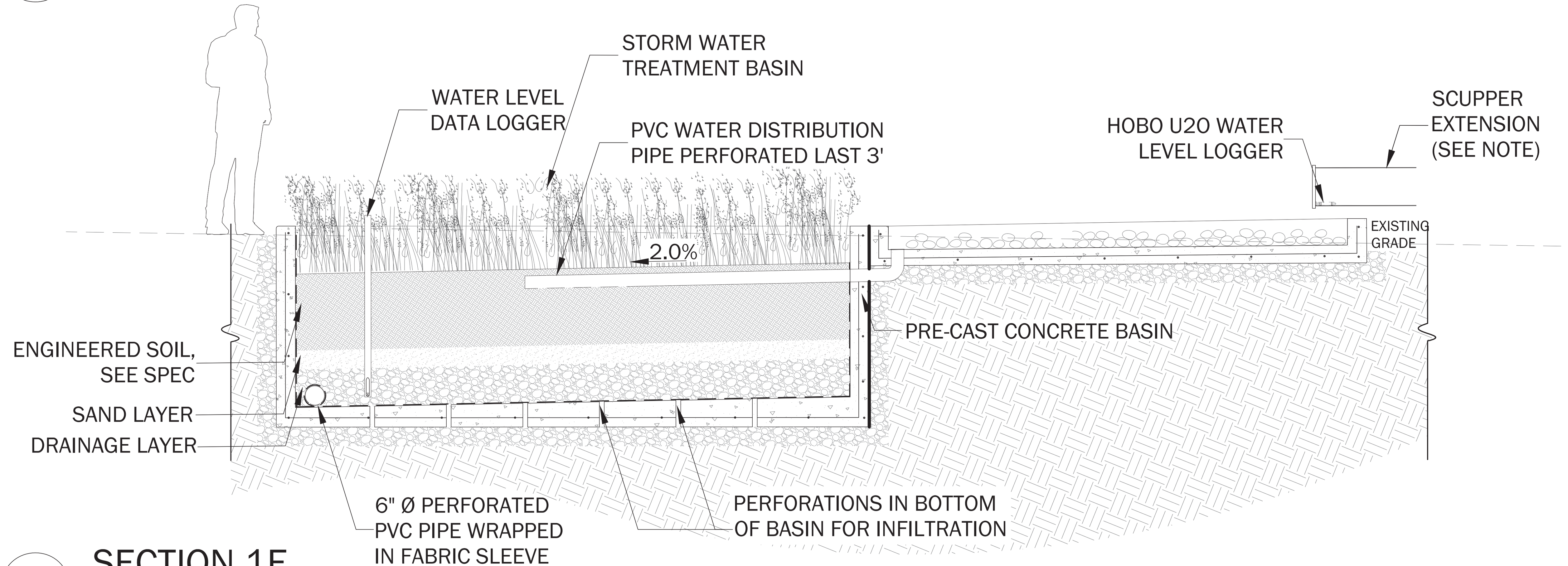
NOTES:

1. Scupper pipe extension and bends (12" Ø) shall be added as necessary to direct the scuppers to the treatment basins. All fittings to be restrained mechanical joints for ductile iron pipe.

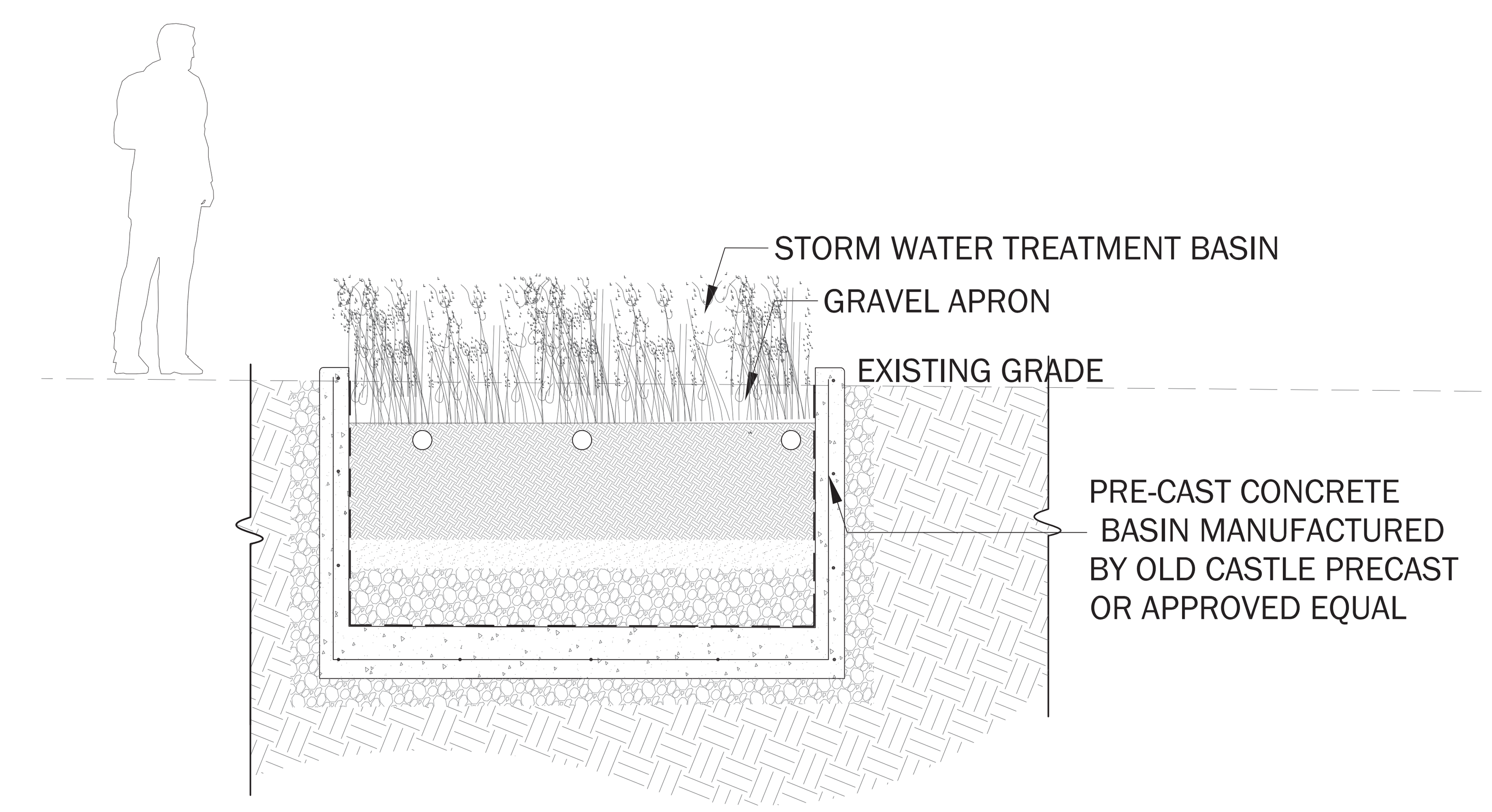
2. The end of the scupper pipe extension shall be the socket/bell end of the pipe.

3. Locate Soil Moisture Data Logger and Water Level Data Logger near basin outlet.

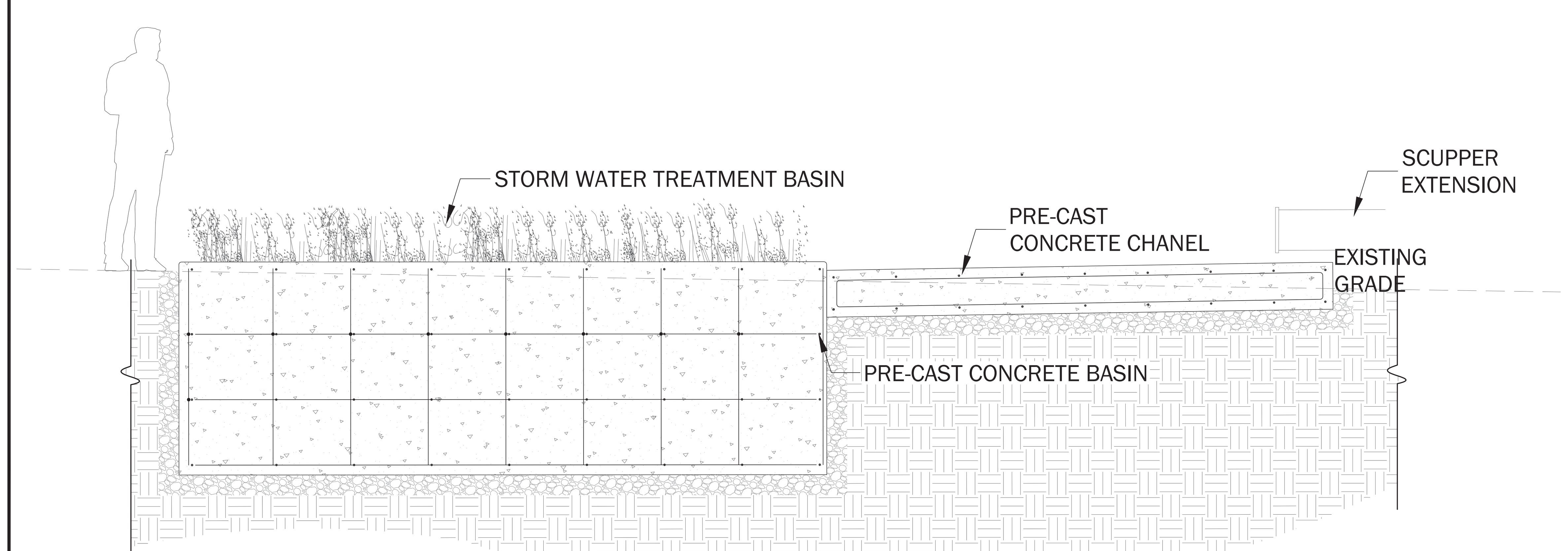
BC 7.6/ TC 8.1



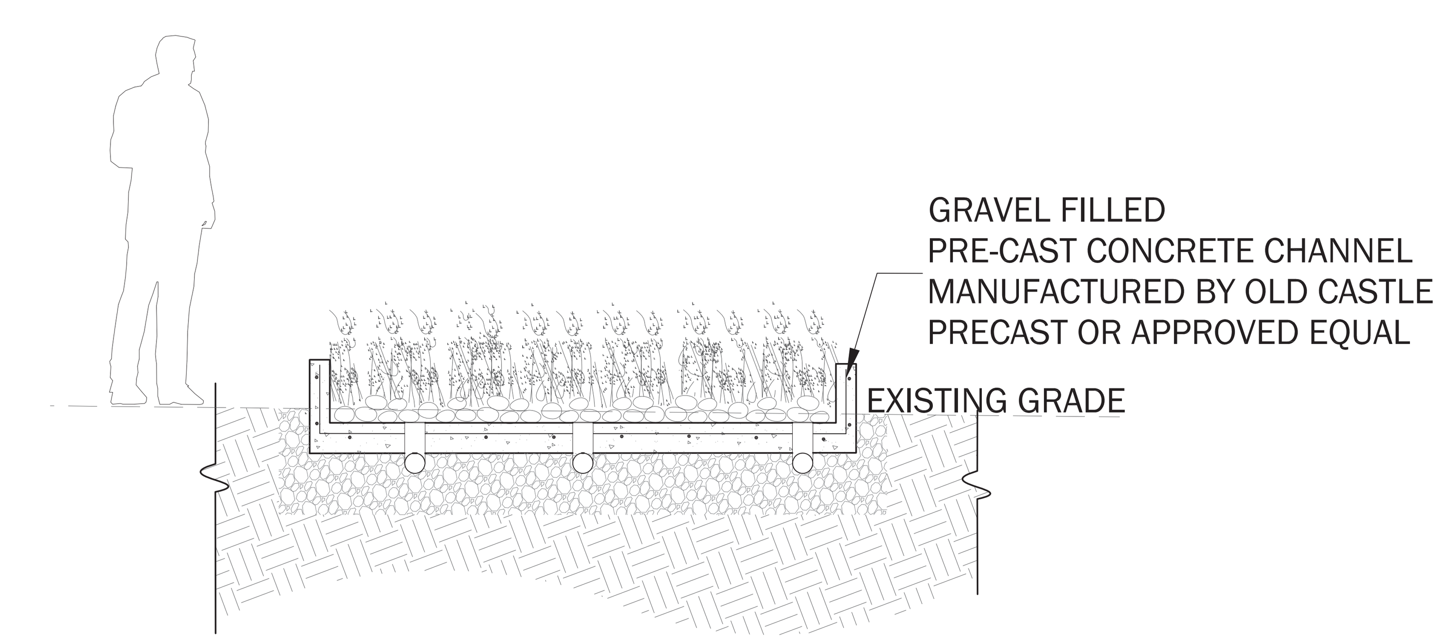
5 SECTION 1E
SECTION



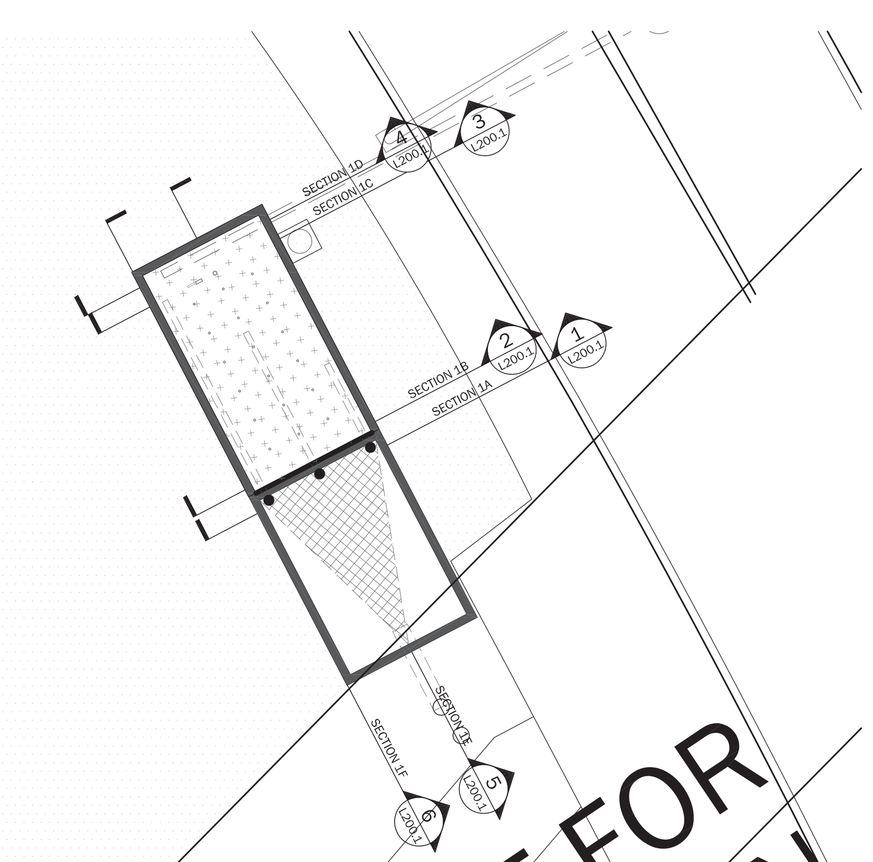
2 SECTION 1B
SECTION



6 SECTION 1F
SECTION



1 SECTION 1A
SECTION



KEY PLAN SCALE: 1"=10'

DRAFT NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	
REVISIONS			

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

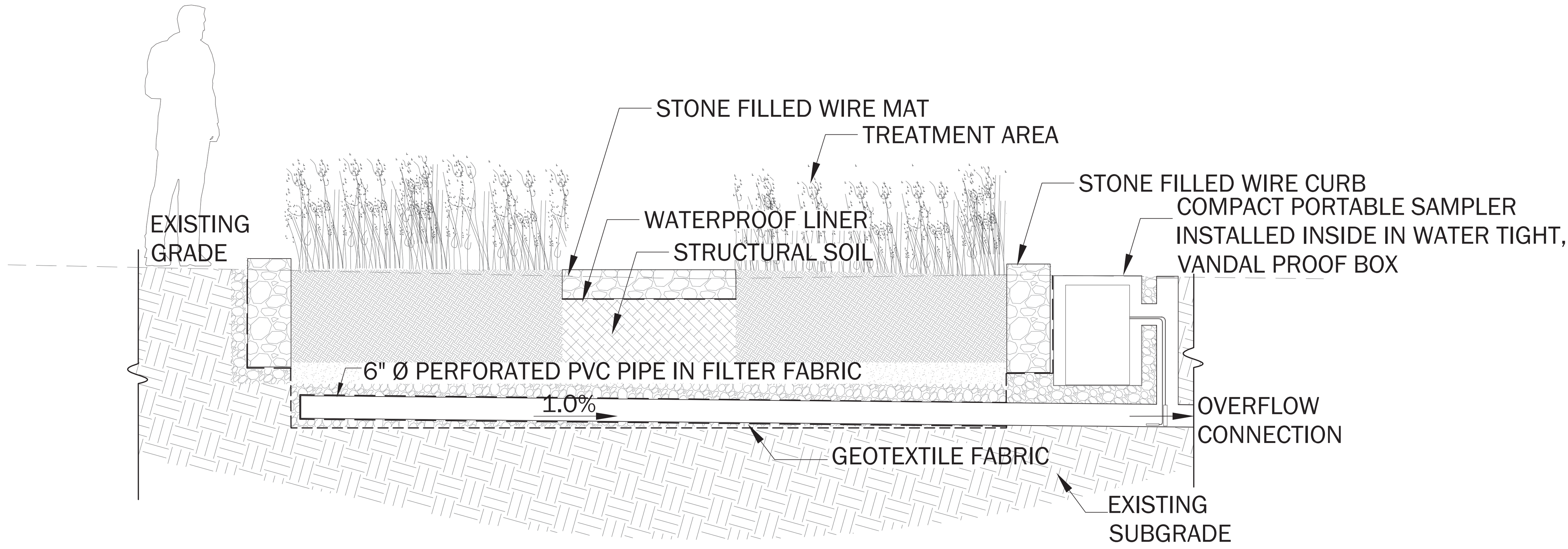
SCALE: 3/8"=1'-0"

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 1
SECTIONS

DATE: APRIL 16, 2012
DWG. NO.: 16 OF: 22
SHEET NO.: L-200.1



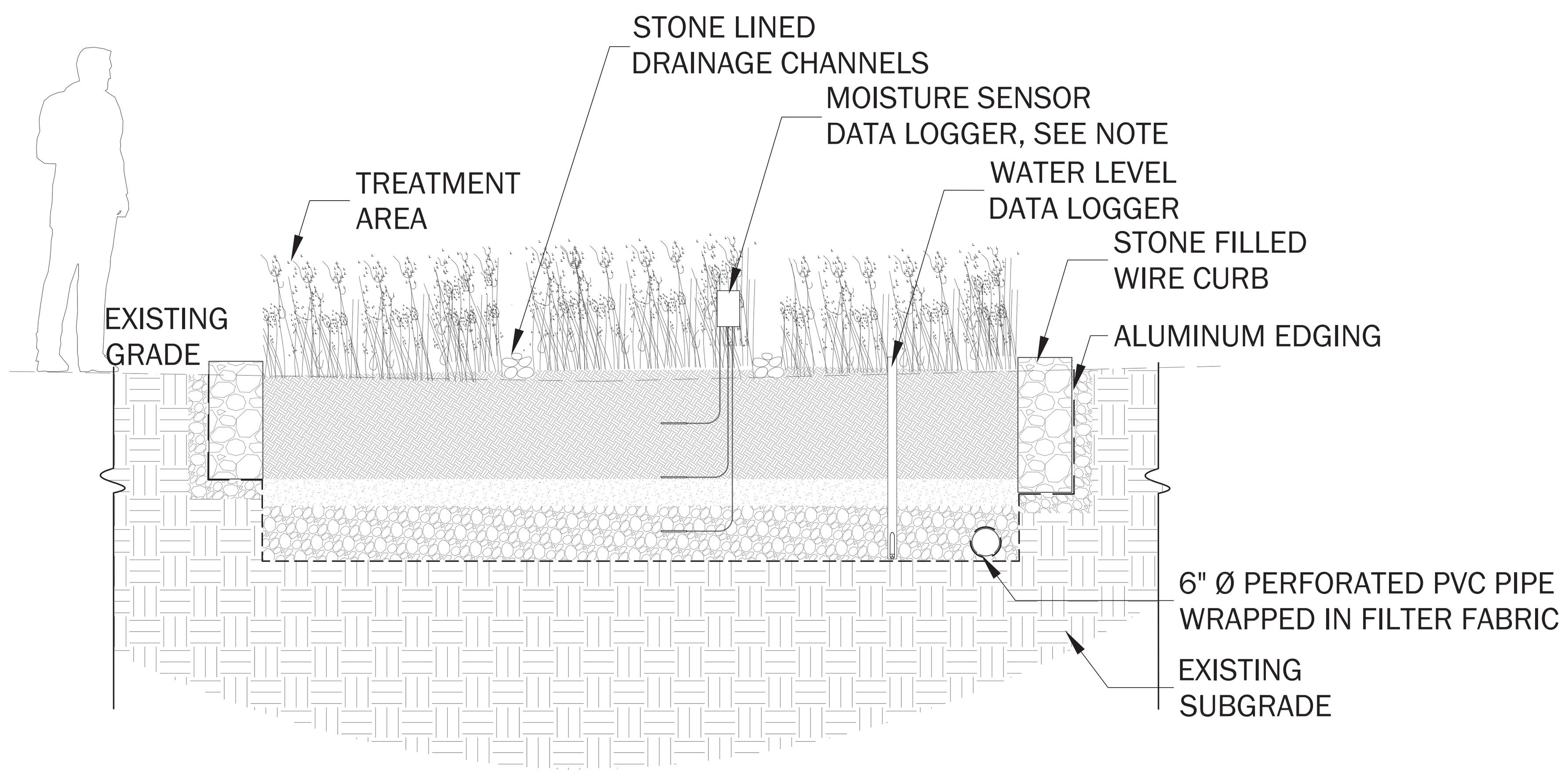
3 SECTION 2C
SECTION

NOTES:

1. Scupper pipe extension and bends (12" Ø) shall be added as necessary to direct the scuppers to the treatment basins. All fittings to be restrained mechanical joints for ductile iron pipe.

2. The end of the scupper pipe extension shall be the socket/bell end of the pipe.

3. Locate Soil Moisture Data Logger and Water Level Data Logger near basin outlet.



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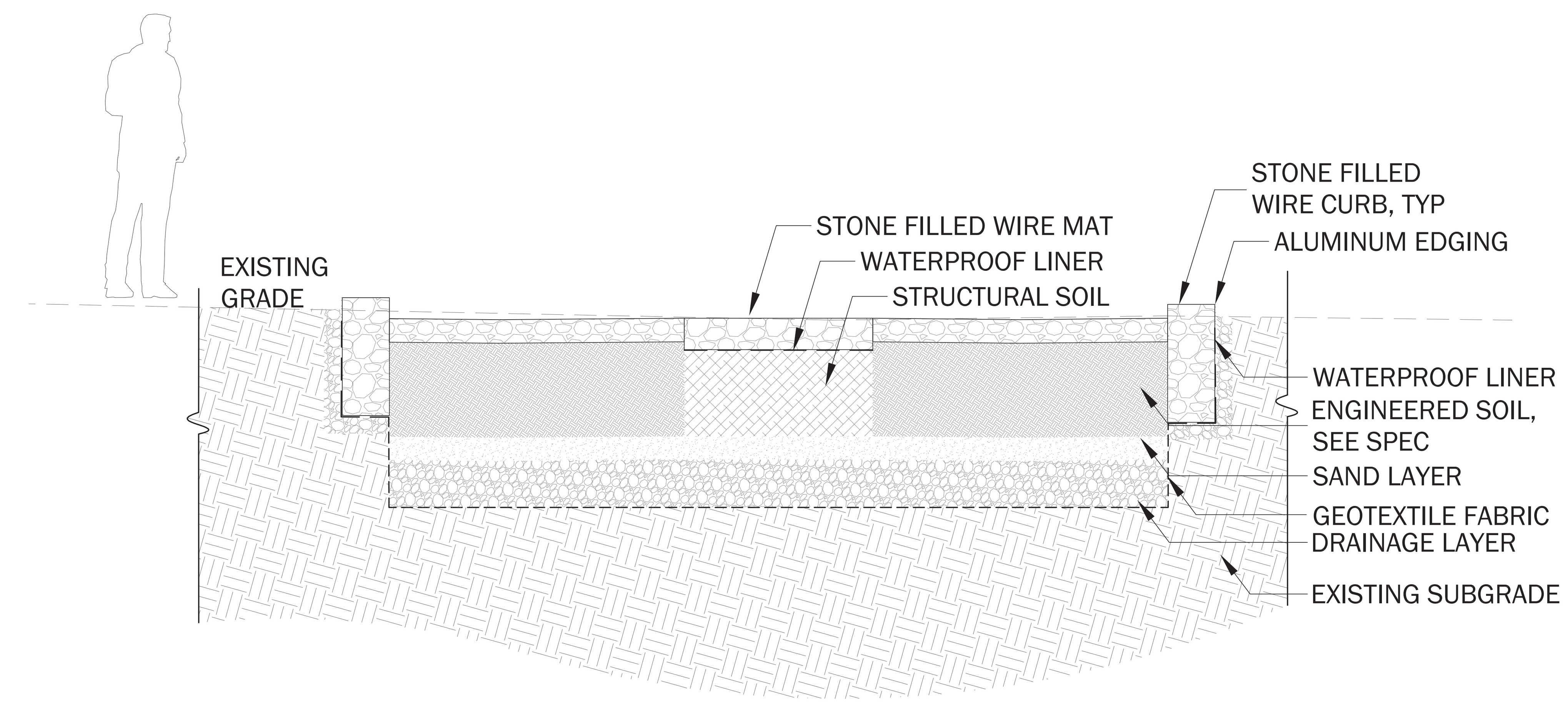
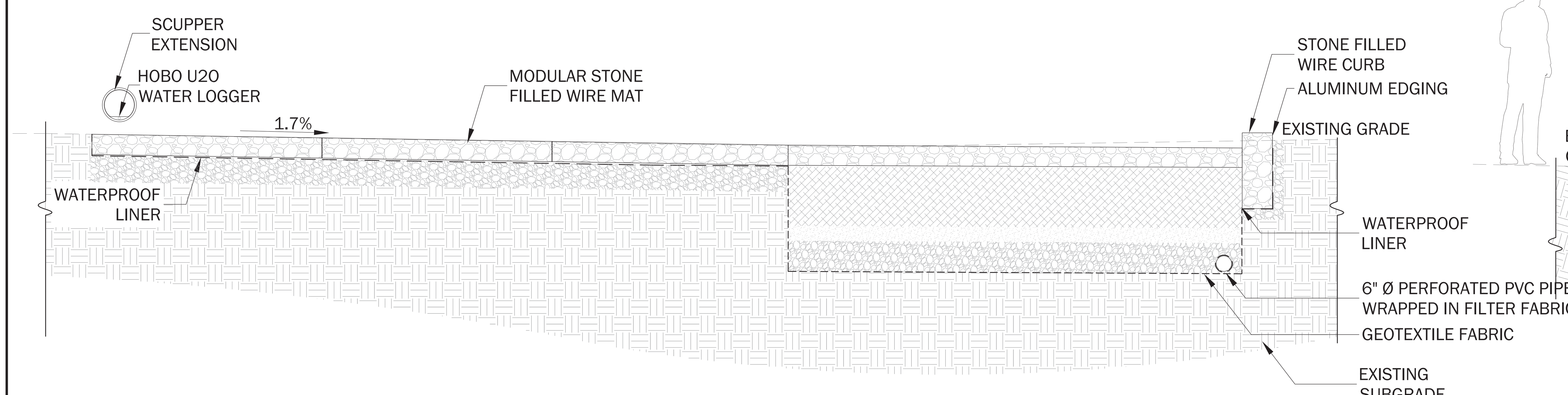
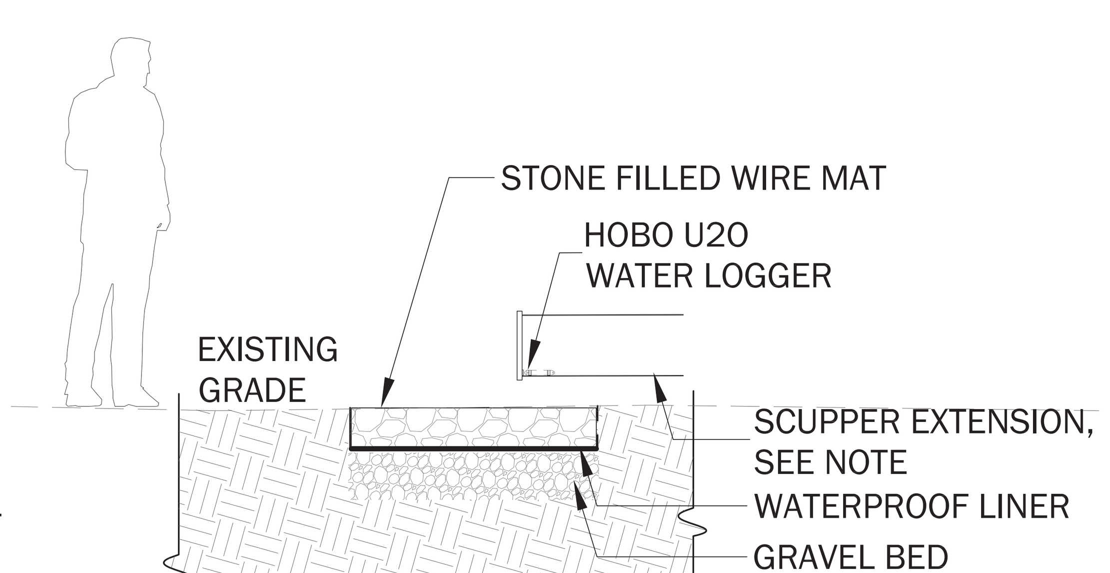
SECTION



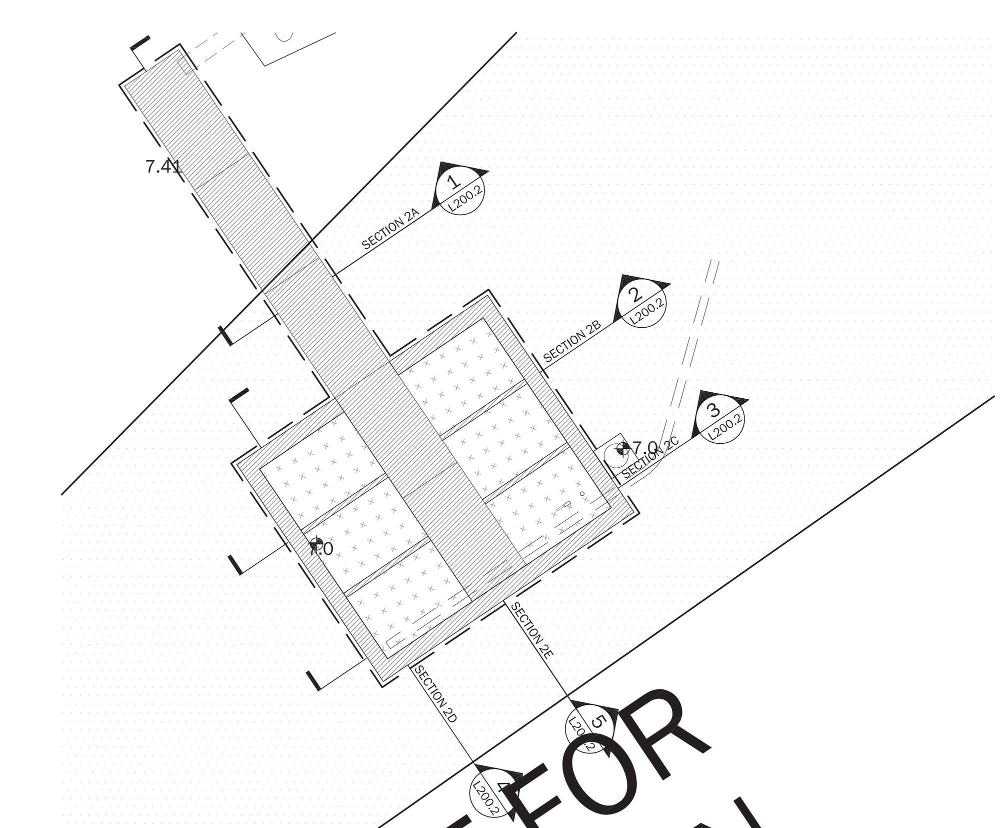
2 SECTION 2B
SECTION



5 SECTION 2E
SECTION



1 SECTION 2A
SECTION



KEY PLAN SCALE: 1" =10'

DRAFT NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 3/8"=1'-0"

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

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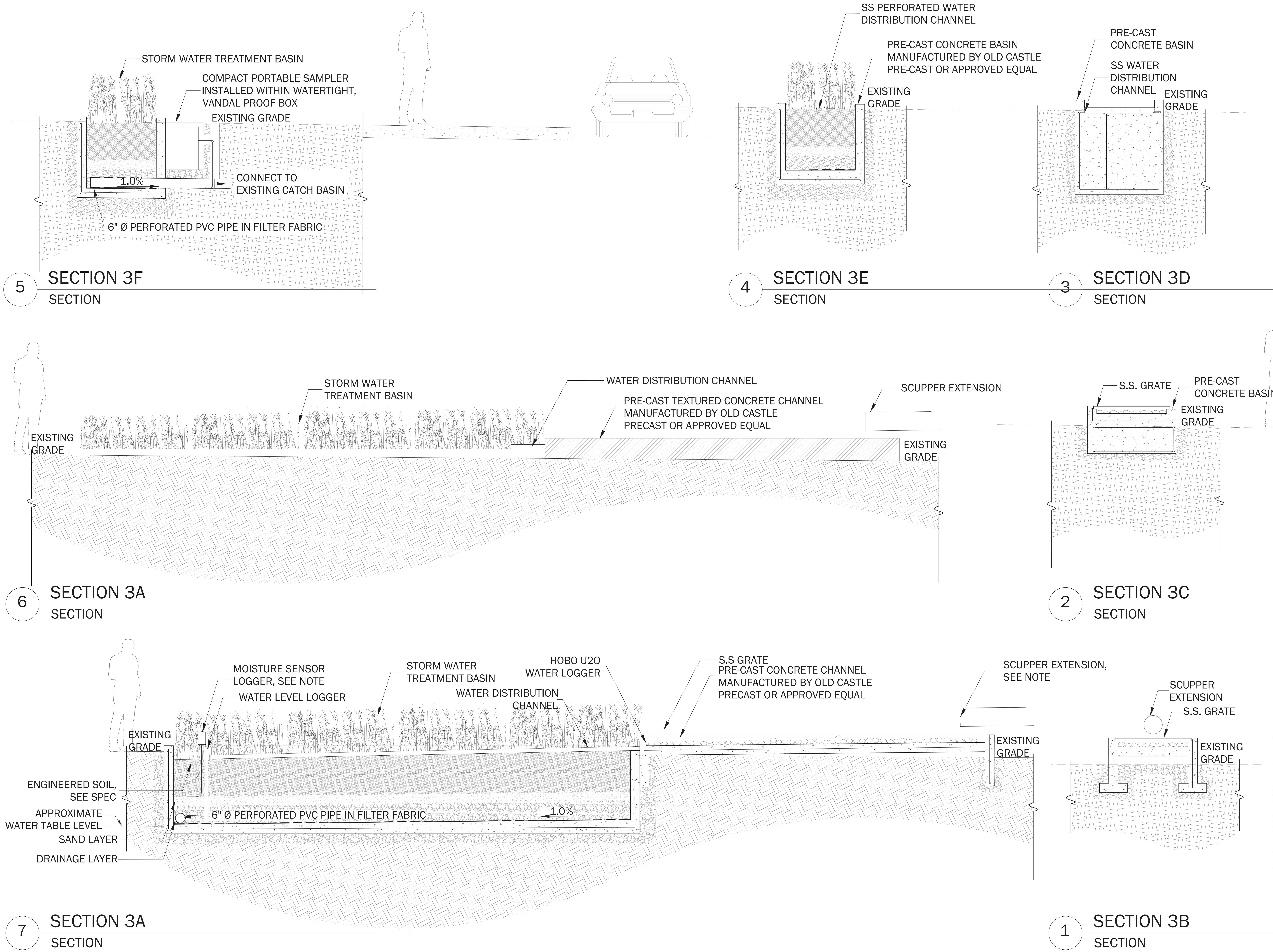
THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 2
SECTIONS

DATE: APRIL 16, 2012
DWG. NO.: 17 OF: 22
SHEET NO: L-200.2

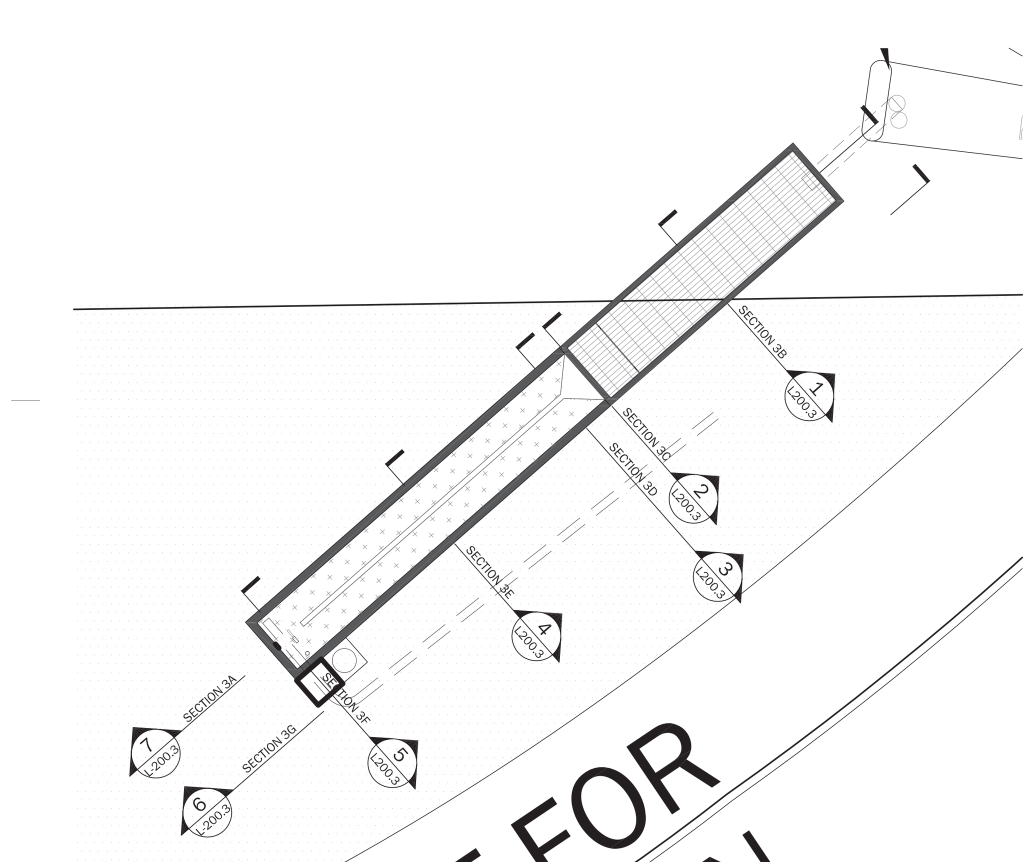


NOTES:

1. Scupper pipe extension and bends (12" Ø) shall be added as necessary to direct the scuppers to the treatment basins. All fittings to be restrained mechanical joints for ductile iron pipe.

2. The end of the scupper pipe extension shall be the socket/bell end of the pipe.

3. Locate Soil Moisture Data Logger and Water Level Data Logger near basin outlet.



KEY PLAN SCALE: 1" =10'

DRAFT NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: 3/8"=1'-0"

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

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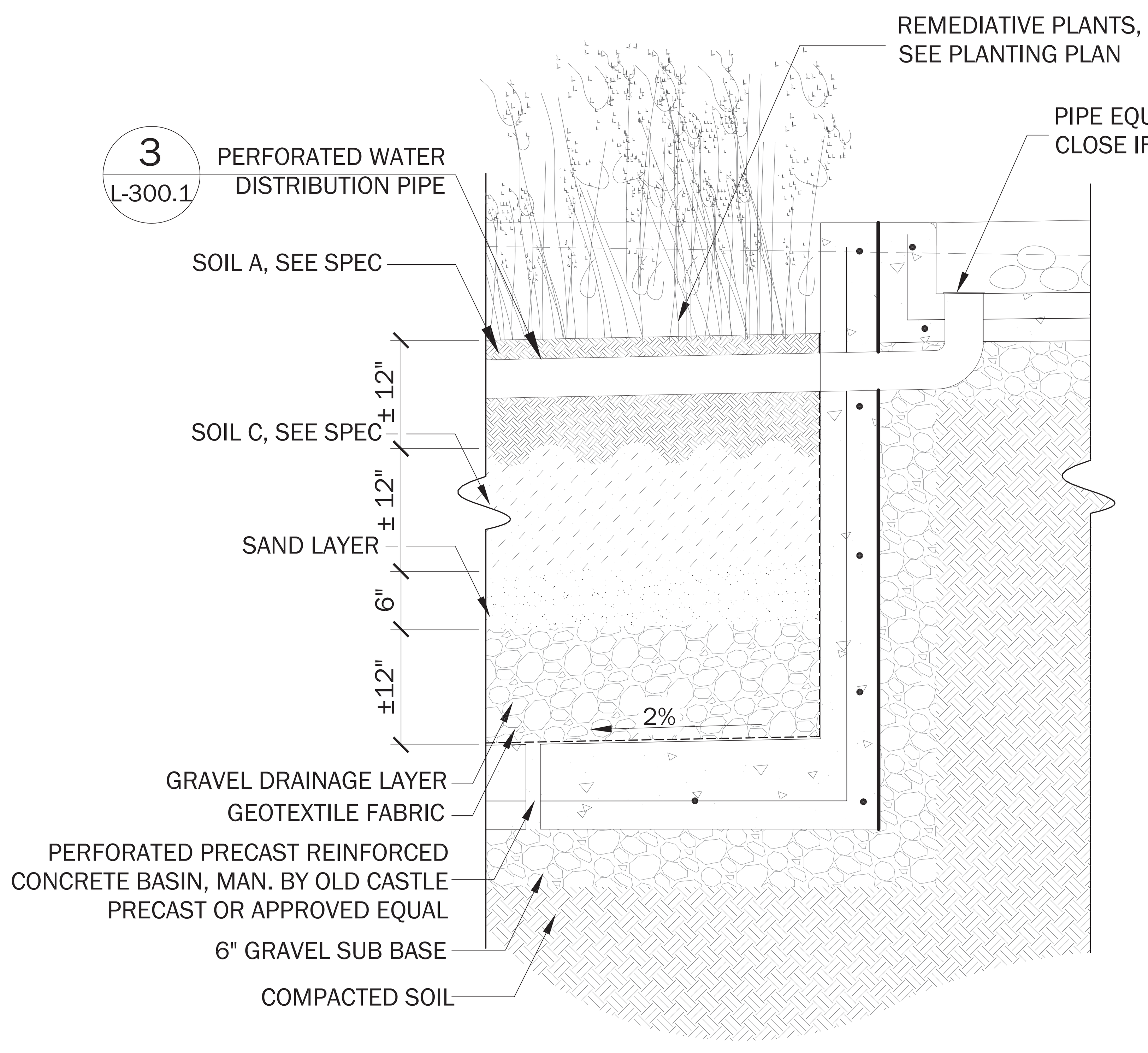
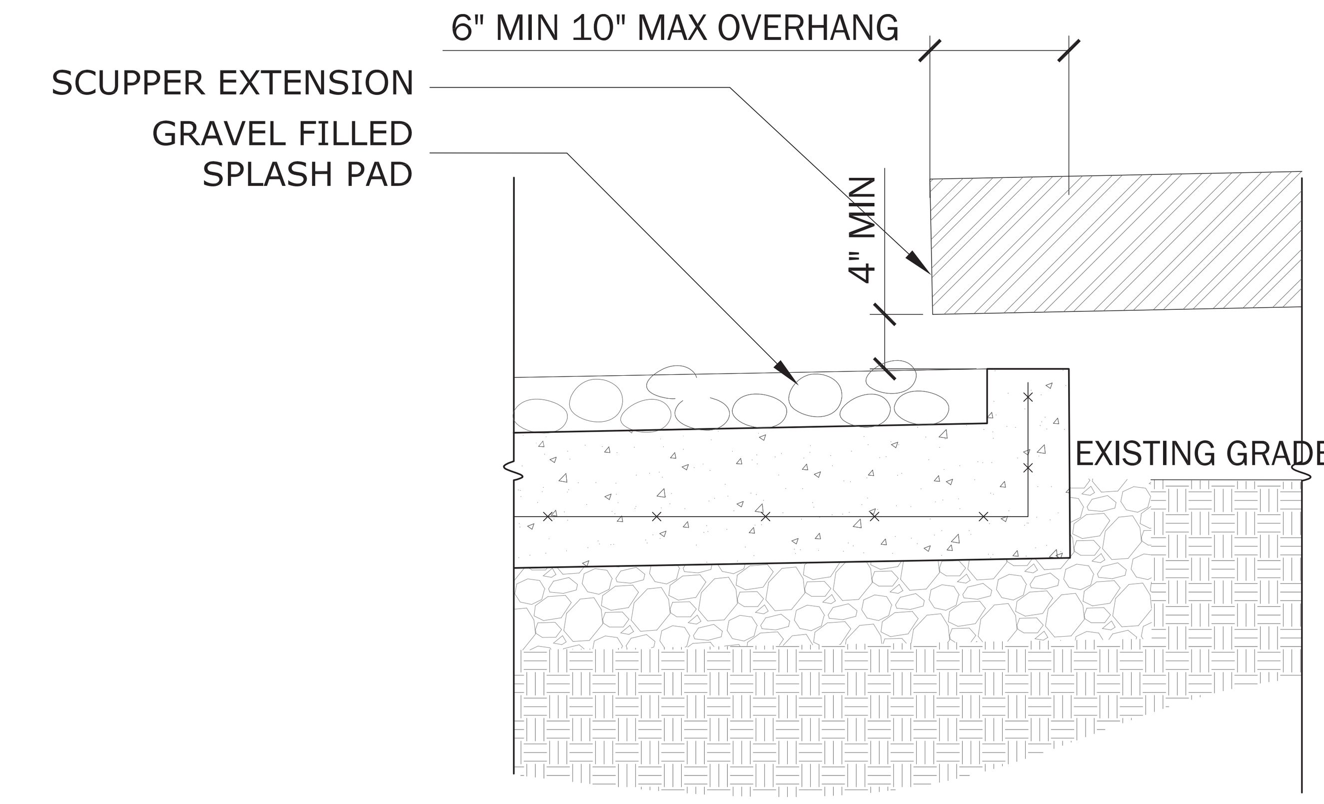
THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
SITE B SCUPPER 3
SECTIONS

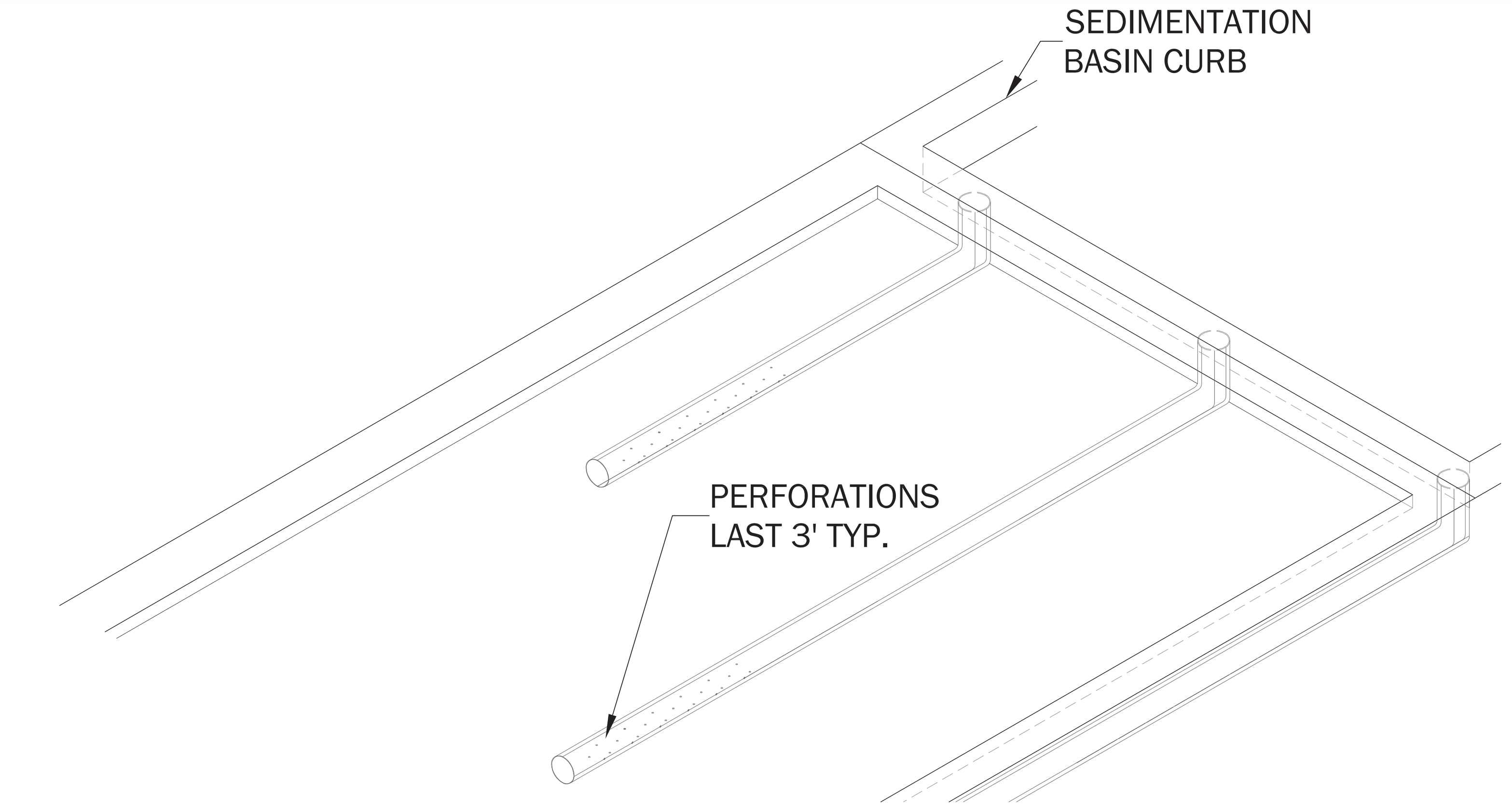
DATE: APRIL 16, 2012
DWG. NO.: 18 OF: 22
SHEET NO: L-200.3 OF:



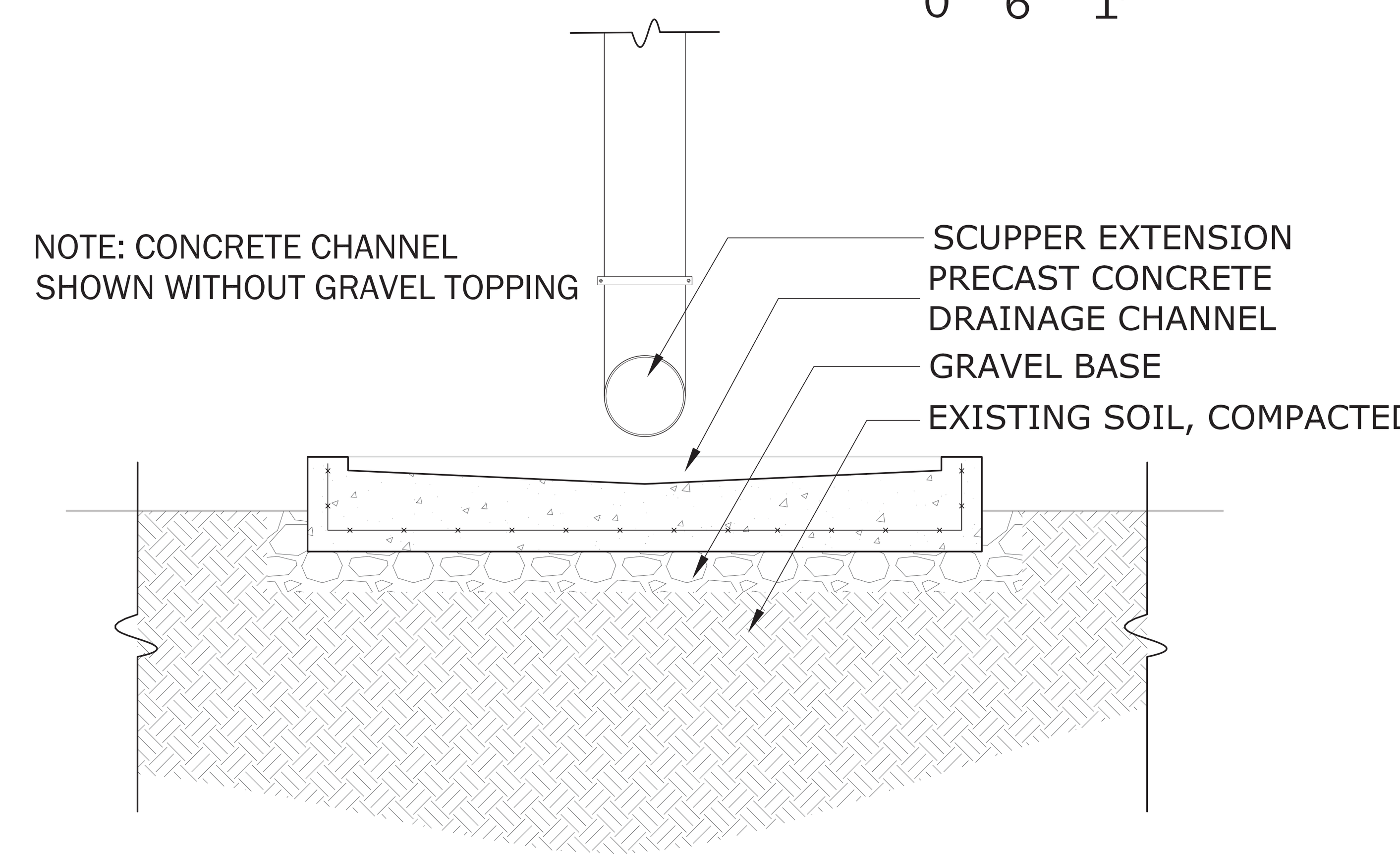
8 TREATMENT BASIN
DETAIL SCALE: 1" =1' 0 6" 1'



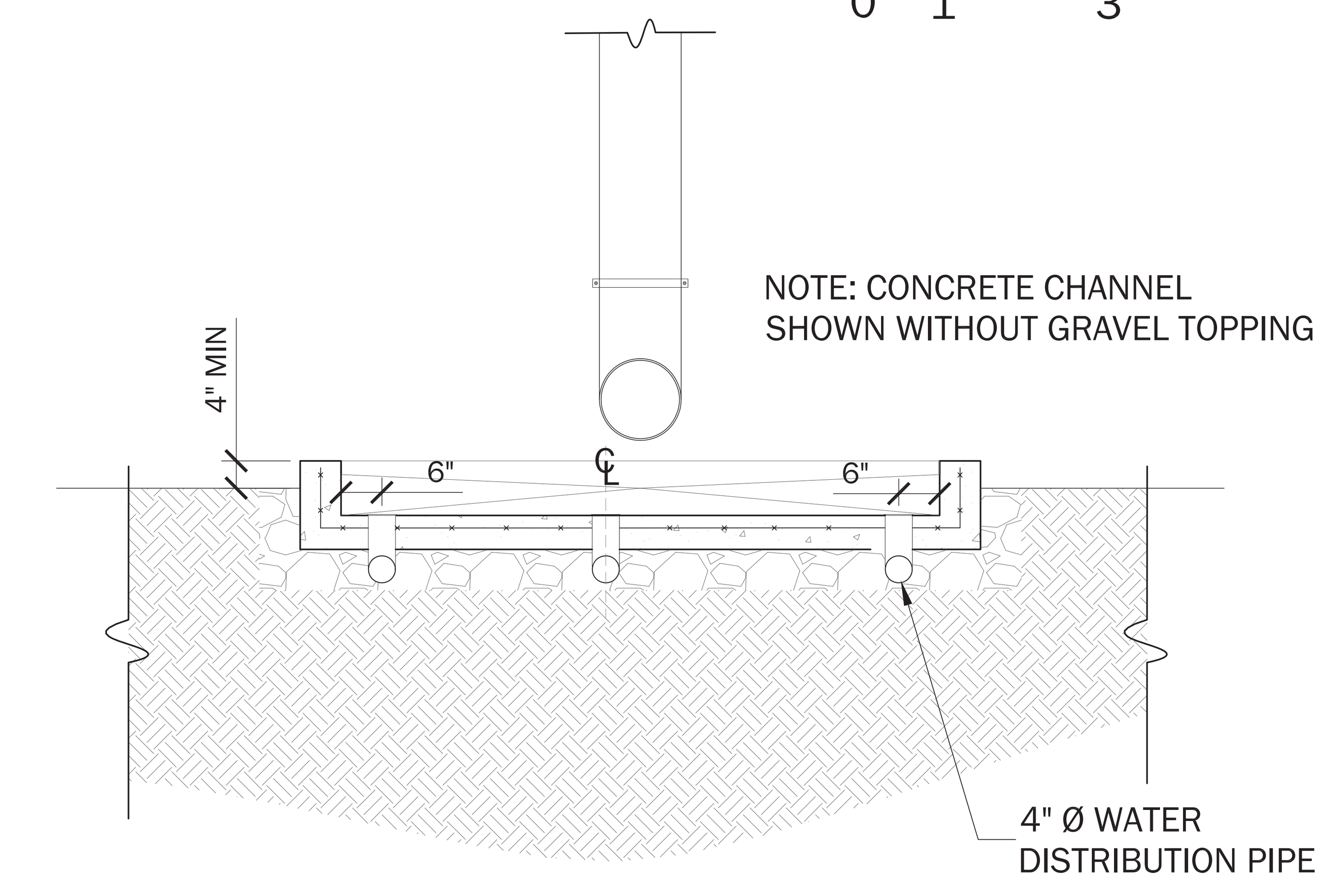
6 SCUPPER @ CONCRETE CHANNEL
DETAIL SCALE: 1" =1' 0 6" 1'



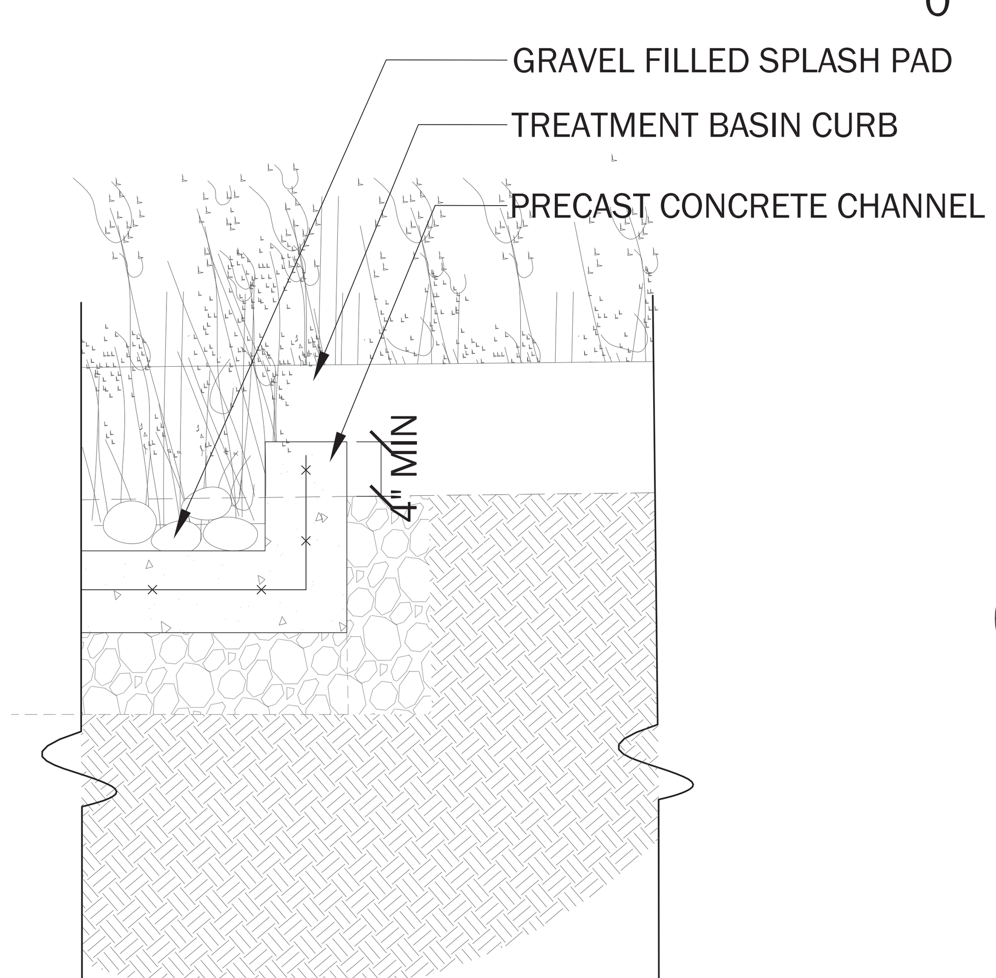
3 PERFORATED WATER DISTRIBUTION PIPES AXON
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



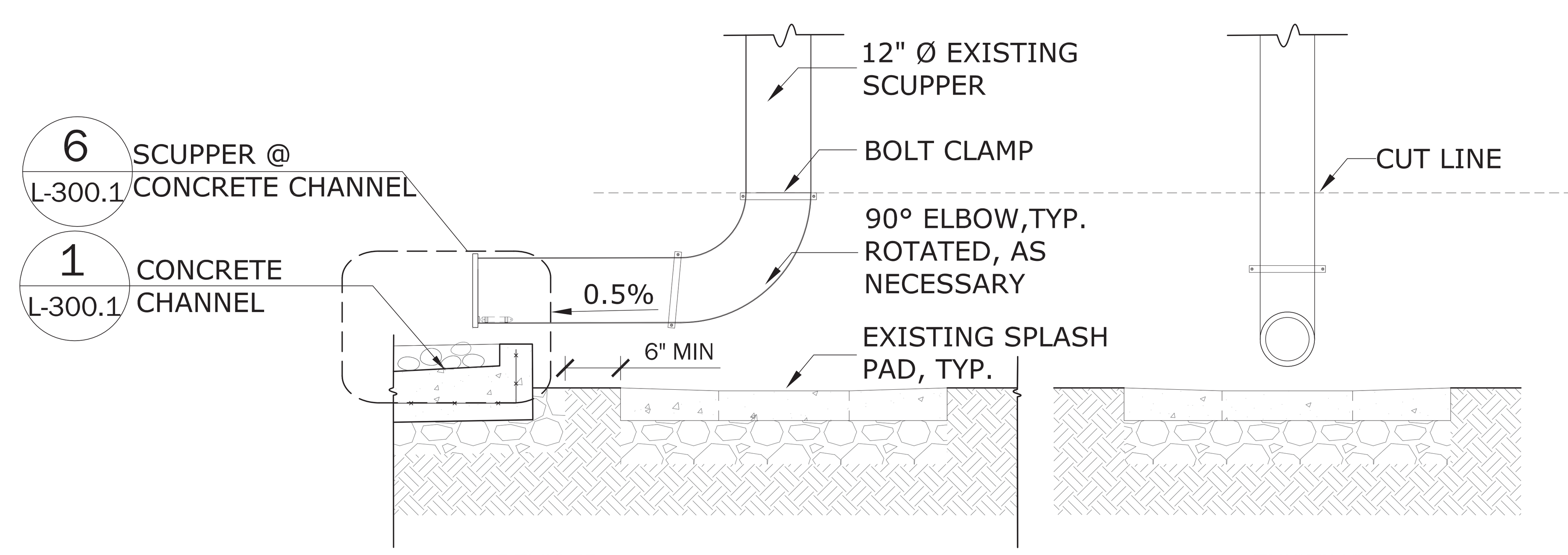
5 CONCRETE CHANNEL @ SCUPPER
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



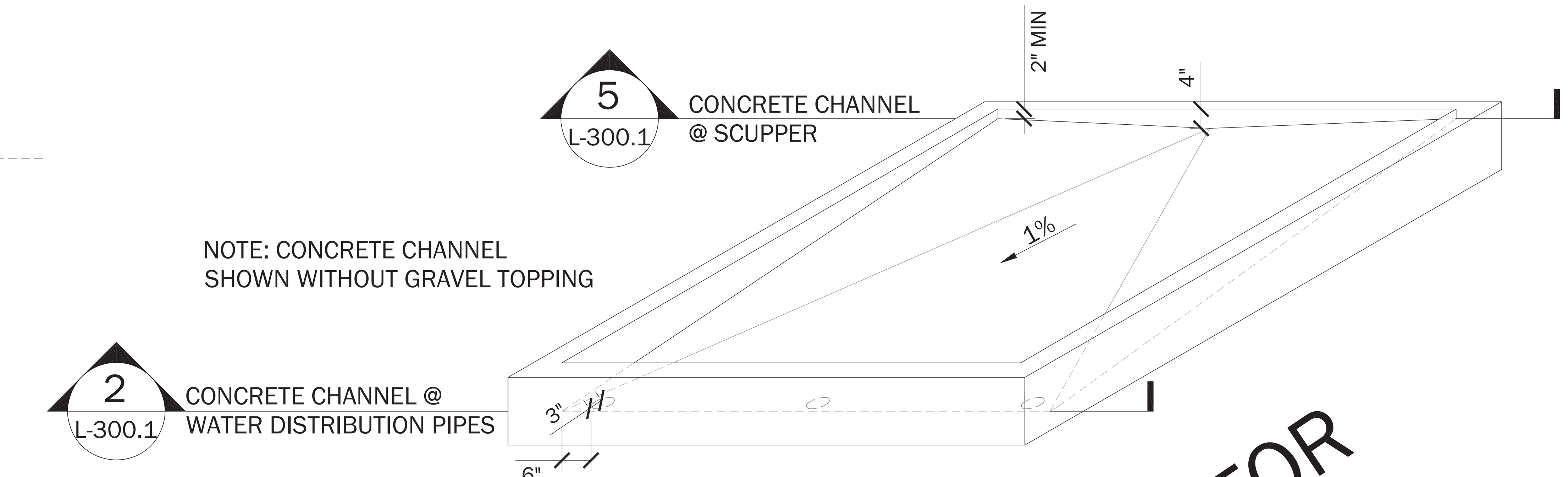
2 CONCRETE CHANNEL @ WATER DISTRIBUTION PIPES
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



7 CONCRETE CHANNEL AT EXISTING GRADE
DETAIL SCALE: 1" =1' 0 6" 1'



4 SCUPPER EXTENSION
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



1 CONCRETE CHANNEL AXON
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'

DRAFT NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

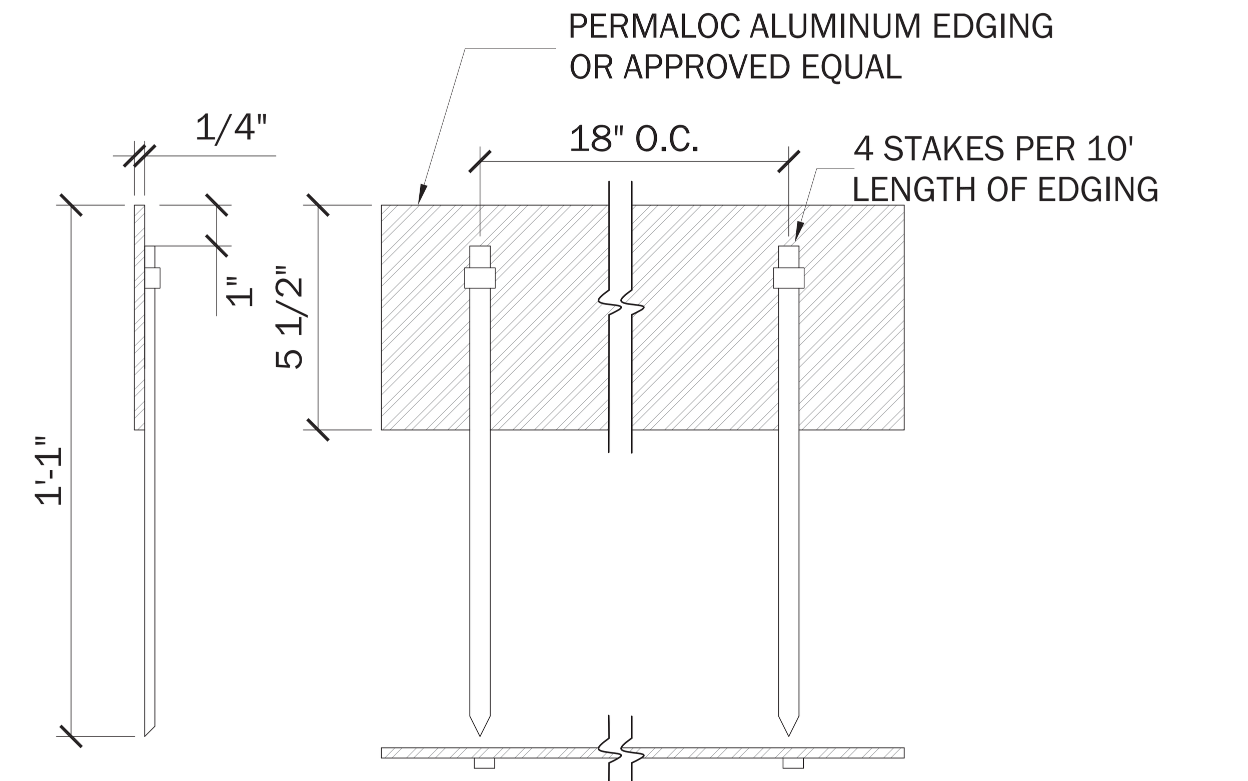
SCALE: AS NOTED

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

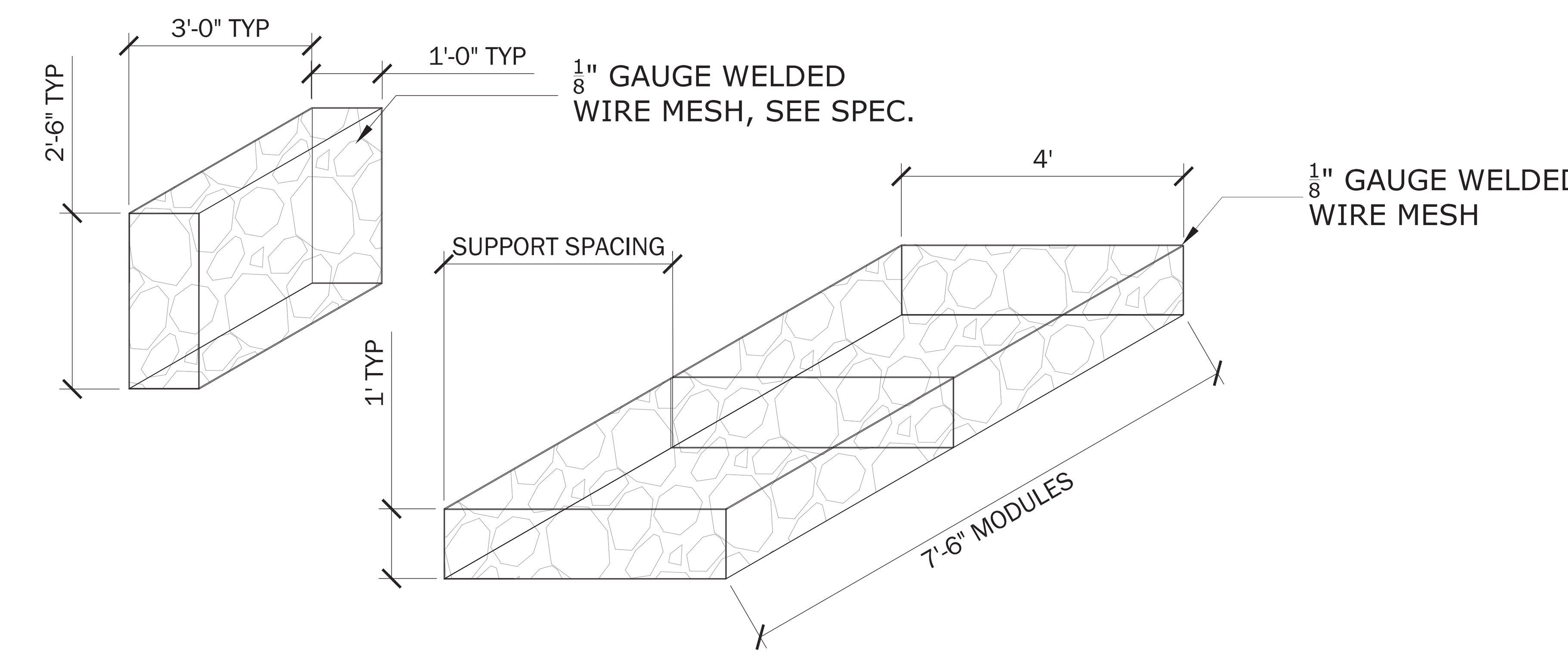
THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
SITE A SCUPPER 1 DETAILS

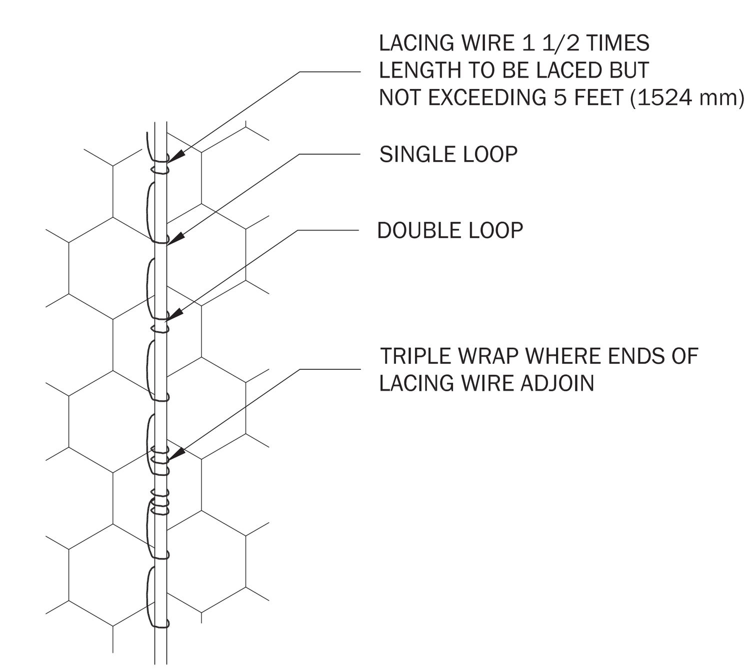
DATE: APRIL 16, 2012
DWG. NO.: 19 OF: 22
SHEET NO: L-300.1



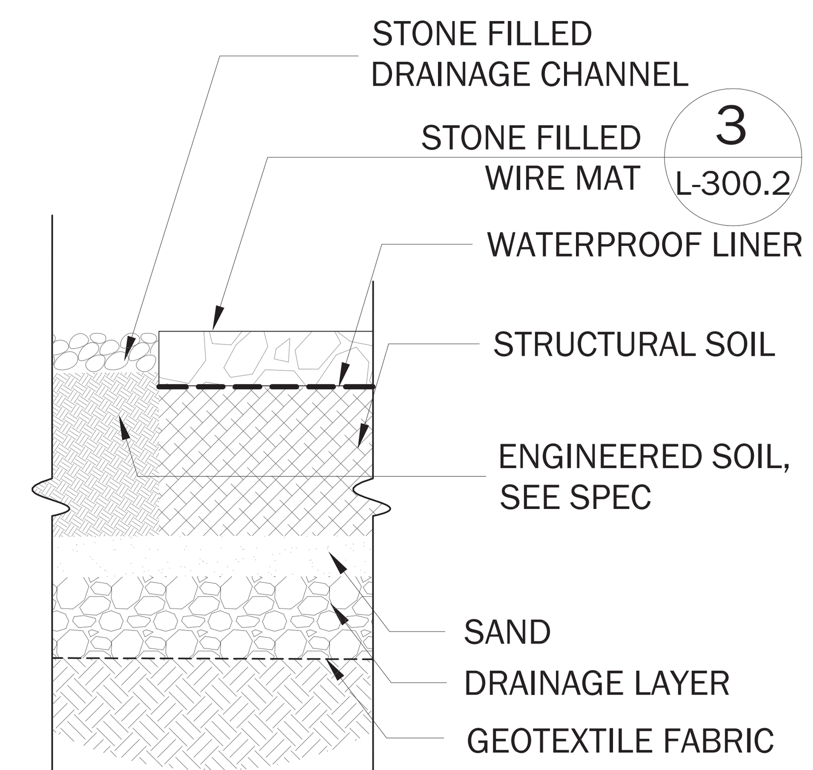
6 ALUMINUM EDGING
DETAIL SCALE: 3" =1' 0 3" 6" 1'



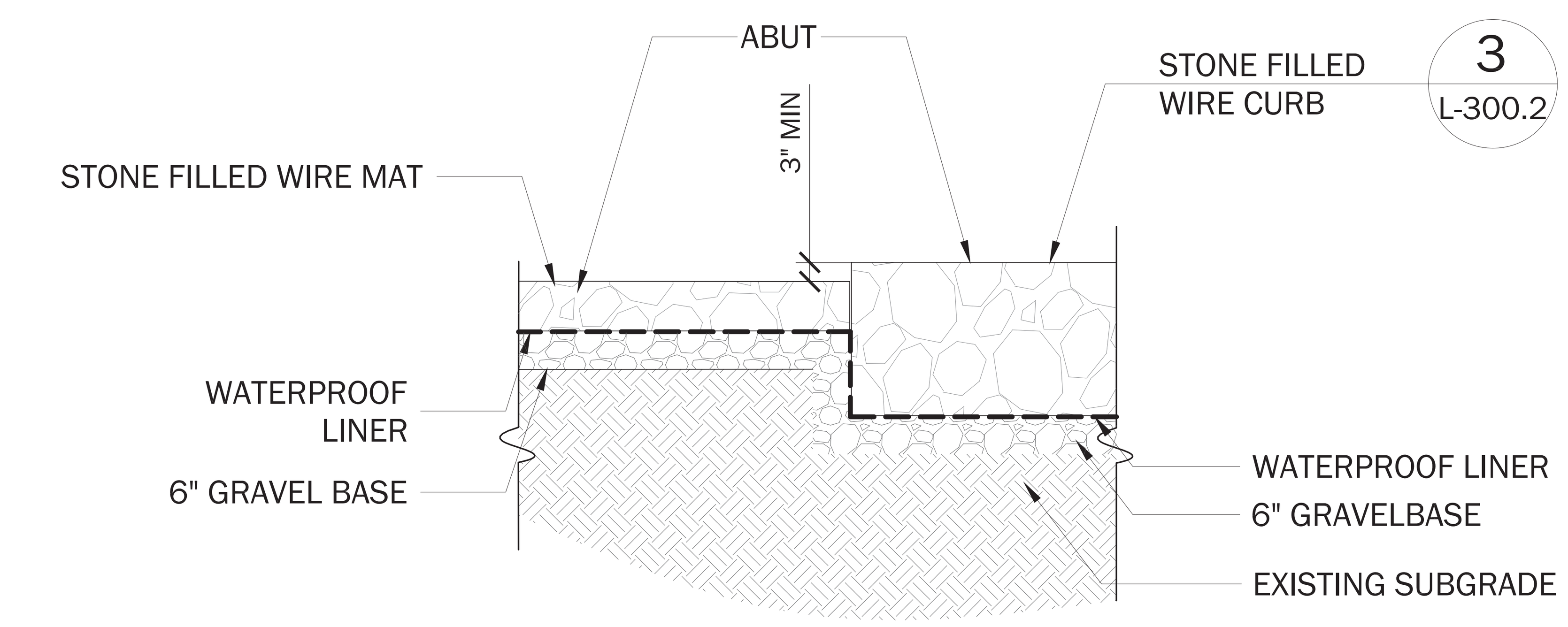
3 STONE FILLED WIRE MAT AND CURB
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



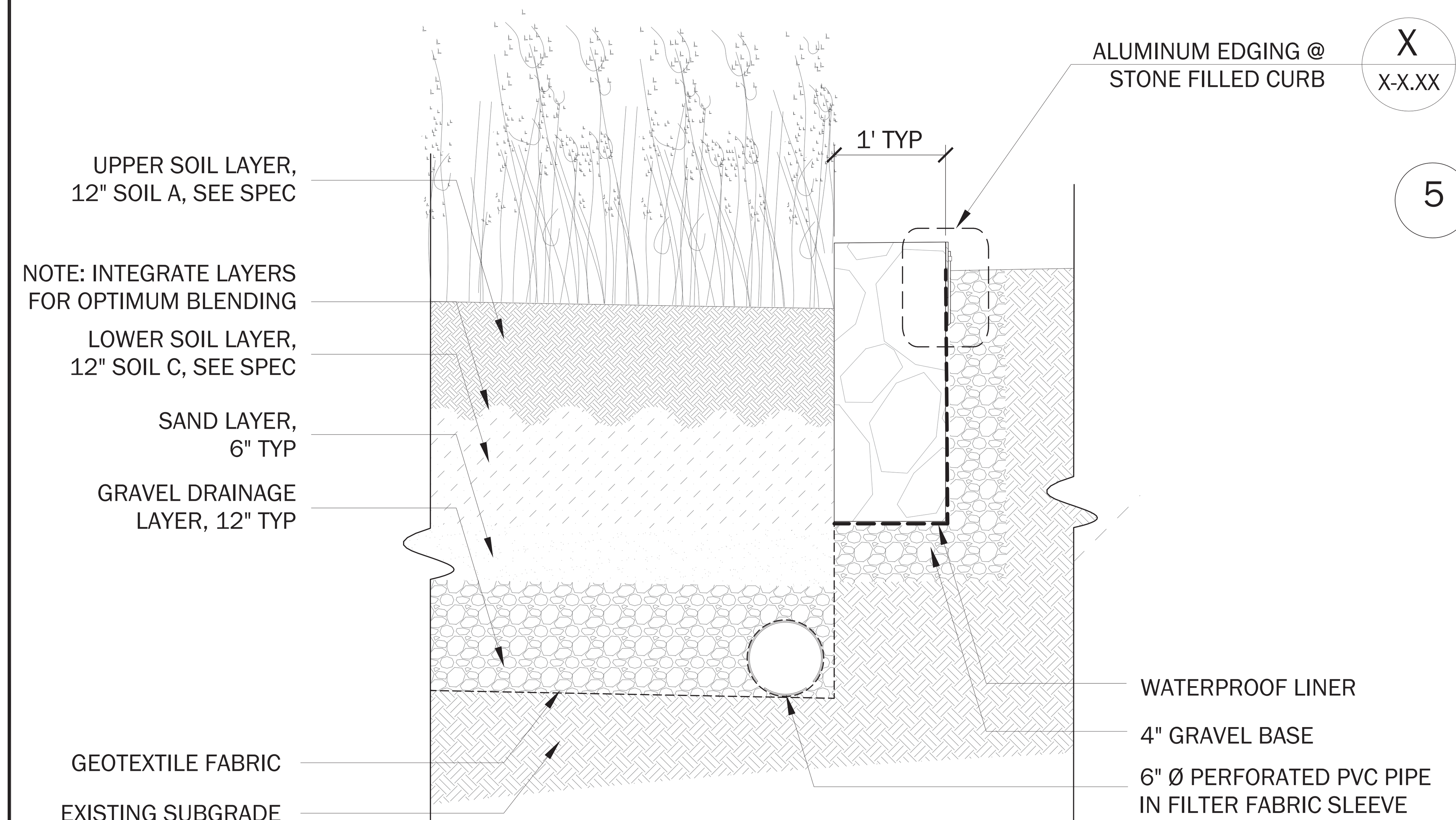
8 WIRE LACING
DETAIL SCALE: 3" =1' 0 3" 6" 1'



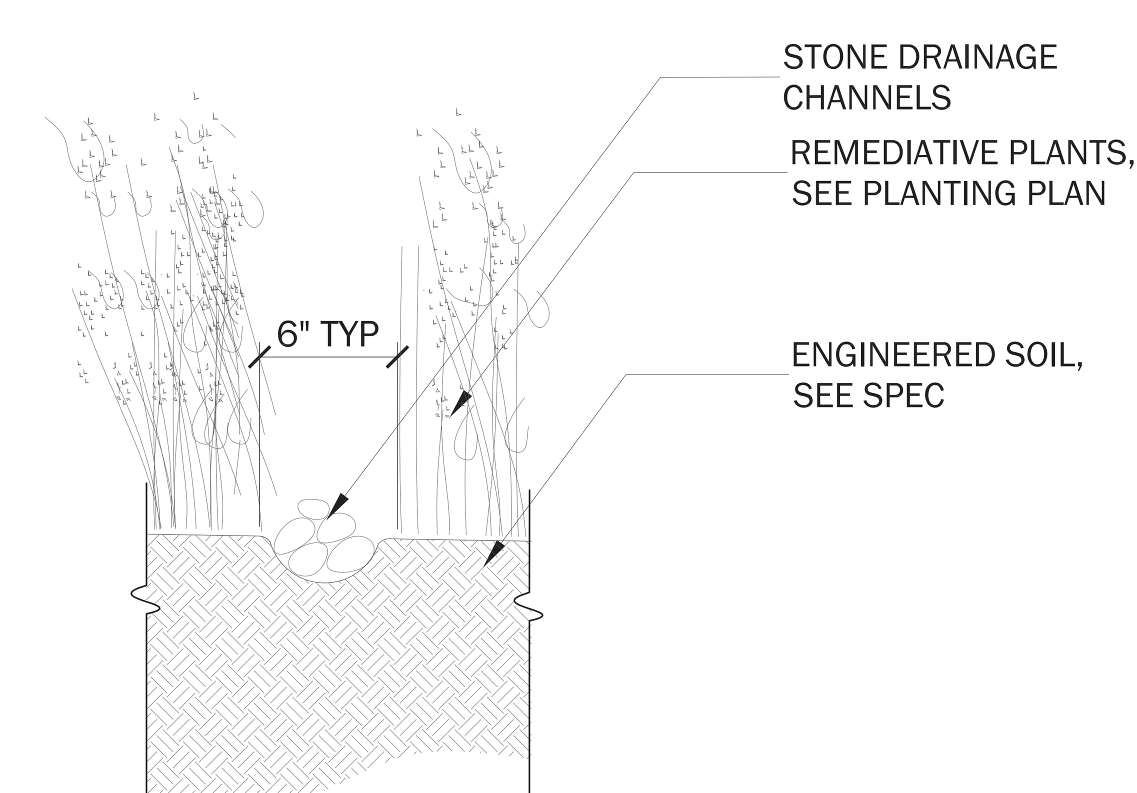
5 STONE FILLED WIRE MAT @ DRAINAGE CHANNEL
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



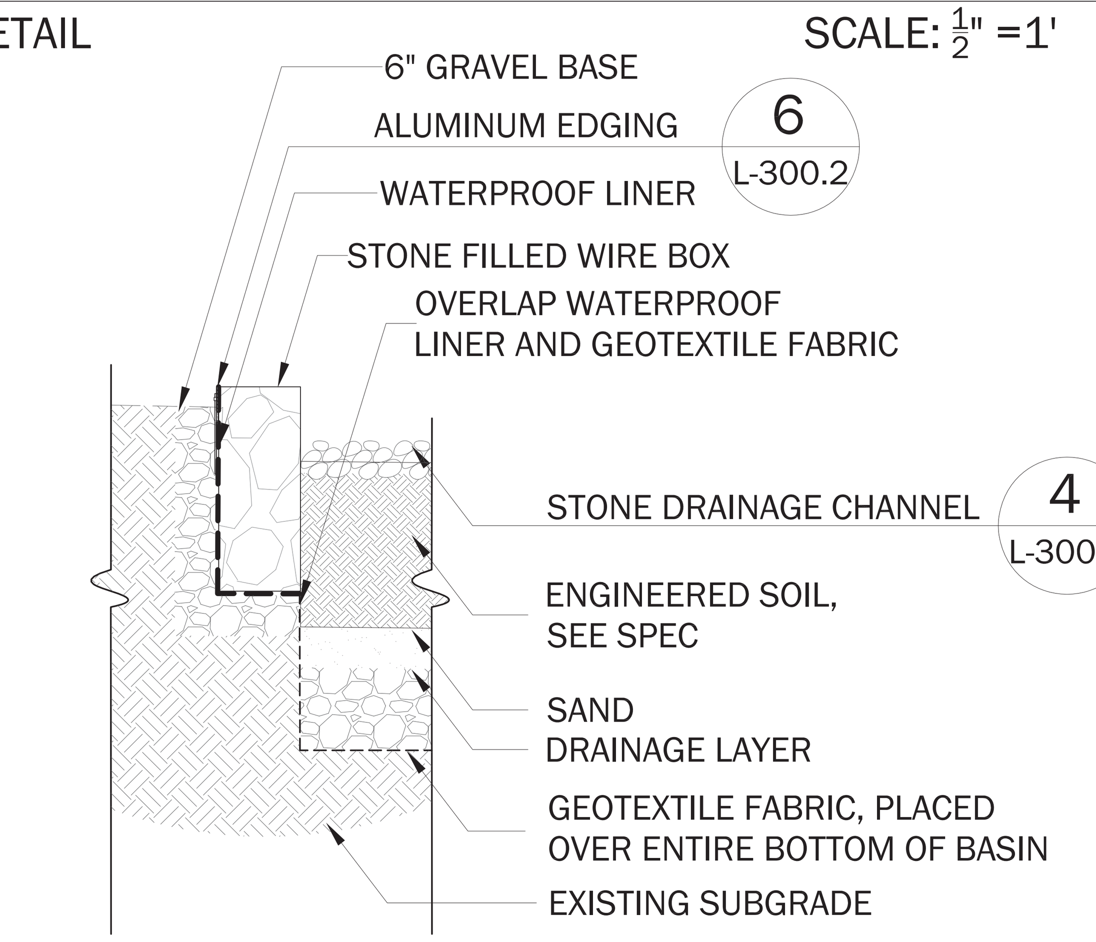
2 STONE FILLED WIRE MAT @ STONE FILLED WIRE CURB
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'



7 TREATMENT AREA EDGE AND PROFILE
DETAIL SCALE: 1" =1' 0 1' 2' 3'



4 STONE DRAINAGE CHANNELS
DETAIL SCALE: 1" =1' 0 1' 2'



1 STONE FILLED WIRE CURB @ DRAINAGE CHANNEL
DETAIL SCALE: $\frac{1}{2}$" =1' 0 1' 3'

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	
REVISIONS			

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: AS NOTED

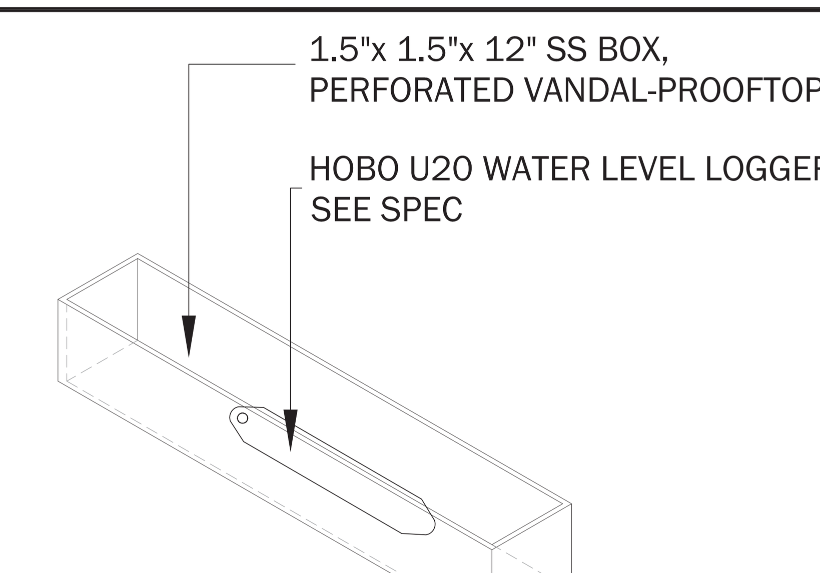
PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

THE CITY OF NEW YORK
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

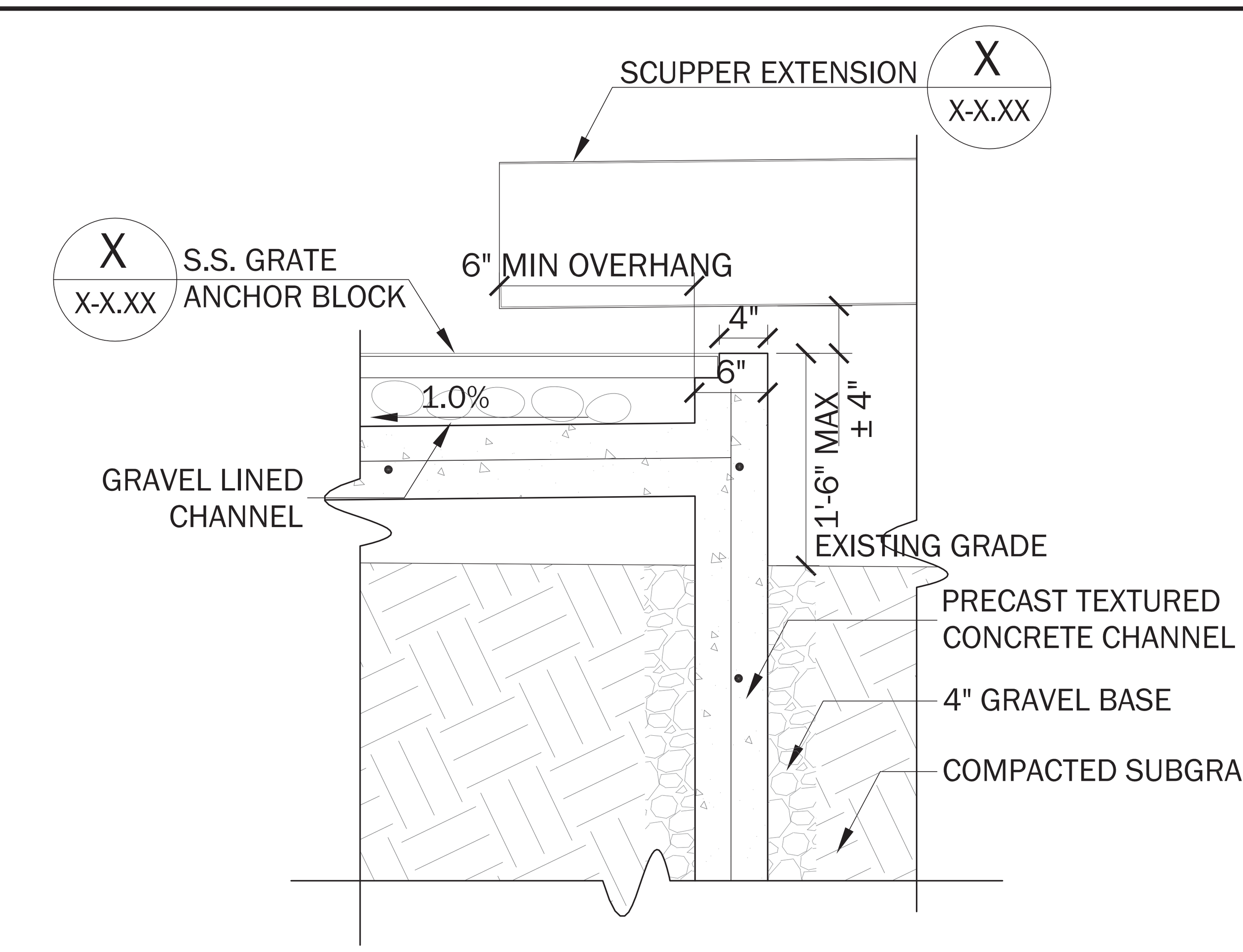
FLUSHING MEADOWS PILOT SPONGE SWALE

SITE A SCUPPER 2 DETAILS

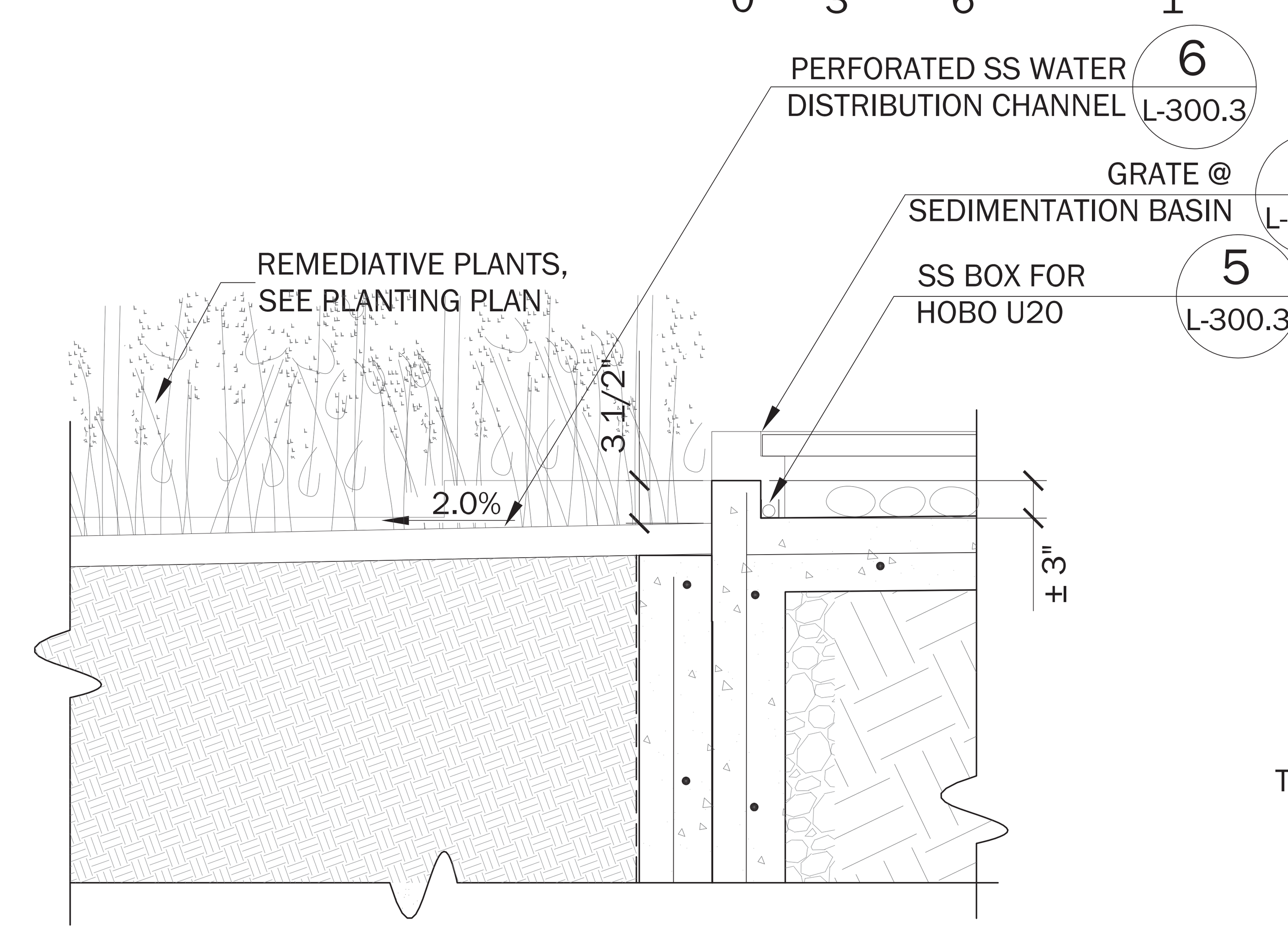
DATE: APRIL 16, 2012
DWG. NO.: 20 OF: 22
SHEET NO: L-300.2 OF:



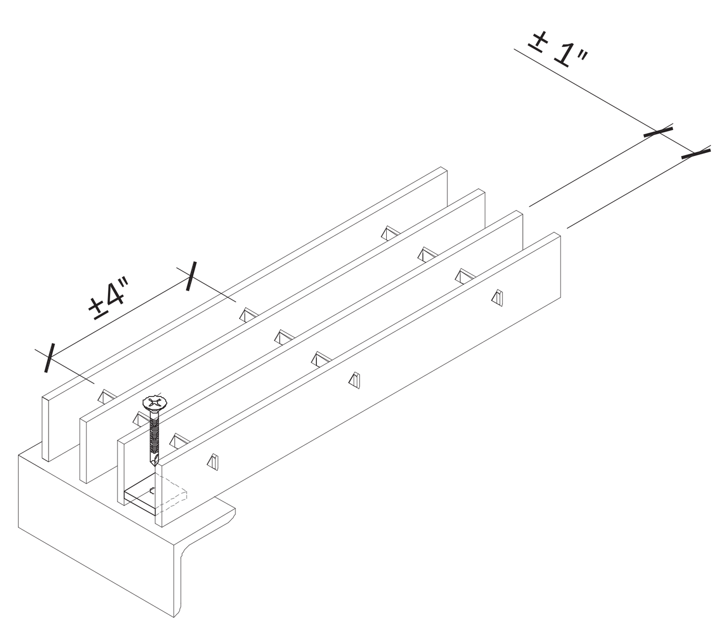
5 S. S. BOX FOR HOBO U20
DETAIL SCALE: 3" =1' 0 3" 6" 1'



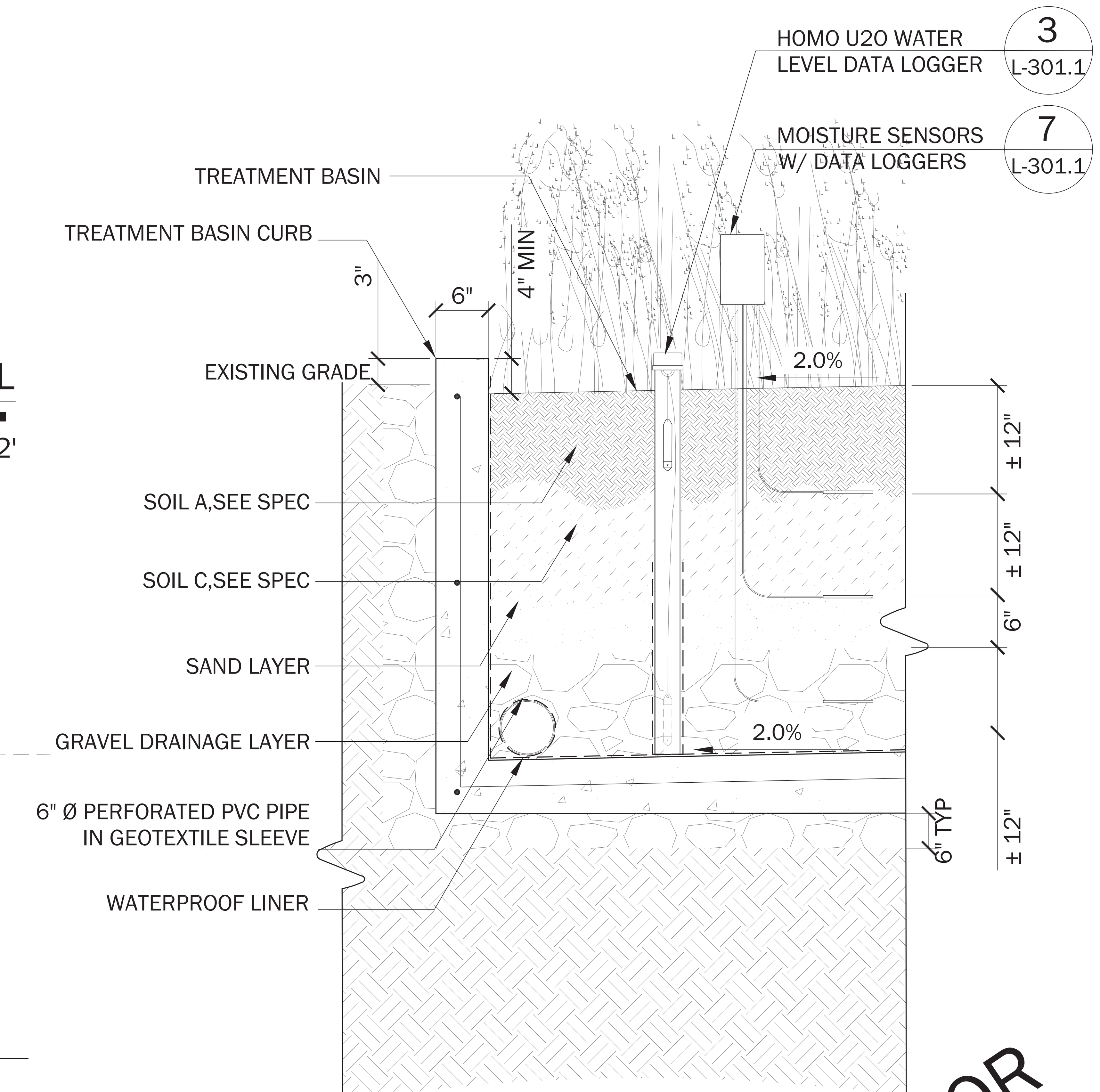
2 SCUPPER @ SEDIMENTATION BASIN
DETAIL SCALE: 1" =1' 0 1' 2'

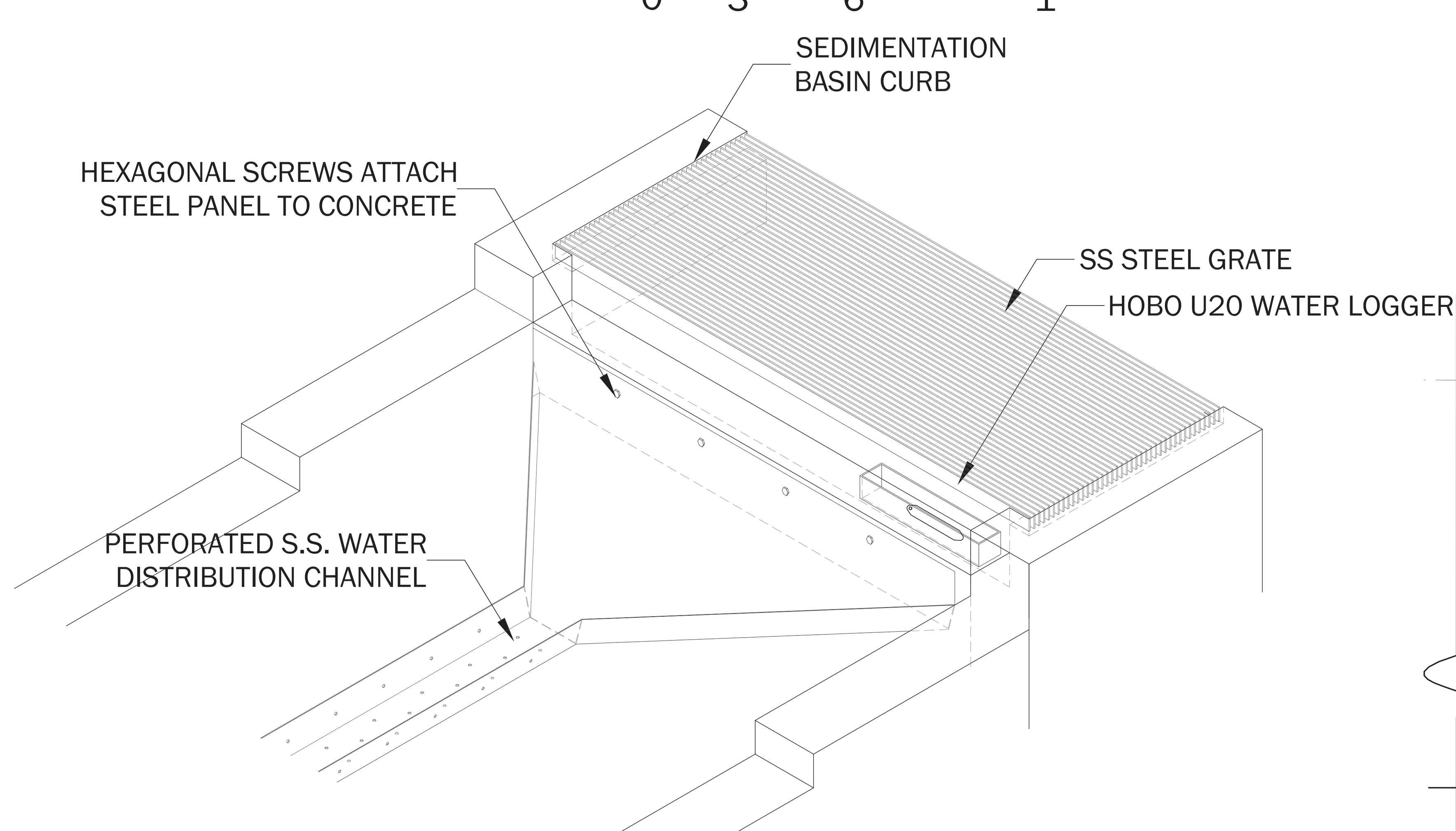


4 SEDIMENTATION BASIN @ WATER CHANNEL
DETAIL SCALE: 1" =1' 0 1' 2'

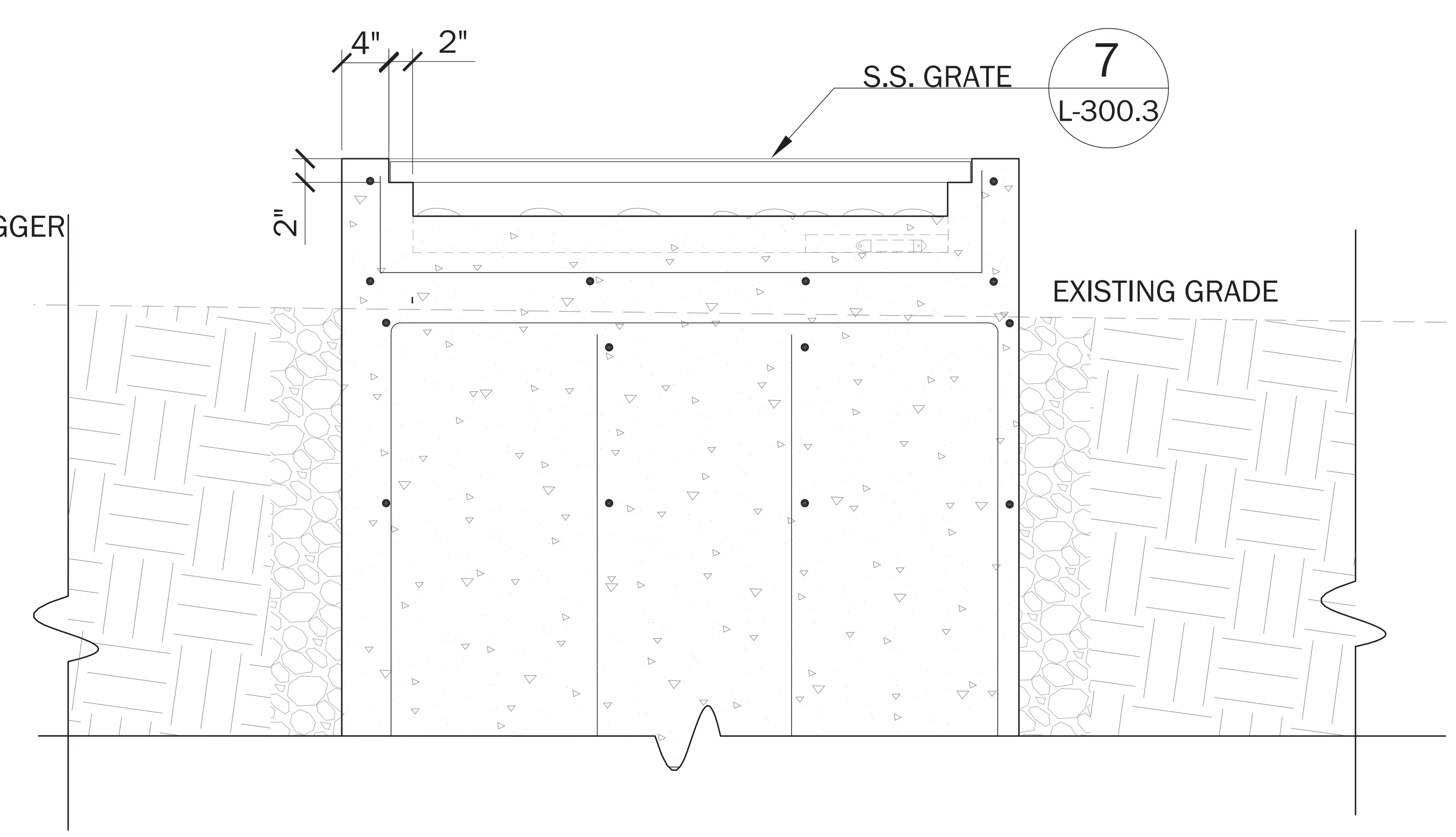


7 SS GRATE
DETAIL SCALE: 3" =1' 0 3" 6" 1'





6 WATER DISTRIBUTION CHANNEL
AXON SCALE: 1" =1' 0 1' 2'



3 GRATE @ SEDIMENTATION BASIN
DETAIL SCALE: 1" =1' 0 1' 2'

1 TREATMENT BASIN
DETAIL SCALE: 1" =1' 0 1' 2'

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: AS NOTED

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

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BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE
SITE B SCUPPER 3 DETAILS

DATE: APRIL 16, 2012
DWG. NO.: 21 OF: 22
SHEET NO: L-300.3 OF:

DRAFT NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	APPR'D.
	4/13/12	90% CD REVIEW	
	2/17/12	60% CD REVIEW	

REVISIONS

DRAWN BY: REBECCA HILL
DESIGNED BY: dlandstudio llc
CHECKED BY: SUSANNAH DRAKE
GROUP LEADER:
SECTION CHIEF: ROBERT CUEVAS, R.A.

SCALE: AS NOTED

PROJECT MANAGER
CHIEF, DIVISION OF FAC. DES. N (S)
CHIEF, DIVISION OF IN-HOUSE DESIGN

THE CITY OF NEW YORK
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
BUREAU OF ENGINEERING DESIGN & CONSTRUCTION

FLUSHING MEADOWS PILOT SPONGE SWALE

MONITORING EQUIPMENT DETAILS

DRAFT NOT FOR CONSTRUCTION

DATE: APRIL 16, 2012
DWG. NO.: 22 OF: 22
SHEET NO: L-301.1

Quality Assurance Project Plan

1 Title And Approvals

Project title: Post-construction Monitoring of the Sponge Park™
in Flushing Meadow Corona Park, Queens, New York
Organization name: Manhattan College, Regional Plan Association; dland studio, llc;
Effective date of plan: 08/29/13
Approving officials

Kirk R. Barrett — 11/7/13

Dr. Kirk Barrett, PE — Date
Department of Civil and Environmental Engineering, Manhattan College
Technical Project Manager for Monitoring

11/7/13

Dr. Dibyendu Sarkar — Date
Department of Earth and Environmental Studies, Montclair State University
QA/QC Officer

11/3/13

Mr. Robert Pirani — Date
Regional Plan Association

11/7/13

Ms. Susannah Drake — Date
dland studio, llc

11/11/2013

Lynn Dwyer — Date
National Fish and Wildlife Foundation

11/19/13

Date

USEPA
EPA project manager

10/29/13

Kathryn Drisco — Date
USEPA
QA officer

2 Table Of Contents

Contents

3 Distribution List

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Riverdale, NY 10471
kirk.barrett@manhattan.edu

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Department of Earth and Environmental Studies
Montclair State University
1 Normal Ave.
Montclair, NJ 07043
sarkard@mail.montclair.edu

Robert Pirani
Regional Plan Association
4 Irving Place, 7th Floor
New York, NY 10003
rob@rpa.org

Ms. Susannah Drake
dland studio, llc
137 Clinton Street
Brooklyn, NY 11201
sdrake@dlandstudio.com

Lynn Dwyer
National Fish and Wildlife Foundation
40 West 4th Street, #151
Patchogue, NY 11772
Lynn.Dwyer@NFWF.ORG

USEPA project manager

USEPA QA officer
Kathryn Drisco
drisco.kathryn @epa.gov

4 Project/Task Organization

Technical Project Manager for Monitoring: Dr. Kirk Barrett, PE, Department of Civil and Environmental Engineering, Manhattan College. Dr. Barrett will be responsible for all the technical aspects of monitoring, including sample collection, preservation and analysis. He will also be responsible for data analysis and reporting.

QA/QC Officer: Dr. Dibyendu Sarkar, Department of Earth and Environmental Studies, Montclair State University. Dr. Sarkar will be responsible for ensouring QA procedures are followed, especially during sample analysis. Dr. Sarkar will also review and approve results of laboratory analysis.

Overall Project Manager: Robert Pirani, Regional Plan Association.
Project Designer: Ms. Susannah Drake, dland studio, llc
Mr. Pirani is responsible for contracting and project management. Ms. Drake is responsible for project design.

5 Special Training Needs/Certification

Dr. Kirk Barrett, the Monitoring Project Manager, holds a PhD in civil engineering and is a registered professional engineering. Dr. Dibyendu Sarkar, the Monitoring QA Manager, holds a PhD in geochemistry. As experts in their fields, both are highly familiar with the methods and equipment described in this QAPP and well qualified to conduct and supervise the monitoring and sample analysis described herein without further training.

6 Problem Definition and Background

The problem addressed by the Sponge Park^{tm} bioretention basins is excessive volume of runoff from urban areas that, in areas like New York City with combined sewer systems, can lead to combined sewer overflows. A closely related problem is pollutants in this runoff can impair water quality in waterways.

The stormwater from the elevated highways through Flushing Meadows Corona Park and the stormwater's associated pollutants are discharging directly into the Flushing River. The site combines a discrete source of pollution, easily accessible downspouts, and a park site that would benefit from plantings in the basins.

No specific problems have been identified. The basins are being constructed as a research demonstration project to treat, detain and retain urban stormwater

This project's approach to solving this project is to divert runoff from a road into the basins, allowing the water to infiltrate into an engineered soil. The soil will detain and retain a portion of the water and remove pollutants, especially those associated with particles.

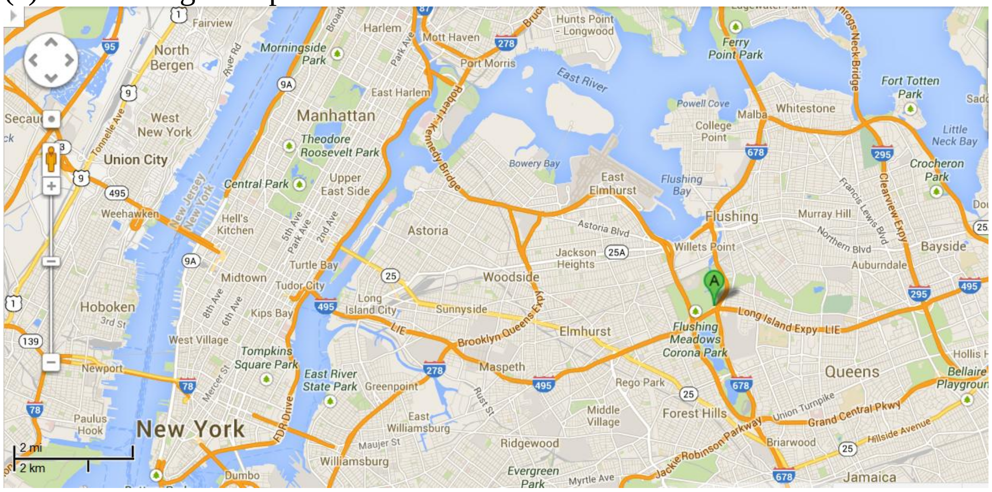
7 Project/Task Description

The project addressed by this QAPP is post-construction monitoring of hydrology and water/soil chemistry of two Sponge Park^{tm} bioretention basins in Flushing Meadows Corona Park, Queens, NY (Figure 1-3). The purpose of the monitoring described in this document is to compute the volume of runoff that enters each basin during storm events and to measure the mass and percentages of various pollutants that are removed by the basins by comparing influent loads to effluent loads and by measuring the amount and quality of sediment accumulated on the basins' surfaces.

The project consists of two bioretention basins under the Long Island Expressway near the Van Wyck Expressway. Each basin consists of a drainage system to receive water from scuppers from the Expressway overpass, engineered soils, and specific plants that absorb and filter heavy metals and other pollutants. Basin # 1 measures 9' by 28'7". The dimensions for basin #2 are 38' by 18'6".

Figure 1a and b: Map of project location (label A), Flushing Meadows Corona Park, Queens, NY

(a) From Google Maps



(b) From Google Maps

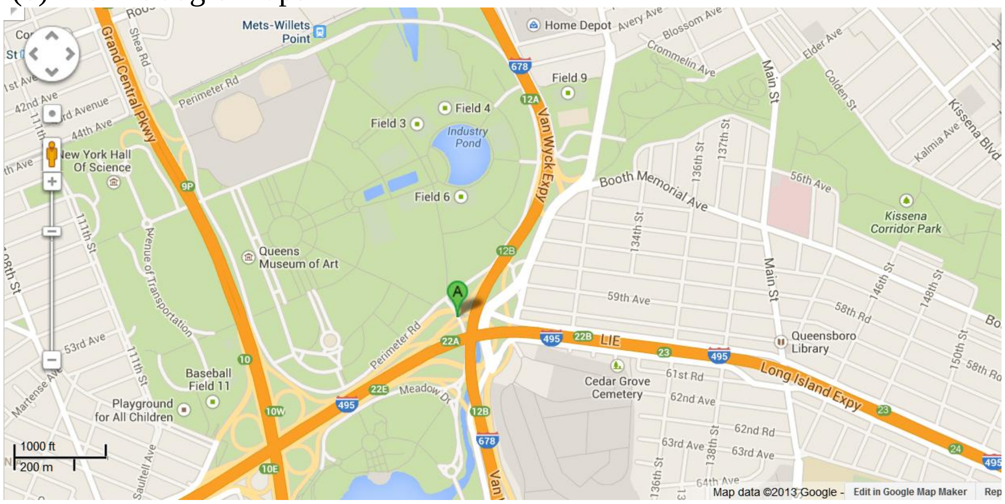
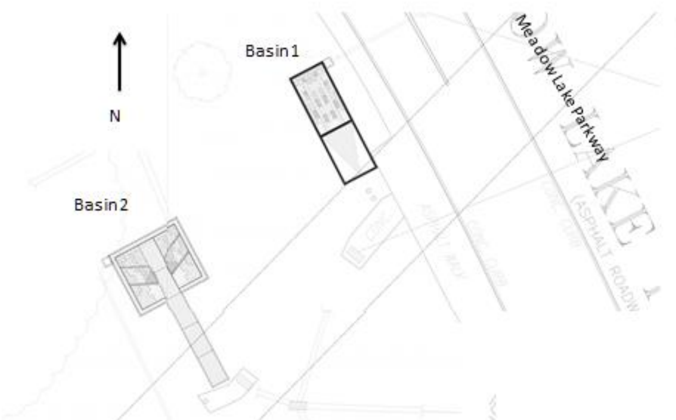


Figure 2: Project location detail, labeled 1 (project is located underneath elevatd highway); downspouts or scuppers from elevated highway are indicated by small, red circles

Figure 3: Plan of Sponge Park^{tm} bioretention basins



Monitoring will be conducted for 3 years in each of two basins on-site following the construction. The monitoring program will include measurements of the following:

1. inflow and outflow rates
2. depth of water ponding in the three basins and the groundwater elevation
3. soil moisture
4. inlet and outlet water quality
5. sediment accumulation
6. sediment quality

Variables 1 through 3 will be measured continuously. Water quality will be monitored for three storms per year. Sediment accumulation will be measured quarterly, and sediment quality will be measured annually.

Reports presenting and summarizing the data will be produced annually.

8 Quality Objectives and Criteria for Measurement Data

The data quality objective is to achieve data of sufficient quality to differentiate pollutant concentrations in influent samples vs. pollutant concentrations in effluent samples, and to allow computation of inflow and outflow mass flow rates for various pollutants.

Accuracy will be assessed by analyzing recovery of matrix spikes for water samples. A matrix spike will be analyzed each round of sampling. Acceptable accuracy is a result within the +/- 25% range of the spike concentration.

Precision will be assessed by splitting a sample from each storm into duplicates, then subjecting each replicate to the sample handling, preservation, storage, digestion and analytical method and instruments. Precision will be calculated by relative percent difference. Acceptable precision is 25% relative percent difference for each duplicate, for each analyte.

Representativeness will be assessed by evaluating whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment being measured or studied. In this case, the environmental is stormwater runoff from an urban highway. Industry-standard procedures are being employed for sampling and analysis. Storms from different seasons will be sampled and multiple samples will be collected during each storm from the inlets and the outlets. Therefore, representativeness is considered acceptable.

Completeness will be considered acceptable, for water quality, if at least 5 samples are collected from both the inlet and outlet during each of 3 storms.

Comparability relates to ensuring this data can be compared with other relevant data sets. The most relevant data sets for comparison are monitoring data from other green infrastructure projects in New York City. Since this project is employing standard monitoring protocol and measuring inflow and outflow quality and quantity, the performance data (in terms of mass and percent removal) will be comparable to other projects.

9 Non-Direct Measurement (Secondary Data)

No non-direct measurements will be used.

10 Field Monitoring Requirements

10.1 Monitoring Design

The monitoring plan is designed to assess the effectiveness of the basins in 1) detain and retaining runoff and 2) removing pollutants from runoff. Accordingly, we will monitor the flow rates into and out of the basins continuously to determine annual and per-storm mass balances. Flow rate (determined from measured water level) will be measured continuously using electronic instruments as explained below.

We will also monitoring water quality during storm events to compute the inlet and outlet pollutant mass load, and the mass removed by difference. We will also measure the sediment accumulated in the basin and the quality of this sediment as another way of assess the effectiveness of pollutant removal.   In each basin, inlet and outlet water samples will be collected for three storms per year. The total number of samples in each basin will be 10 per storm -- five at the inlet and five at the outlet of the basin. Sediment accumulation and sediment quality will be measure quarterly.

10.2 Monitoring Methods

Monitoring equipment will be installed under the supervision of Dr. Barrett and will be maintained by personnel from Manhattan College under his supervision. Personnel from Manhattan College will collect, preserve and transport all samples, under the supervision of Dr. Barrett.

Table 1 below summarizes the monitoring equipment that will be used.

Item	Manufacturer and Model	Notes
Rain gauge	HOBO Data Logging Rain Gauge - RG3-M with BASE-U-4 Optic USB Base Station and HOBOware Pro software	Located at boat house on Meadow Lake
Equipment needed for each basin		
Inlet water level/flow rate	HOBO U20 Water Level Data Logger - U20-001-04 13 Foot Depth – freshwater	Laid flat at the bottom of the inlet pipe/channel to measure water depth, which is then converted to flow rate. Needs to submerged with >1” of water during flow.
Groundwater level	HOBO U20 Water Level Data Logger - U20-001-04 -- 13 Foot Depth – freshwater	Hung by a cable at a depth of 6" above the bottom of the basin, within a 2” diameter well , constructed from perforated PVC pipe wrapped with filter fabric.
Soil moisture sensors	Decagon 10HS sensors	Three sensors will be buried at depths of 1’, 2’ and 3’. They need to be wired to the data logger,
Soil moisture logger	Decagon Em50 Data Logger	Powered by internal batteries; comes with an enclosure.
Inflow water sample bottles	Nalgene	
Outflow water sampler and flow meter	Teledyne Isco 6712C Compact Portable Sampler with Module 730 bubble meter and flow monitoring insert.	Measures water depth behind a weir with air bubble and converts to flow rate. Collects water samples based on flow volume. Placed in a vault near the surface with a sampling and air tubes running down to the outlet pipe.

10.2.1 Measuring Inflow and Outflow

We will continuously (5 minute frequency) measure inflow and outflow in each basin. Flow will be summarize on hourly and annual basis, as well as for individual storms.

To measure inflow , we will install continuously-logging water level sensors in the inlet structures of each basin, namely HOBO U20 Water Level Data Loggers. We will compute the flow rate from the water levels that are measured in the inlet and outlet using standard relationship for a two-side-contracted, sharp-crested, rectangular weir, namely

$$q = 3.33 (b - 0.2 h) h^{3/2}$$

where q = flow rate (ft^3/s), h = head above the weir (ft), b = width of the weir (ft).

To measure outflow, in each basin, we will install an automated water sampler (Isco Model 6712) located in a vault above the outlet pipe, equipped with an Isco 730 Bubbler Flow Module connected to a flow metering insert. The 730 module measures the pressure needed to force out an air bubble through an orifice located at the bottom of a flow-metering insert installed in the outflow pipe. The required pressure is directly related to the depth of water above the orifice. The orifice is located at the bottom of the flow-metering insert, which also contains a 60-degree V-notched weir. The flow depth is converted into a flow rate using the manufacture-specified equation. Flow depth and flow rate will be logged by meter, again at a 5-minute frequency with daily, yearly and annual summaries.

Flow data will be downloaded bi-weekly for both the inlet and outlet.

10.2.2 Measuring Depth of Water Ponding and Groundwater Elevation

We will install another continuously logging water level sensor at the bottom of a piezometer well in each basin to measure the depth of water ponded in each basin and the groundwater elevation in each basin. Knowing the morphology of each basin via a post-construction survey, we will establish the stage-storage (depth vs. volume) relationship and convert measured depths into volumes. Water depth will converted to volume by multiplying depth by basin width and length and by the porosity of the media, using 0.3 for gravel layers and 0.4 for soil layers. With this data, we will compute a continuous timeseries of water volume in the basin, which also provides a check on the inflow and outflow measurements.

10.2.3 Measuring Soil Moisture

To measure soil moisture, in each basin, we will install a set of three Decagon ECH2O Soil Moisture Sensors at depths of 1.0, 2.0 and 3.0 feet. Each set of sensors will be connected to a Decagon Em50 Data Logger. The sensors will take a reading every 15 minutes. Data will be downloaded bi-weekly.

10.2.4 Measuring Water Quality

At the inlets, samples will be collect by hand into bottles as water flows out of each scupper. The first inlet sample will be collected within 30 minute of the start of runoff. Subsequent inlet samples will be collected at least 30 minutes apart. Clean sampling techniques will be used, with clean, acid-washed, pre-acidified bottles.

At the outlets, samples will be collected from the outlet pipe via a tube from the pipe to the Isco automatic water sampler located in a vault above the pipe. The tube will sit on the bottom of the pipe. The sampler is connected to the flow meter mentioned above, and will be programmed to take flow-weighted samples, that is, to collect a sample each time a specified volume of flow

(1000 liters) has passed. The samples are collected into 500 ml bags that sit in a carousel in the sampler. A separate 500ml sample will be collected for analysis of Total petroleum hydrocarbons. Water samples will be analyzed unfiltered for total organic carbon, total nitrogen, total phosphorus, total petroleum hydrocarbons, metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), and total salts (measured by conductivity).

Field QC activities include collecting ne field blank will be collected during each storm. Also, for each storm, one inlet sample and one outlet sample will be split into duplicates in the field.

10.2.5 Measuring sediment accumulation

Measuring sediment accumulation and the concentration of pollutants in the sediment gives us another way to measure the performance of basin, ie, mass of pollutant removal via sedimentation. We will monitor sediment accumulation by three different methods. First, we will install three sediment horizon markers in each basin, composed of a layer of colored feldspar, a granular material that is commonly used by the US Geological Survey for this purpose (www.pwrc.usgs.gov/set/installation/markers.html). These markers form a base layer on top of which sediment will accumulate. Second, we will install sediment plates, in which a hard plate is placed flush with the sediment surface and accumulation is measured. Third, we will install vertical sediment pins – a rod driven into the ground, from which one measures the distance from the top of the rod to the sediment surface. Once each quarter, we will collect a core through each horizon marker and measure the depth of sediment accumulated above the maker. Similarly, we will measure the accumulation on the sediment plates with a graduated steel rod and read the sediment pin. We will dry and weigh the accumulated sediment to compute an estimate of the dry mass of sediment retained in each basin by scaling the measured accumulation by the ratio of the area of basin to the area of the cores. Accumulated sediment will remain on the sediment horizon markers.

10.2.6 Measuring Sediment Quality

The samples of accumulated sediment from each basin will be composited to form a single sample for each sampling foray. The samples will be analyzed for total organic carbon, total petroleum hydrocarbons, metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), total phosphorus and total nitrogen.

11 Sample Handling and Custody Requirements

Water samples from the inlets will be collected manually into clean, preacidified glass bottles. Outlet samples will be collected by the ISCO automated sampler into preacidified Isco-developed ProPak® sample bags. The bags will be retrieved within 4 hours of sample collection.

Water and sediment samples will be placed in a cooler with "blue ice" propylene glycol cooling packs. When sampling is complete, the cooler(s) will be driven to Montclair State University. Samples will be stored at 4C until analysis within the allowed holding time.

A "chain of custody" form (see Appendix A) will be filled out when each sample is placed in the cooler. The form will detail the date, time and location of sample collection, names of the sampling crew, and the contents of the sample. The crew leader will sign the form signifying the information is correct. When arriving at Montclair State, the field crew will place the sample bags in a refrigerator . The crew leader will indicate the time at which this was done on the chain of custody form and sign it.

12 Analytical Requirements

12.1 Analytical Methods

Water samples will be analyzed in labs at Montclair State's Department of Earth and Environmental Studies for the following parameters by the indicated methods.

Table 2: Analytical Methods for water and sediment samples

Analyte	EPA Method	Method Detection Limit	Sample Container and Preservation Method	Maximum Holding Time (Stored at 4C)	Number of samples to be analyzed
total petroleum hydrocarbons	8015B	50 µg/L	500mL plastic, H_2S0_4 added to pH<2, cooled to 4C	7 days	
total suspended solids	160.2	5.0 mg/L	500mL plastic, H_2S0_4 added to pH<2, cooled to 4C	7 days	
total phosphorus	365.3	25.0 µg/L	500mL plastic, H_2S0_4 added to pH<2, cooled to 4C	28 days	
total nitrogen	351.1(water) and 1687 (sediment)	0.25 mg/L	500mL plastic, H_2S0_4 added to pH<2, cooled to 4C	28 days	water: 90 Sediment: 12 for all analytes
metals (total) - arsenic, copper, chromium, cadmium, lead, mercury, nickel, silver, zinc	SW 846 3050a (water) and 3050b (sediment)	As: 3.3 µg/L Cu: 7.5 µg/L Cr: 7.5 µg/L Cd: 7.5 µg/L Pb: 10.2µg/L Hg: 0.42µg/L Ni: 7.5 µg/L Ag: 15.4 µg/L Zn: 7.5 µg/L	500mL plastic, H_2S0_4 added to pH<2, cooled to 4C	28 days	
total organic carbon	9060A	2 mg/l	500mL plastic, H_2S0_4 added to pH<2, cooled to 4C		

Samples will be digested as required according to USEPA SW 846 method 3050b, which is a "very strong acid digestion that will dissolve almost all elements that could become environmentally available." Digested samples will be analyzed for mercury by cold-vapor atomic absorption spectrometry and for the other metals by inductively coupled plasma optical emission spectrometry.

12.2 Analytical Quality Control

The quality control checks that will be used include processing/analysis of duplicate samples, matrix spike, field blanks, method blanks, and calibration checks. Calibration checks (zero, span and mid-point) will be run at the end of the batch.

13 Testing, Inspection, Maintenance and Calibration Requirements

13.1 Instrument/EquipmentTesting, Inspection and Maintenance

The Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and Ion Chromatograph (IC) at Montclair State University receive regular maintenance and inspection. They are inspected before each batch of samples is analyzed. They receive regular maintenance according to the manufacturer's recommendations. Inspections and maintenance activities are documented in the lab analyst's logbook. The effectiveness of inspection and maintenance is documented through the analysis of blanks and standards.

The field-deployed instruments (water level sensor/loggers, soil moisture sensors) tested by the manufacturer before delivery. Only the Isco sampler requires any routine maintenance. The desiccant on the air tube and the battery will be replaced every two weeks. The data from these instruments will be downloaded every two weeks and examine for anomalous values that may represent erroneous measurements. If failing instruments are found, they will be removed and replaced.

Sample bottles and laboratory glassware will be acid-washed after use.

13.2 Instrument/Equipment Calibration and Frequency

The ICP-MS and IC will be calibrated before each batch of samples with five point minimum calibration using lab standards. The calibration will then be checked with a standard from a different lot than that used for calibration. Calibration data will be recorded in the analyst's log book.

The field instruments do not require calibration, nor can they be calibrated.

13.3 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables necessary for this project include reagents used in digestion, purified water, glassware, and standard reference materials. Reagents, glassware and sample bottles are ordered from standard chemical supply firms such as Fisher Scientific. Glasswater and sample containers are visually inspected upon receipt. When reagents are received, the date and lot number are recorded in a log book and the date is written on the bottle. The lot number of reagents that are used is recorded in the analyst's logbook during analysis. Purified water is supplied through Montclair State's system. Its purity will be checked by analyzing method blanks.

The field instruments do not require any consumables.

14 Data Management

Data will be managed through a combination of paper and electronic systems. The paper system comprises notebooks holding field notes, chain-of-custody forms, packing lists from orders of reagents and supplies and instrument maintenance records, plus the lab analysts' log books containing information and results of individual analyses. These records will be maintained in the laboratory.

Field notes to be recorded include the following:

- date and time of each visit and each sample collected.
- whether water is flowing over the inlet weir
- results of visual inspection of the integrity of all equipment
- maintenance activities taken, such as changing desiccant and battery

The Project Manager will review this information after the batch of samples is processed. The results will be placed into a report which includes results of analyses sample and standard reference materials, as well as results of quality control procedures such as precision calculations. A hardcopy of the report will be kept in the lab notebook and an electronic version will be supplied to RPA and government agencies.

Electronic records will be maintained on the computer of the Project Manager through the end date of the project. The Project Manager will make them available to all on the QAPP distribution list upon request.

Methods and data will be assessed by the Project Manager. Assessment points include

- before sampling to review sampling procedures with the field crew
- after sampling to discuss any issues with the field crew
- before analysis to review analytical procedures with the lab analysts after analysis of each batch of samples to discuss any issues with the lab analysts

The date and time of assessment points will be recorded, and this log will be made available to all on the QAPP distribution list upon request. Any significant changes to procedures due to such assessments will be reported to RPA. The approved QAPP will be revised to reflect changes as necessary.

15 Assessments/Oversight

Assessments include quarterly reviews field and lab personnel conducted by the Project Manager and QA officer to ensure to ensure that the QAPP is being followed.

The QA officer and Project Manager will review the results of each storm sampling, including the QA procedures to ensure the data is acceptable. If a problem is found, the Project Manager, upon consultation with the QA officer, will recommend appropriate corrective action. All deficiencies and corrective actions will then be documented in writing via a memo to Regional Plan Association.

16 Data Review, Verification, Validation and Usability

The criteria for deciding to accept or reject data will be whether the data achieved the precision, accuracy and method-blank purity goals listed above. The Project Manager is responsible for performing data review.

Data will be verified by the Project Manager, who will examine field and lab notebooks and log books to assess whether all QA processes were followed in accordance with this QAPP. Data will be validated by determining whether it achieved the precision, accuracy and method-blank purity goals listed above.

The Project Manager will recommend appropriate corrective action and determine the acceptability of affected data when deficiencies are noted.   The Project Manager will notify RPA in writing anytime a deviation from the approved plan occurs. Results of all corrective actions will then be documented.

17 Reporting, Documents and Records

Dr. Kirk Barrett, PE, the Project Manager, will be responsible for maintaining documentation and records and for ensuring that needed information is received from and distributed to other project team members. The Project Manager will set up and maintain a project web site that will contain the most current approved QA Project Plan and any other necessary information so that project staff will always have access to it. Records will be maintained in hard copy in the Project Manager's office at Manhattan College campus and/or computer hard drive of the Project Manager as appropriate.

Additional records will be kept by the Project Manager and made available include

- field notes and photos recorded during sample collection
- chain-of-custody forms
- lab log books
- instrument calibration records and result files
- reports from any subcontracted labs

Records will be kept by the Project Manager for at least three years. Originals or copies of all records, electronic and paper, will be offered to the main project sponsor, the New York City Department of Environmental Protection, as well as the NFWF and the USEPA.

Montclair State University -- Passaic River Institute
1 Normal Ave. ML 116 Montclair, NJ 07043
phone: 973-655-7117 fax: 973-655-6810 email: pri@montclair.edu web: www.csam.montclair.edu/pri

Sample Chain of Custody (COC) Form

Project name:	
Sampler's name:	
Notes:	

Sample ID/Description	Collection Date/Time	Collection Location	Sample Type (eg soil, sediment, water, etc.)	**Preservation** (eg, H_2SO_4 , ice)	Notes

	Relinquished by	Date/Time	Notes	Received by	Date/Time	Notes
1						
2						
3						

Flushing Creek Sponge Park – Monitoring and Maintenance of Pilot Projects

This monitoring plan supersedes all monitoring and maintenance protocols discussed in the Best Management Practices Agreement.

Scope

Monitoring will be conducted for 3 years in each basin following the completion of construction of the pilot project. The monitoring program will include the following procedures:

1. Measuring inflow and outflow;
2. Measuring the depth of water ponding in the three basins and the groundwater elevation;
3. Testing Water Quality; and
4. Measuring sediment accumulation
5. Testing Sediment Quality.

Monitoring Procedures

1. Measuring Inflow and Outflow

We will continuously measure inflow and outflow in each basin and compute infiltration as the difference between inflow and outflow[1]. To measure inflow, we will install continuously-logging water level sensors in the inlet structures of each basin, namely HOBO U20 Water Level Data Loggers. We will compute the flow rate from the water levels that are measured in the inlet and outlet using standard relationships for the inlet structure (e. g., rectangular weir).

We will develop an independent estimate of inflow to check our computed value by multiplying precipitation by the drainage area, which is 100% impervious so we can assume that all precipitation runs off into the basin. We will install a weather station with a logging rain gauge at a secure site near the basins (e. g., the boat house on Meadow Lake, with the Parks Dept.'s permission) to provide precipitation, temperature, wind speed, and relative humidity data[2].

To measure outflow, in each basin we will install an automated water sampler (Isco Model 6712) located in a vault above the outlet pipe, equipped with an Isco Model 750 flow monitoring module and connected to an Isco Low Profile Area Velocity Sensor that will sit inside the pipe.

2. Measuring Depth of Water Ponding and Groundwater Elevation

We will install another continuously logging water level sensor at the bottom of a piezometer well in each basin to measure the depth of water ponded in each basin and the groundwater elevation in each basin. Knowing the morphology of each basin via a post-construction survey, we will establish the stage-storage (depth vs. volume) relationship and convert measured depths into volumes. With this data, we will compute a continuous timeseries of water volume in the basin, which also provides a check on the inflow and outflow measurements.

3. Measuring Soil Moisture

To measure soil moisture, in each basin, we will install a set of three Decagon ECH2O Soil Moisture Sensors at depths of 1.0, 2.0 and 3.0 feet. Each set of sensors will be connected to a Decagon Em50 Data Logger.

[1] Evapotranspiration will be negligible during periods of storm flow because storm durations are short and the humidity is high.
[2] We will use weather data from LaGuardia Airport as a backup if needed.

4. Measuring Water Quality

In each basin, inlet and outlet water samples will be collected for three storms per year. The total number of samples in each basin will be 10 per storm event, with five samples taken at the inlet and five samples taken at the outlet of the basin.

At the inlet, samples will be collect by hand into bottles as water flows out of each scupper. At the outlet, samples will be collected from the outlet pipe via a tube from the pipe to the Isco automatic water sampler located in a vault above the pipe.

Furthermore, during each storm, one composite water sample will be collected from the well in each basin.

Unfiltered water samples will be analyzed for total organic carbon, total nitrogen, total petroleum hydrocarbons, metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), total phosphorus and total salts (measured by conductivity).

5. Measuring sediment accumulation

To monitor sediment accumulation, we will install three sediment horizon markers in each basin, composed of a layer of colored granular material like feldspar. These markers form a base layer on top of which sediment will accumulate. Twice per year, we will collect a core through each horizon marker and measure the depth of sediment accumulated above the maker. We will dry and weigh the accumulated sediment to compute an estimate of the mass of sediment retained in each basin.

6. Measuring Sediment Quality

The samples of accumulated sediment will be composited to form a single sample from each basin. The samples will be analyzed for total petroleum hydrocarbons, metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), total phosphorus and total salts (measured by conductivity).

Monitoring Best Practices / Quality Control

To assess the accuracy of the analysis, we will also analyze a soil SRM (standard reference material, which has known concentrations, such as those from the National Institute for Standards and Technology). Acceptable accuracy is a result within the acceptable range established by NIST for the material.

Precision will be assessed by splitting samples and the reference material in the lab into duplicates, then subjecting each replicate to the sample handling, preservation, storage, digestion and analytical method and instruments. Precision will be calculated by relative percent difference. Acceptable precision is 25% relative percent difference for each duplicate, for each analyte.

Data Management

The water level, flow, sediment accumulation and water and sediment concentration data will be input into a MS-Access database. Flow will be multiplied by corresponding concentration to determine incoming and outgoing mass loads for each measured constituent and the mass and percent trapped by each basin. Sediment mass accumulation will be multiplied by sediment concentrations to determined mass of pollutants trapped by the basin as sediment.

Site Visits

We will visit the sites every month to download data from the water level sensors and ensure that they are working properly.

RPA Regional Plan Association dlandstudio

Highway Overpass Landscape Detention System™

Pilot Project and Potential Sites Analysis

Summary and Overview

It's time to shift the paradigm of highway runoff in the Long Island Sound and Hudson-Raritan Estuary. The thousands of miles of highways, parkways, and bridges that weave the region together generate millions of cubic feet of stormwater runoff during each rain event. A fraction of that runoff percolates through nearby soils to recharge groundwater, but the majority is channeled through a series of scuppers, culverts, and pipes until it can be discharged to surface waters – along with debris and pollutants picked up along the way. This problem is particularly acute on elevated roadways, which rely on engineered drainage systems to quickly move water from roadways and discharge directly to local streams, rivers, and estuaries. Over three million gallons of stormwater runoff are generated from elevated highways during a single 90% rainfall event (approximately 90% of the average annual stormwater runoff volume) that affect impaired waterways. Over 900,000 gallons of stormwater runoff are generated from elevated highways during a single rain event that affect priority habitat areas. The Highway Overpass Landscape Detention System (HOLD SYSTEM™) is a planted, modular green infrastructure system designed to absorb and filter pollutants common to highways – including oil, grease, and heavy metals – out of runoff before releasing it. A pilot project is now in place near the Flushing Creek. There are more than 58 other sites around the Long Island Sound and Hudson- Raritan River Estuary shorelines where a combination of highway overpasses, public parkland, and important water and habitat resources make installation of these systems an important consideration.

Rethinking Stormwater Infrastructure

Cities across the US are working to improve the way they manage stormwater, and for good reason. Untreated stormwater degrades water quality, stresses aquatic life and sometimes results in use restrictions. Combined sewer systems – which carry both stormwater and domestic sewage – pose an additional challange. Combined sewer systems are common throughout New York City and certain Connecticut cities. When sewer volume exceeds system capacity, combined sewers are designed to overflow. Because of the age of the sewer systems in the study area, even moderate rain events can bring the system beyond capacity, resulting in the discharge of diluted sewage to area water bodies. The Clean Water Act requires states to assess water bodies for impairments and develop a Total Maximum Daily Load, or pollution diet, to improve water quality. Additonally, recent action by the US EPA and state environmental agencies has set stringent standards for point and nonpoint source polluters – requiring municipalities to reduce the amount of untreated runoff entering tributaries.

The traditional answer to stormwater issues are gray infrastructure systems including pipes, storage tanks, and other physical "hard" structures that collect, direct, and retain runoff. Such structures rely on centralized, large-scale systems that prevent groundwater recharge and can further fragment the landscape.

On surface highways, vegetated strips on either side of the roadway can help slow the flow of runoff by allowing for some infiltration. For elevated roadways, however, there is no soil below or along these sections. To prevent pooling on elevated roadways, surfaces are engineered with stormwater infrastructure that funnels runoff through pipes, often discharging directly into neighboring water bodies. As runoff flows to these pipes, it picks up roadway debris and contaminants, including heavy metals, nutrients (nitrogen, phosphorous, and organic carbon), petroleum distillates, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), herbicides, and pesticides, which contaminate water and harm aquatic species[1].

New gray infrastructure projects are difficult to complete because of high costs and siting constraints. However, by restoring natural funcitons, municipalities can enhance the capacity and effectiveness of existing infrastructure and improve stormwater outcomes.

Natural hydrologic flow patterns are interrupted in urbanized places by impervious cover. Which prevents rain and snow melt from percolating down through the soil to recharge groundwater. Allowing water to percolate through soils can reduce pollutant loads to surface waters and improve water quality, while providing important co-benefits. When it rains, terrain and

1 Center for Environmental Excellence by AASHTO Stormwater Management Community of Practice. "State of the Practice Report: Source Control". May 2011. AASHTO.

Figure 1: Finished highway overpass landscape detention system in Flushing Meadows-Corona Park

Source: dlandstudio

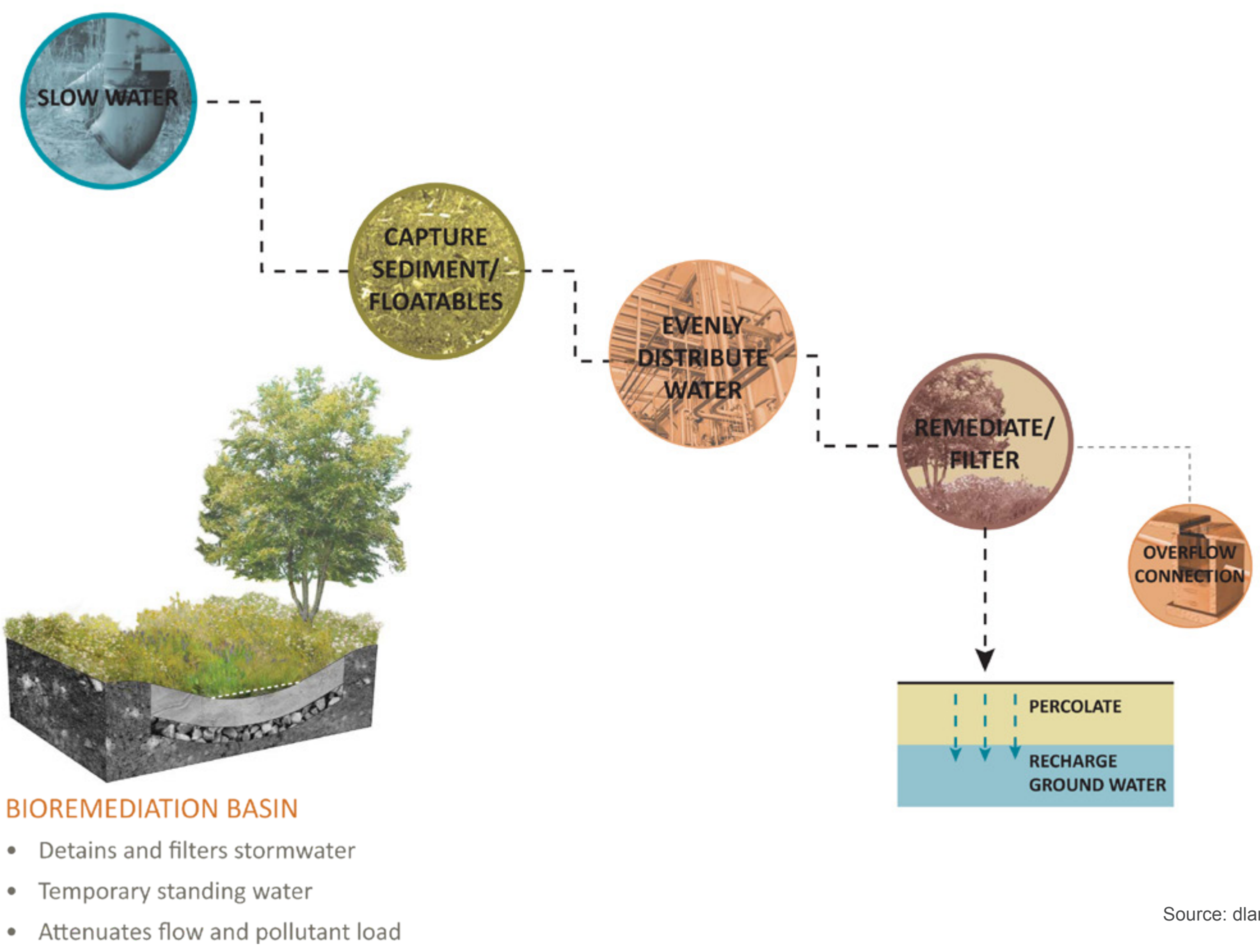
gravity allow water to infiltrate soils, which recharges groundwater, or the surface flow into streams and helps to reduces overload combined sewer systems and avoid system overflows.

Many city agencies are turning to green infrastructure systems that manage stormwater through forests, fields, and wetlands – and in urban areas, via engineered systems that mimic natural systems. Grading, soils, and plantings work together to retain stormwater, slow the flow of runoff, and filter pollutants naturally. Green infrastructure systems reduce peak flows to combined sewer systems – often expanding city-wide system capacity to mitigate overflows.

The systems are distributed, rather than centralized, so they are relatively simple to site. Instead of funneling runoff directly to receiving waters, water is able to recharge groundwater and support plants. These plants and underlying soil are an integral component improving runoff quality as it infiltrates. Most importantly, the systems replace concrete basins and steel pipes with native plants that serve as habitat create a healthy ecosystem to improve the quality of place.

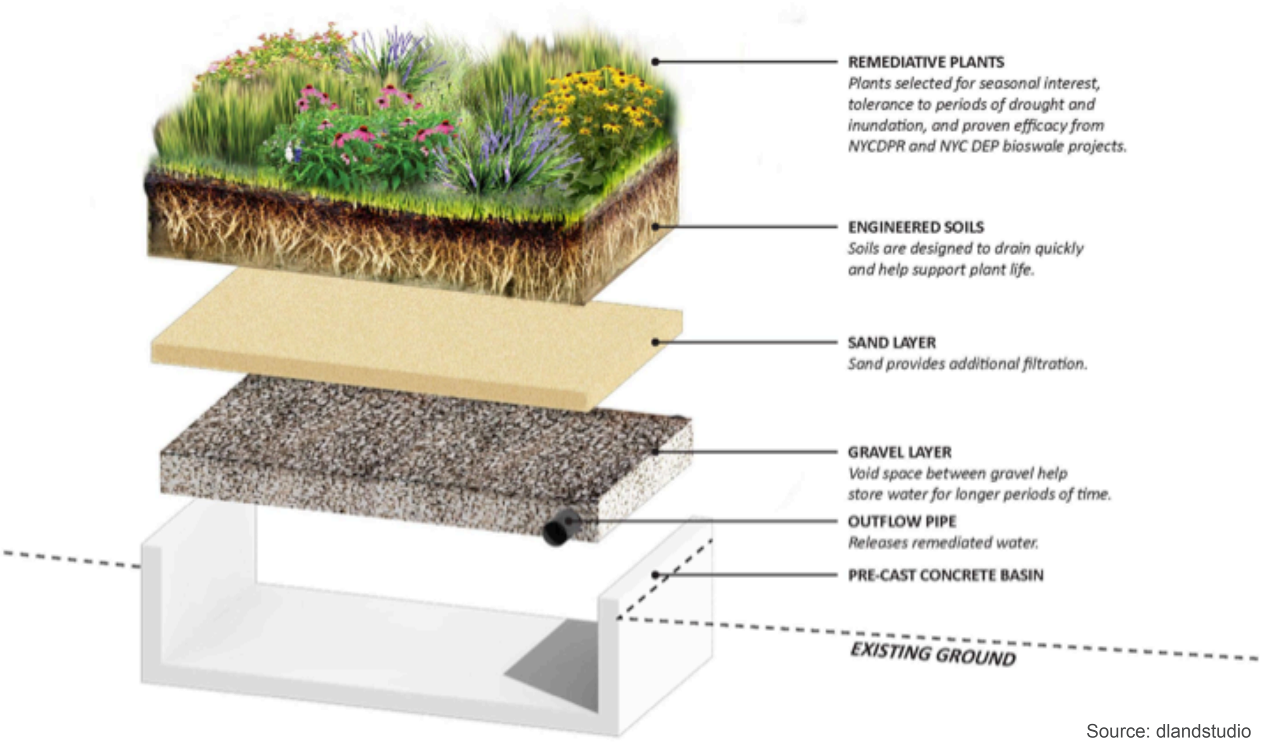
Bioswales are one example of green infrastructure that are increasingly being deployed to address stormwater runoff. Gently sloping drainage courses in parking lots and along roadways use plants and soils to retain and treat stormwater locally. Elevated roadways' specific drainage systems requires that green infrastructure be redesigned to address spatial and safety constraints. HOLD SYSTEM™ is designed to address these constraint, by retrofitting existing down spouts commonly referred to as highway scuppers to create a hybrid form of bioswale.

Figure 2: Green stormwater management strategy



Source: dlandstudio

Figure 3: HOLD SYSTEM™ layers



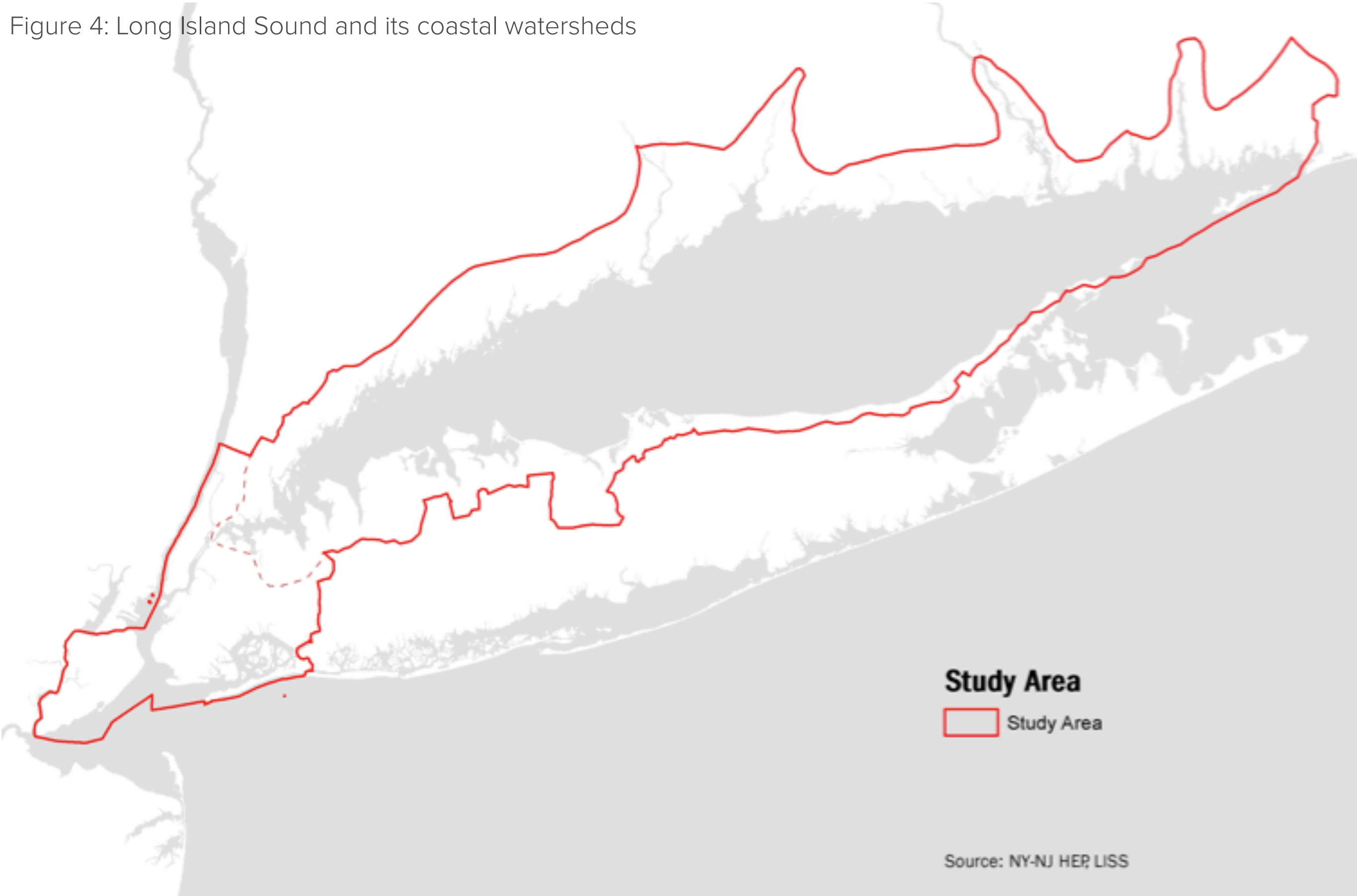
Source: dlandstudio

The Highway Overpass Landscape Detention System (HOLD SYSTEM™)

The HOLD SYSTEM™ is a planted, modular green infrastructure system designed to absorb and filter pollutants common in highway shoulders – including oil, grease, and heavy metals – before releasing it in to the ground or in to surrounding water bodies.

HOLD SYSTEM™ is composed of two basins – a sedimentation basin, which captures suspended sediments and debris, and a filtration basin that uses remediative plants and engineered soils to remove toxins. Water is released through an outflow pipe ad groundwater recharge to neighboring water bodies.

Figure 4: Long Island Sound and its coastal watersheds



Study Area

Over 25 million people live within 50 miles of the Long Island Sound and the Hudson-Raritan Estuary. These waterways are surrounded by some of the most densely developed land in the US. Draining, filling, dredging, and culverting projects completed in the 20th century resulted in significant losses to natural drainage systems, with wetland removal, shoreline hardening, and impervious coverage altering the landscape. Decades of industrial, sewer, and urban discharges (direct and via tributaries) have resulted in significant impairments to both waterways – with toxicity, floatable debris, pH, sediment, persistent organic compounds, pathogens, and low dissolved oxygen contributing to use restrictions.

The Study Area is defined as the land and water area boundaries of New York City and the Long Island Sound Coastal Boundary (defined as the Long Island Sound and its coastal watersheds).

The Long Island Sound is an estuary of the Atlantic Ocean, lying between the southern coast of Connecticut and the northern coast of Long Island. The Sound hosts a range of activities, including shipping, boating, fishing, and sunbathing, in addition to serving as home to hundreds of invertebrates, fish, and birds. The Sound suffers from the legacy of decades of industrial pollution, compounded by daily nutrient loads from wastewater treatment plants, CSOs, and urban runoff. Hypoxia, toxic contaminants, pathogens, and floatable debris all contribute to the Sound's degraded water quality.

According to the Long Island Sound Study, the three largest sources of toxic substances are its tributaries, wastewater treatment plants, and urban runoff, including combined sewer overflows and stormwater discharges. [2,3]

The Hudson-Raritan Estuary is made up of bays and tidal rivers around New York City and northern New Jersey. The HRE is the most densely populated estuary in the US, with residential, commercial, and industrial land uses predominating its shorelines – only 20% of historic wetlands remain. Its waters are home to hundreds of species of fish and birds and scores of migrating species. It is also home to the most active commercial port on the East Coast. The Hudson River Foundation estimates that 20% of sediment loadings to the Estuary are from sewage treatment plants, combined sewer overflows, and stormwater runoff. Sediment loads frequently carry toxic substances, including heavy metals, dioxin, and pathogens, as well as nutrients, like nitrogen, phosphorus, and organic carbon. Combined with habitat loss and historic industrial discharges, contaminants and nutrients have resulted in a degraded estuary.[4,5]

2 Long Island Sound Study, "About the Sound", LongIslandSoundStudy.net, 2013, Web.
3 Long Island Sound Study, "Toxic Substances", LongIslandSoundStudy.net, 2013, Web.
4 Hudson River Foundation, "Health of the Harbor: The First Comprehensive Look at the State of the NY/NJ Harbor Esutary," 2004, for the NY/NJ Harbor estuary Program.
5 US Army Corps of Engineers and the Port Authority of NY & NJ. "Hudson-Raritan Estuary Comprehensive Restoration Plan". March 2009.

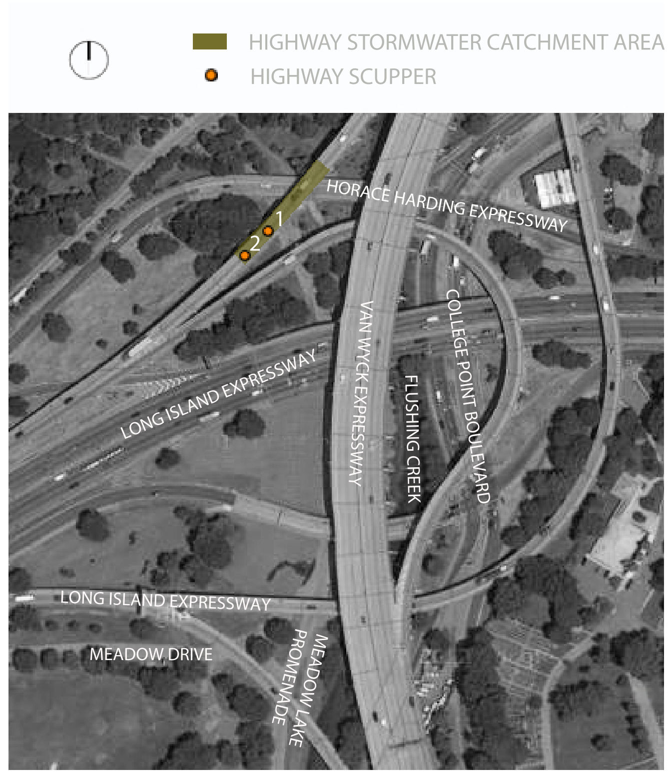
HOLD SYSTEM™: Flushing Bay

This study seeks to build on the success of a pilot recently completed by RPA and dlandstudio. It was financed by a grant from the New York City Department of Environmental Protection in connection with the settlement of an enforcement action taken by New York State and the New York State Department of Environmental Compliance for violations of New York State law and DEC regulations. Monitoring and dissemination of the project's results was also supported by a grant by National Fish and Wildlife Foundation (NFWF) Award.

The system is composed of two bioretention basins in Flushing Meadows-Corona Park. Elevated portions of the Long Island Expressway and Van Wyck Expressway pass over Flushing Creek in the northeast corner of the park. The two bioretention basins are connected to downspouts carrying runoff from the highway above.

Flushing Creek, and ultimately the Long Island Sound, benefit from the removal of contaminated runoff – estimated at over 26,000 cubic feet of stormwater each year. Pedestrians and bicyclists using nearby paths benefit from the beauty of perennial beds that replace existing stormwater grates. Pollinators, birds and other fauna enjoy new habitat.

Figure 5: Design location of HOLD SYSTEM™ in Flushing Bay



Source: dlandstudio

Figure 6: Flushing Bay HOLD SYSTEM™ (before construction)

Source: dlandstudio

Figure 7: Outfall under the highway (before construction)

Source: dlandstudio

Figure 8: Flushing Bay HOLD SYSTEM™ (under construction)

Source: dlandstudio

Figure 9: Flushing Bay HOLD SYSTEM™ (finished basin 1)

Source: dlandstudio

Figure 10: Flushing Bay HOLD SYSTEM™ (finished downspout2)

Source: RPA

Figure 11: Flushing Bay HOLD SYSTEM™ (finished basin 2)

Source: RPA

Opportunities for Additional Installations

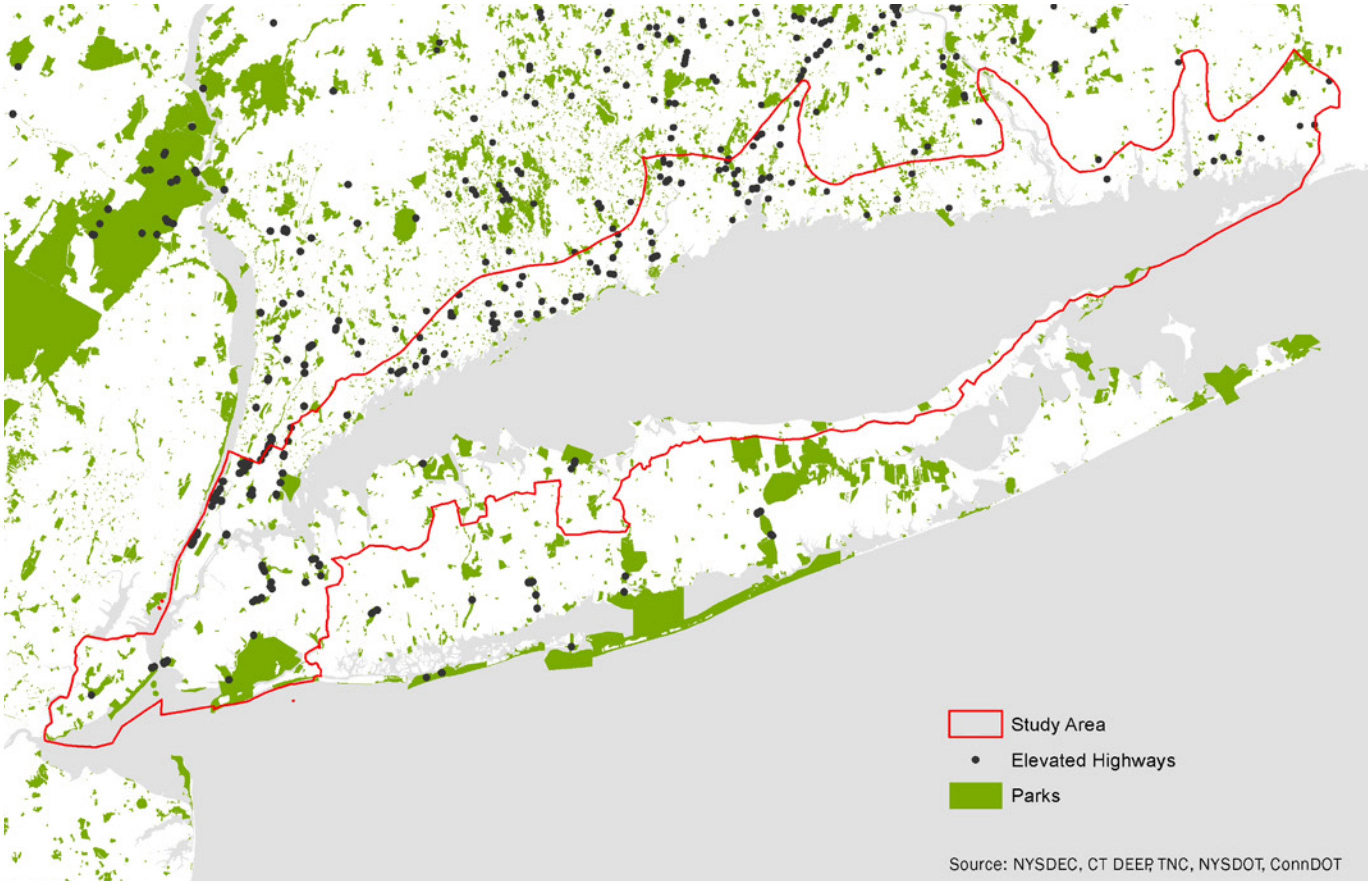
In order to understand where additional installations of the HOLD SYSTEM™ might best benefit Long Island Sound and the Hudson Raritan Estuary, RPA and dlandstudio conducted an analysis that factored in the locations of elevated highways, public parks, noted habitat, and degraded water quality.

For this study, we limited our analysis to portions of elevated roadways located within (or above) public parks. This ensures that the planting in the system will be enjoyed by the public. It also provides the possibility for easy maintenance of the system, with plant care and debris and litter removal integrated into routine park maintenance. In the study area, there are 215 segments of elevated highway over parks identified by these base criteria.

Figure 12: Candidate Sites selection process

Source: RPA

Figure 13: Elevated highways over park land



The next set of criteria helped us prioritize these sites according to water quality and ecological considerations.

Water quality criteria include sewer sheds with Tier 1 combined sewer out falls (in New York City) and cities with known combined sewer overflow issues (in Connecticut). Watersheds draining to surface waters listed as impaired under Section 303(d) of the Clean Water Act and with quality concerns attributed to urban runoff, stormwater runoff, or combined sewer out falls were also prioritized. Over three million gallons of stormwater runoff are generated from elevated highways during a single 90% rainfall event (approximately 90% of the average annual stormwater runoff volume) in the region that affect impaired waterways.

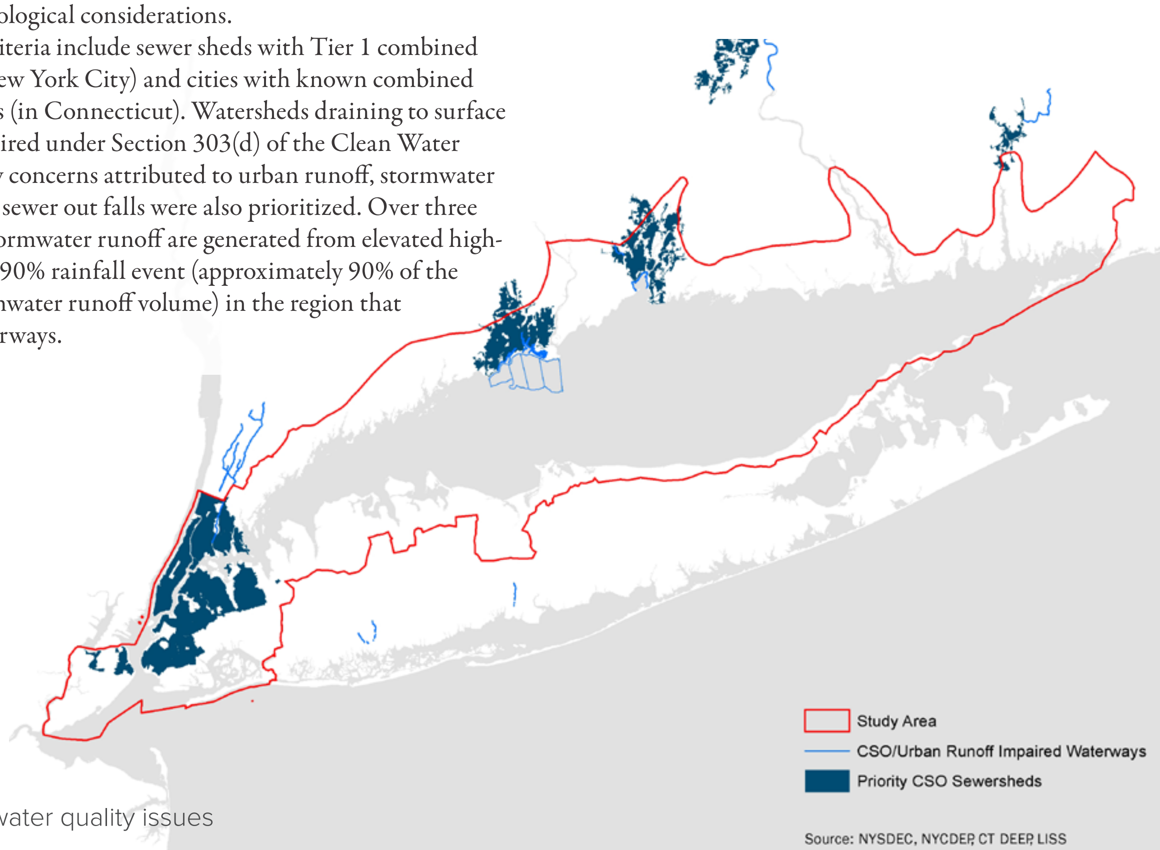


Figure 14: Urban water quality issues

Ecological criteria include critical habitat sites identified by various planning efforts in the study area. The Long Island Sound Study has identified Stewardship Areas in Connecticut and Long Island that "provide exceptional ecological and recreational value". In Connecticut, the Long Island Sound Study Habitat Restoration Sites have been designated. The NY-NJ Harbor and Estuary Program keeps an ongoing database of Comprehensive Restoration Sites, where public and private organizations are focusing their efforts. Over 900,000 gallons of stormwater runoff are generated from elevated highways during a single rain event that affect these priority habitat areas.

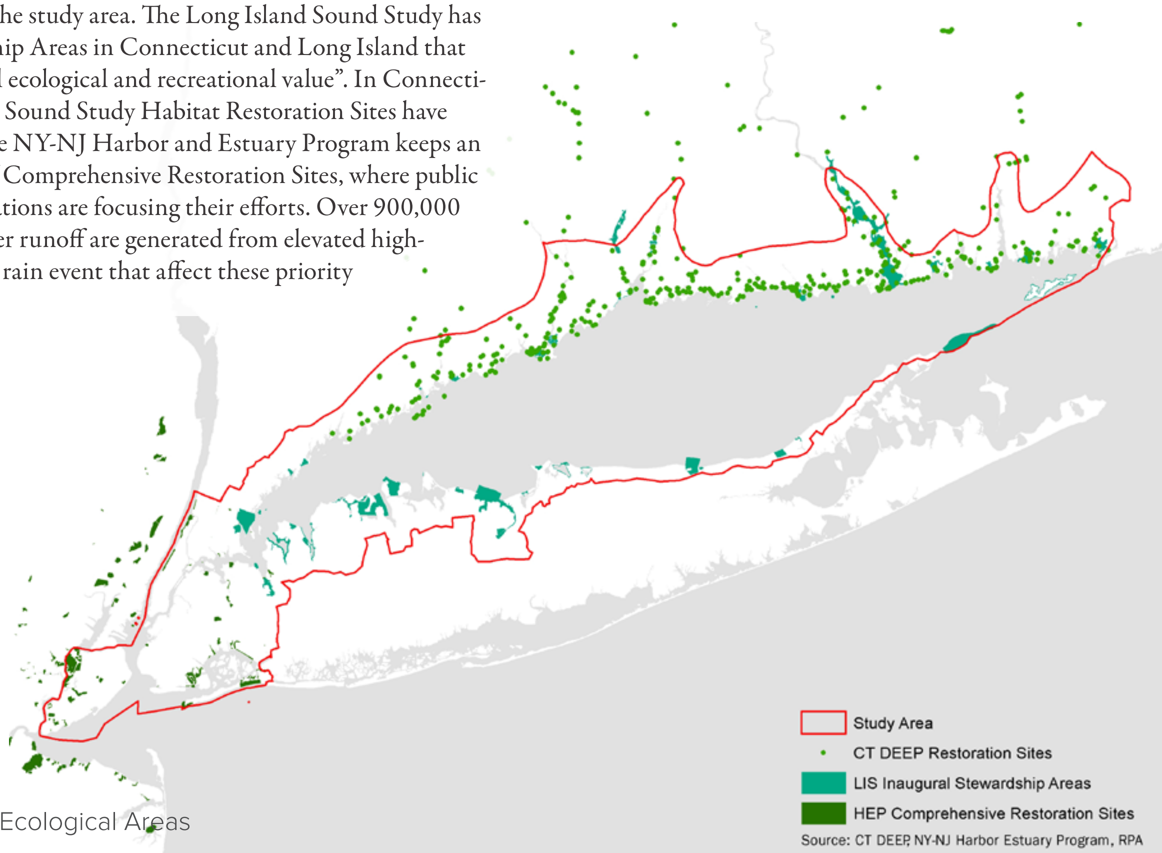


Figure 15: Priority Ecological Areas

A combination of these values helped us to identify the most important places in the Study Area for consideration for the HOLD SYSTEM™. These issues are linked: Improving water quality may be critical to success of habitat restoration efforts; restored wetlands can further improve water quality. By screening for a combination of water quality issues and habitat concerns, we identified 58 Priority Sites: elevated highway segments over park land where stormwater management would likely benefit water and habitat resources.

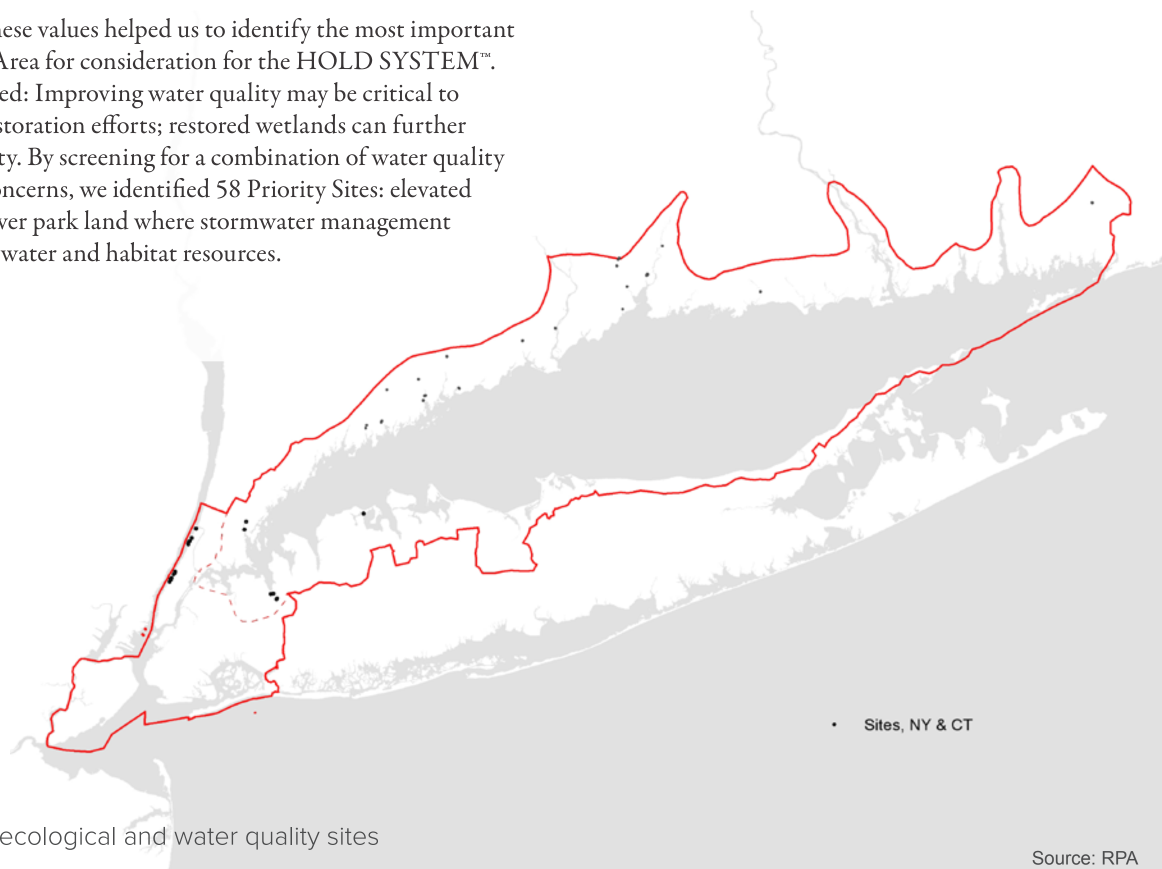


Figure 16: Priority ecological and water quality sites

The sites were then examined in Google Earth to eliminate railroad crossings, areas with limited or no physical access, and tunnels. The resulting 51 sites were considered the Candidate Sites. Appendix I provides an overview of each of these site locations.

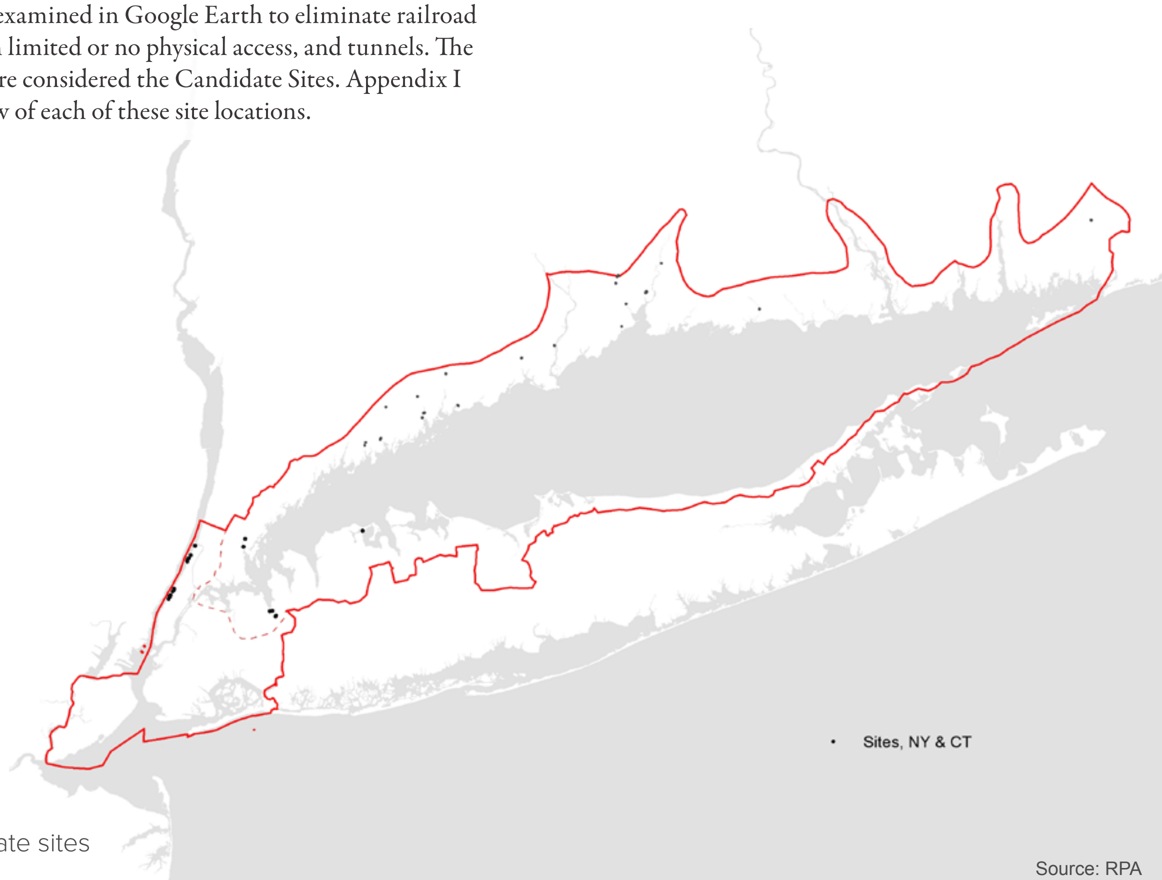


Figure 17: Candidate sites

HOLD SYSTEM™'s planted bioretention basins transform sewer grates into gardens. Because these systems improve the aesthetics of stormwater infrastructure, visual inspection using Google Earth further winnowed down the list of Candidate sites to 12 Top Sites where public pedestrian access was possible. Appendix II provides an overview of these site locations.

Figure 18: Top sites

Site Visits

Following GIS and Google Earth analysis, and based on conversations with local planners and government officials, seven potential HOLD SYSTEM™ locations were visited (two in Bridgeport, CT; four in New Haven, CT; and one in Manhattan, NYC). Three of the seven visited sites were not identified in the GIS analysis but were recommended to us by local partners. The goal of the site visits was to observe the qualities and conditions necessary for project feasibility, including the condition of the downspouts, natural lighting, space for construction and maintenance accessibility, land ownership, proximity to water body, and general site conditions. Three of the seven sites were deemed potentially feasible for further investigation.

Four sites were found to be unfeasible for a successful implementation of the HOLD SYSTEM™. One site, located on Front Street under the I-95 overpass in Fair Haven, New Haven was found unfeasible due to the lack of an existing downspout. Two of the sites, under the I-91 overpass at Willow Street in New Haven and Beardsley Park at Route 8 overpass in Bridgeport, were determined to be unfeasible locations because they contained downspouts that terminate high above the ground or water body. The downspouts in these locations would, therefore, need to be extended in order to successfully install the HOLD SYSTEM™. And lastly, High Bridge Park in northern Manhattan under the Harlem River Drive on-ramps and off-ramps contained numerous downspouts, however the site was deemed unfeasible because the downspouts drained into a hard infrastructure drainage system that protects the very steep hillside sloping down to the Harlem River. Following are more in-depth descriptions of the three potentially feasible visited sites.

Figure 19: Downspout into Pequonnock River at Beardsley Park, Bridgeport, CT (March 2014)

Source: RPA

Figure 20: High Bridge Park drainage at skate park, Manhattan, New York City, NY (June 2014)

Source: RPA

Figure 21: High Bridge Park drainage below Harlem River Drive, Manhattan, New York City, NY (June 2014)

Source: RPA

Ferry Street at the I-91 Overpass
New Haven, CT

One feasible site is located roughly a half a mile between the Quinnipiac and Mill Rivers on Ferry Street under the Interstate 91. This site was not included as a top site in the GIS analysis and was observed while travelling between two identified sites. However, because the property is located along a pedestrian pathway near residential neighborhood, a HOLD SYSTEM™ could greatly improve the aesthetic value of the area. The downspout has significant space for installation and is in good condition, making it easy to alter. There are no other visible downspouts in the area and the pitch of the roadway suggests that this single downspout handles all of the runoff water for visible areas of the overpass. The space was also easily accessible and open. Additionally, sunlight conditions were good during our visit and the abundance of vegetation adjacent to the downspout area suggests ideal growing conditions and consistent amounts of water and light. However, there were a number of sumac trees, weeds, broken bottles, and trash among the vegetation, which will need to be removed. Within the site, there was a gravel area, probably installed to prevent erosion. The site is owned by Connecticut Department of Transportation.

Figure 22: Site at Ferry Street and I-91 overpass New Haven, CT

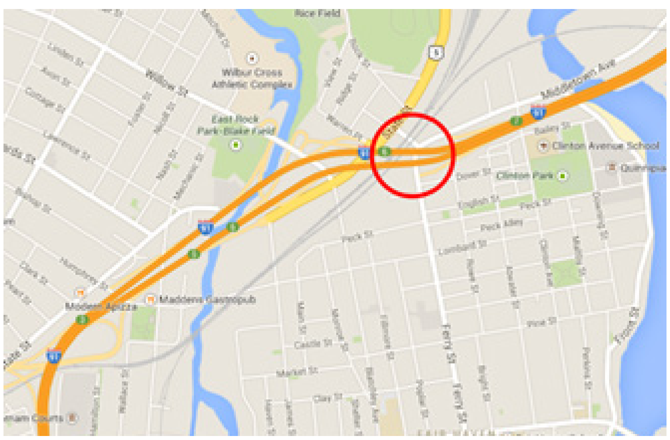


Figure 23: Downspout and terrain at Ferry Street site in New Haven, CT (March 2014)

Source: RPA

Figure 24: Panoramic view of Ferry Street site under I-91 overpass in New Haven, CT (March 2014)

Source: RPA

State Street at the I-91 Overpass
New Haven, CT

The State Street site below the I-91 overpass alongside the Mill River in New Haven, CT was initially identified as a top site in the GIS analysis. It is located in close proximity to the Willow Street site, which was deemed unfeasible, and just a few streets southwest of the Ferry and I-91 site. While the site has been under construction for several years as the State Street bridge over the Mill River is reconstructed, it has many of the qualities necessary for a HOLD SYSTEM™. There are two visible downspouts from I-91, however only one reaches the ground. This downspout is in good condition, drains out to a gravel patch, and receives a decent amount of natural light. The site is directly adjacent to Mill River, and the terrain is generally flat or gently sloping from the downspout toward the river. The land below I-91 and east of Mill River is owned by the Connecticut Department of Transportation. When questioned about the site, a ConnDOT representative voiced concerns about permitting challenges in retrofitting highway drainage systems and the amount of available space following the completion of the bridge reconstruction project.

Figure 25: Site at State Street and I-91 over Mill River New Haven, CT

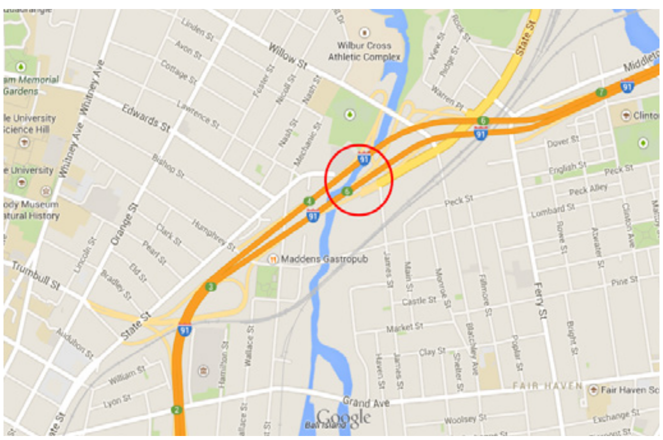


Figure 26: Downspout at State Street below I-91, east of Mill River in New Haven, CT (June 2014)

Source: RPA

Figure 27: View of State Street site from East of Mill River in New Haven, CT (June 2014)

Source: RPA

Kossuth Street at I-95 Overpass Bridgeport, CT

Another potentially feasible site is located under the I-95 overpass adjacent to the Steel Point redevelopment in Bridgeport. This site was not initially identified in the GIS analysis, but was recommended by Davey Ives, Environmental Projects Coordinator in the City of Bridgeport as it is in very close proximity, but not adjacent to, the Pequonnock River. The site is open, easily accessible, and contains several large downspouts that could be improved with the HOLD SYSTEM™. The enormous width of the overpass is not ideal as it limits the amount of natural light to the site, however the downspouts are mostly located on the outer edge pillars and receive sufficient light. The ground of the site is mostly covered with dirt and gravel. The area beneath I-95 is owned by the City of Bridgeport and is currently being used as a temporary parking lot for on-going redevelopment in the area, which could create opportunities for green infrastructure site improvements in the future.

Figure 28: Site at Kossuth Street & I-95 overpass Steel Point, Bridgeport, CT

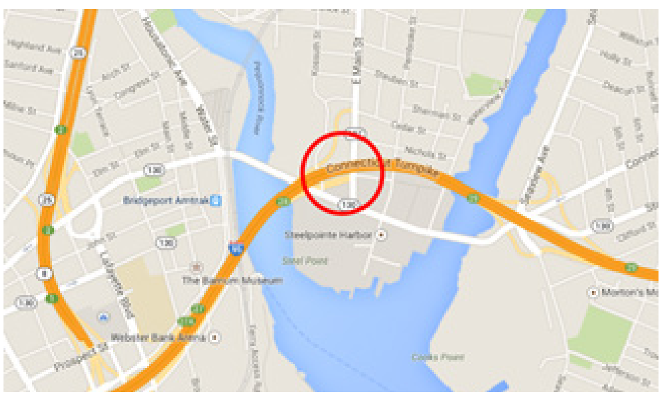


Figure 29: One of the downspouts underneath the I-95 overpass at Steel Point, Bridgeport, CT (March 2014)

Source: RPA

Figure 30: A view of the site below the I-95 overpass at Steel Point, Bridgeport, CT (March 2014)

Source: RPA

Next Steps

A key next step for these six as well as other candidate sites is identifying potential sources of funds for additional site assessment work, conceptual design, and ultimately installation and maintenance of HOLD SYSTEM™ sites. The following is a brief list of some of the sources available:

Long Island Sound Futures Fund

The National Fish and Wildlife Foundation typically issues an RFP annually for projects within the Long Island Sound Study Coastal Boundary. Since 2005, over $20 million has been granted through the Fund. www.nfwf.org/lisff

Long Island Sound Habitat Restoration Initiative

The Long Island Sound Study provides grants to projects focused on habitat restoration. http://longislandsoundstudy.net/

Hudson-Raritan Estuary Resources Program - The Port Authority of New York-New Jersey has made $60 million available for land acquisition of priority sites in the NY-NJ Harbor Estuary. http://www.harborestuary.org/

New York City Department of Environmental Protection

Through an enforcement Order with New York State Department of Environmental Conservation, NYCDEP will invest $1.5 billion in green infrastructure projects to improve water quality. Funding may also be available through the NYC Green Infrastructure Grant Program. www.nyc.gov/dep

Connecticut Clean Water Fund

Municipalities seeking funding for projects improving non point source pollution to the LIS may apply for a grant through the Fund. http://www.ct.gov/deep/

Bronx River Watershed Initiative

The National Fish and Wildlife Foundation provides funding for projects to improve water quality of the Bronx River. Funds come from a settlement of $7 million for a settlement between the State Attorney General and NYSDEC resulting from violations related to raw sewage discharges. www.nfwf.org/brwi/

Acknowledgements

The Flushing Bay HOLD SYSTEM™ project was financed by a grant from the New York City Department of Environmental Protection in connection with the settlement of an enforcement action taken by New York State and the New York State Department of Environmental Compliance for violations of New York State law and DEC regulations. Monitoring and dissemination of the project's results was also supported by a grant by National Fish and Wildlife Foundation (NFWF) Award.

This report was written and designed by **Robert Pirani**, **Emily Kilroy, Kyle Kozar, Zach Zeilman** and **Sunny Gao** of RPA. The GIS analysis was established by **Fiona Zhu** of RPA. Thanks to **Susannah C. Drake** and **Halina Steiner** of Dlandstudio, and **John McLaughlin** of NYC Department of Evironmental Protection for their comments.

RPA
Regional Plan Association

RPA is America's oldest independent urban research and advocacy organization. RPA works to improve the prosperity, infrastructure, sustainability and quality of life of the New York-New Jersey-Connecticut metropolitan region. RPA enjoys broad support from the region's and nation's business, philanthropic, civic, and planning communities. A cornerstone of RPA's work is the development of long-range plans and policies to guide the region's growth. Since the 1920s, RPA has produced three landmark plans for the region and is about to begin work on a fourth plan that will tackle the urgent challenges facing our region, including climate change, fiscal uncertainty and declining economic opportunity.

dlandstudio

dlandstudio is an interdisciplinary landscape, architecture, and urban design firm founded in 2005 by Susannah C. Drake, FASLA, AIA. The firm provides an integrated approach to planning, programming and design. Since its establishment, dlandstudio has grown to include both national and international projects. Recent works include the Gowanus Canal Sponge Park™, a public open space system designed to absorb and remediate stormwater.

Appendix I Finalist Sites

- (P) Pedestrian access (imagery survey)
- (LIS) Long Island Sound Stewardship Area (LISS)
- (RS) Long Island Sound Habitat Restoration Site (CT DEEP)
- (WQ) 303(d) Total Maximum Daily Load, due to Urban and/or CSO runoff (CT DEEP)
- (CSO) Combined Sewer Service Area with known overflow issues (LISS)

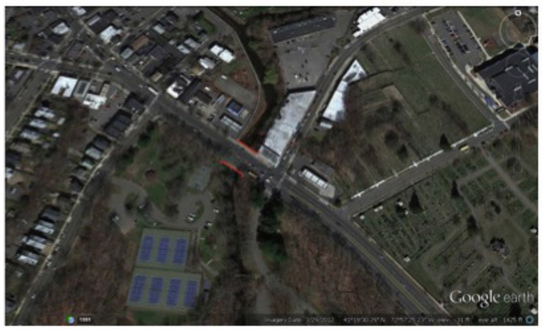
Connecticut Water + Ecological Sites

New Haven

West River Open Space/Pond Lily Nature Preserve
East Ramsdell St. at CT-63, over West River

P LIS RS WQ CSO

- Open Space to the east, Nature Preserve to the west
- Commercial and residential land uses in proximity
- Roadway owned by ConnDOT
- Bridge over West River



New Haven

Wilbur Cross HS, East Rock Park athletic fields
Willow St. over Mill River

P LIS RS WQ CSO

- High School athletic fields
- Park is on the National Register of Historic Places and features trails, bird watching
- Bridge over section of city canoe/ kayak trail
- Light commercial but mostly residential in proximity
- Roadway owned by New Haven
- Bridge over Mill River

Norwalk

Oyster Shell Park
I-95 over Norwalk River

P LIS RS WQ CSO

- Park has received recent attention for redevelopment, with native plantings and a rain garden
- Parkland on an old landfill
- Roadway owned by ConnDOT
- Bridge over Norwalk River

Norwalk

N. Water St. Park/Constitution Park

CT-136 over Norwalk River

P LIS RS WQ CSO

- Parks on both sides of the bridge
- Aquarium in close proximity
- Roadway owned by ConnDOT
- Bridge over Norwalk River

Norwalk

Thomas C. O'Connor Park

US-7 over Connecticut Avenue

P LIS RS WQ CSO

- "Protected open space" – not a park
- Along Norwalk River Valley Trail (northern side)
- Roadway owned by ConnDOT
- Bridge over another roadway

Norwalk

Rotary Park

US-1 Tresser Blvd between Greenwich & Clinton Ave

P LIS RS WQ CSO

- Rotary Park is connected by Greenbelt to Roger Smith Park
- Features a playground
- Roadway owned by ConnDOT
- Bridge over West Branch of the Wippowam River

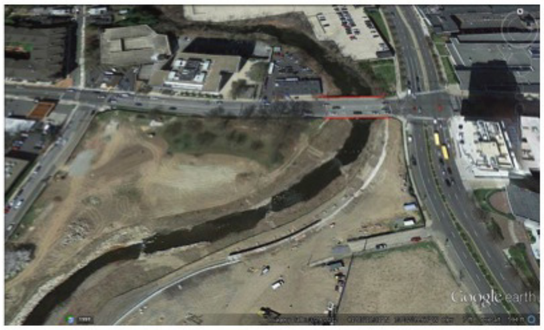
Stamford

Mill River Park

Broad Street near Washington Blvd

P LIS RS WQ CSO

- Mill River Cooperative formed to build and sustain the Mill River Park and Greenway
- Working currently to restore native plants
- Roadway owned by Stamford
- Bridge over West Branch of the Wippowam River



Stamford

I-95 Bridge

I-95 over Hamilton Ave

P LIS RS WQ CSO

- "Protected open space" – not a park
- Roadway owned by ConnDOT
- Bridge over another roadway, sidewalks go through tunnel

Bridgeport

Glenwood Park

Chopsey Hill Road/Boston Ave/US-1

P LIS RS WQ CSO

- Southern corner of park
- Park contains mostly sporting facilities (tennis courts, indoor ice rink)
- Mixed commercial/residential in proximity
- Roadway owned by ConnDOT
- Bridge over Pequonnock River

New Haven

East Rock Park athletic fields

I-91 over Mill River

P LIS RS WQ CSO

- Park athletic fields
- Park on the National Register of Historic Places
- Tide gates under I-91 at this location, pedestrian and boat access limited
- Mostly commercial/light industrial; rail corridor
- Roadway owned by ConnDOT
- Bridge over Mill River

North Haven

I-91 over Sackett Point Rd.

I-91 over Sackett Point Rd.

P LIS RS WQ CSO

- DEP water access point along Front St. just south of bridge
- Mostly industrial/warehousing, some residential on east end
- Roadway owned by ConnDOT
- Bridge over Sackett Point Rd.

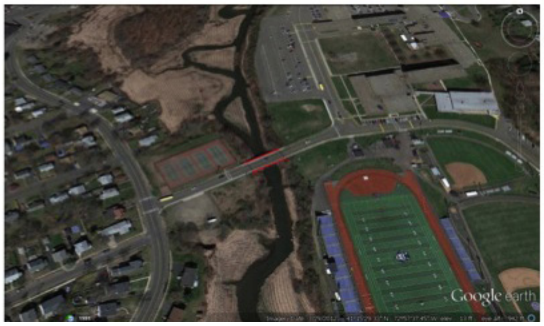
West Haven

Painter Park (NE), West Haven HS (SE)

Educational Way over Cove River

P LIS RS WQ CSO

- Park on the west side and High School on the east side
- Pedestrian access uncertain from imagery
- Roadway owned by West Haven
- Bridge over Cove River



Norwalk

Perry Ave

Perry Ave near Main Ave.

P LIS RS WQ CSO

- "Protected open space" – not a park.
- Roadway owned by Norwalk
- Bridge over Norwalk River

Stamford

I-95 Bridge

I-95 over Brookside Dr.

P LIS RS WQ CSO

- "Protected open space" – not a park.
- Residential land use in proximity
- Roadway owned by ConnDOT
- Bridge over small stream

West Haven

Southern Border, West River Memorial Park

US-1 over West River

P LIS RS WQ CSO

- Southern border of West River Memorial Park; most of park is north of this spot.
- Cemeteries, residential, light commercial/industrial in proximity
- Roadway owned by ConnDOT
- Bridge over West River

Bridgeport

Edge of Beardsley Park

CT-8 Eastbound over Beardsley Park path

P LIS RS WQ CSO

- Beardsley Park is designed by F.L. Olmsted
- Park contains Beardsley Zoo, baseball fields, and paths, along the Pequonnock River
- Cul-de-sacs with residential (east) and commercial (west) uses
- Roadway owned by CTDOT
- Bridge over multi-use path

New Haven

I-91 over Quinnipiac River

I-91 over Quinnipiac River

P LIS RS WQ CSO

- "Protected open space" – not a park, although there are benches
- Mostly industrial/warehousing and ball fields nearby
- Roadway owned by ConnDOT
- Bridge over Quinnipiac River

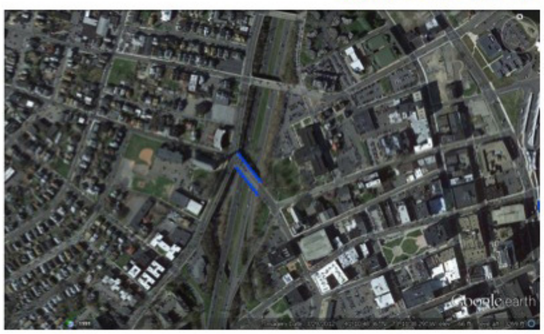
Bridgeport

City Hall Park

Lafayette Square over CT-25/Ct-8

P LIS RS WQ CSO

- Park is "front yard" to City Hall
- Small civic park, does not go down to roadway
- Civic/religious organizations immediately adjacent, residential beyond
- Roadway owned by Bridgeport
- Bridge over CT-25/CT-8



New Haven

West River Memorial Park/Edgewood Park

CT-34 over West River

P LIS RS WQ CSO

- Northern border of West River Memorial Park, Southern border of Edgewood Park; Yale Univ. to the West
- Roadway owned by ConnDOT
- Bridge over West River

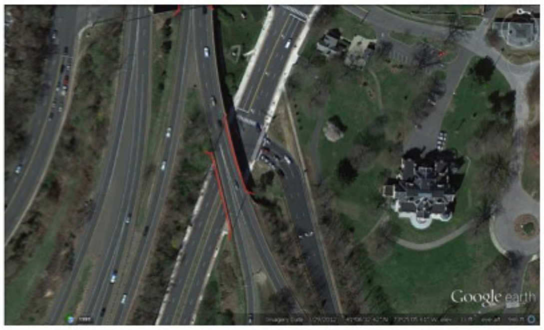
Norwalk

US-7

US-7 over West Avenue

P LIS RS WQ CSO

- "Protected open space" – not a park.
- Near Norwalk River Valley Trail
- Near Lockwood Mathews Park, civic institutions
- Roadway owned by ConnDOT
- Bridge over another roadway



Shelton

Veterans' Memorial Park

CT-8 over Housatonic River

P LIS RS WQ CSO

- Park an old industrial site, now features a farmers' market
- Mixed industrial/residential in proximity
- Roadway owned by ConnDOT
- Bridge over Pequonnock River

Stamford

Vincent Horan Park & Scalzi Park

Bridge Street over Mill River

P LIS RS WQ CSO

- Bridge divides the two parks
- Scalzi Park has some athletic facilities, Horan Park is natural along the river
- Roadway owned by Stamford
- Bridge over Mill River

Westport

I-95 in downtown Westport

I-95 over the Saugatuck River, near Saugatuck Ave

P LIS RS WQ CSO

- "Protected open space" – not a park.
- Wastewater Treatment facility on eastern end; retail on the western end
- Roadway owned by ConnDOT
- Bridge over Saugatuck River

Westport

Merritt Parkway in Westport

Merritt Parkway (CT-15) over Saugatuck, near Clinton Ave

P LIS RS WQ CSO

- Lee's Pond Dam Water Access
- Residential properties in proximity
- Roadway owned by ConnDOT
- Bridge over Saugatuck River

New York Water + Ecological Sites

- P Pedestrian access (imagery survey)
- LIS Long Island Sound Stewardship Area (LISS)
- CRP Comprehensive Restoration Plan Site (NY-NJ Harbor Estuary Program)
- WQ 303(d) Total Maximum Daily Load, due to Urban and/or CSO runoff (CT DEEP)
- CSO Combined Sewer Service Area with known overflow issues (LISS)

Bayville-Millneck

Bayville Bridge, Oyster Bay National Wildlife Refuge

Bayville Bridge/W. Shore Rd. over Mill Neck Creek

P LIS CRP WQ CSO

- Small section of land along Shore Rd on the Millneck side is part of refuge, open space on Bayville side.
- Whole water body is part of Oyster Bay National Wildlife Refuge
- Roadway owned by Nassau County
- Bridge over Mill Neck Creek

Bronx

Pelham Bay Park/Landfill

I-95 over Bronx and Pelham Parkway

P LIS CRP WQ CSO

- Park is the largest in the 5 boros
- Natural and athletic areas, walking paths directly under bridge
- Urban park surrounded by highways
- Roadway owned by NYSDOT
- Bridge over another roadway

Bronx

Pelham Bay Park

Orchard Beach Road over Hutchinson River Parkway

P LIS CRP WQ CSO

- Park is the largest in the 5 boros
- Natural and athletic areas, path along roadway under bridge for bike/ped
- Urban park surrounded by highways
- Roadway owned by NYCDOT
- Bridge over another roadway

Manhattan

Hudson River Greenway

Hudson River Parkway over W. 79th St.

P LIS CRP WQ CSO

- Hudson River Greenway is the longest greenway in Manhattan
- Tunnels under roadways connect neighborhood to greenway
- Roadway owned by NYCDOT
- Bridge crosses other roadway

Manhattan

Inwood Hill Park

Henry Hudson Parkway over pedestrian path in park

P LIS CRP WQ CSO

- Inwood Hill Park is primarily natural lands with hiking trails
- Tunnel serves pedestrian trail only
- Roadway owned by NYCDOT
- Bridge crosses pedestrian trail

Manhattan

Hudson River Greenway

Hudson River Greenway and W. 95th St. under Hudson River Parkway

P LIS CRP WQ CSO

- Hudson River Greenway is the longest greenway in Manhattan
- Tunnels under roadway connects Hudson River Greenway and W. 95th Street ramps
- Roadway owned by NYCDOT
- Bridge crosses roadway and greenway

Manhattan

Hudson River Greenway/Riverside Park

Pedestrian walkway under Henry Hudson Parkway at 73rd St.

P LIS CRP WQ CSO

- Riverside Park starts here
- Hudson River Greenway is the longest greenway in Manhattan
- Connects the greenway with the 72nd Street Dog Run
- Roadway owned by NYCDOT
- Bridge over pedestrian walkway at 73rd Street

Queens

Alley Pond Park

I-495 and ramps over I-295/Cross Island Pkwy

P LIS CRP WQ CSO

- Alley Pond Park has wetlands, conservation areas, athletic fields
- Near ball fields
- Walking path goes beneath elevated portions of roadways
- Large urban park surrounded by highways and residential neighborhoods
- Roadway owned by NYSDOT
- Bridge over I-295

Bronx

Pelham Bay Park

I-95 over Hutchinson River Parkway

P LIS CRP WQ CSO

- Park is the largest in the 5 boros
- Urban park surrounded by highways and residential neighborhoods
- Roadway owned by NYSDOT
- Bridge over Hutchinson River Parkway in the corner of the park

Manhattan

Hudson River Greenway

Riverside Drive over W. 96th St.

P LIS CRP WQ CSO

- Hudson River Greenway is the longest greenway in Manhattan
- Connects neighborhood to park near clay tennis courts
- Roadway owned by NYCDOT
- Bridge crosses other roadway

Manhattan

Hudson River Greenway

Hudson River Parkway over Hudson River Greenway, near W. 84th St.

P LIS CRP WQ CSO

- Hudson River Greenway is the longest greenway in Manhattan
- Tunnels under roadways connect neighborhood to greenway
- Roadway owned by NYCDOT
- Bridge crosses other roadway

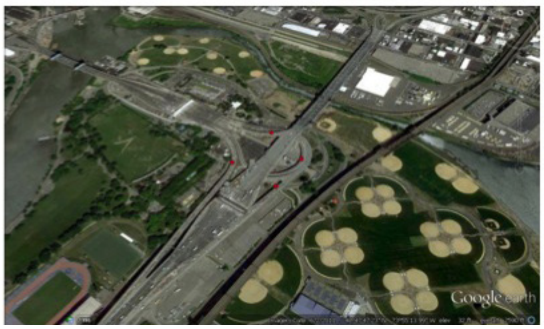
Manhattan

Randall's Island Park

Triborough Bridge Bronx-Manhattan Plaza

P LIS CRP WQ CSO

- While this whole section contains park lands, it is not likely anyone would walk from one side to the other due to roadway dominance.



Queens

Alley Pond Park

NY-25A over I-295/Cross Island Pkwy & NY-25A over Alley Creek

P LIS CRP WQ CSO

- Alley Pond Park has wetlands, conservation areas in addition to sports fields
- Close to the Environmental Center (possible education tie-in)
- Large urban park surrounded by highways and residential neighborhoods
- Roadway owned by NYSDOT
- Bridge over Alley Creek

Manhattan

High Bridge Park

Hamilton & Washington Bridges, bridge and ramps

P LIS CRP WQ CSO

- High Bridge Park features natural areas and athletic facilities
- Multi-use paths cross under elevated roadways
- Roadway owned by NYSDOT
- Bridge crosses other roadways, East River
- High Bridge undergoing rehabilitation to re-open historic pedestrian/bike access, connecting Manhattan and Bronx; park closed until 2014

Bronx

Bronx Park
US-1 over Bronx River

P LIS CRP WQ CSO

- Bronx Park has natural areas and the Bronx Zoo and Botanic Gardens
- This area is natural, with the bioretention system being visible to kayakers and bike/ped users
- Urban park surrounded by highways , residential
- Roadway owned by NYSDOT
- Bridge over river

Bronx

Bronx Park
Bronx River Parkway over US-1

P LIS CRP WQ CSO

- Bronx Park has natural areas and the Bronx Zoo and Botanic Gardens
- Multi-use path along roadway/ clover leaf
- Urban park surrounded by highways, residential
- Roadway owned by NYSDOT
- Bridge over roadway

Bronx

Van Cortlandt Park
I-287 over Nature Trail

P LIS CRP WQ CSO

- Van Cortlandt Park has natural areas and athletic facilities
- This area is connects two woods via nature trail
- Urban park surrounded by highways
- Roadway owned by NYSDOT
- Bridge over path

Bronx

Van Cortlandt Park
I-87 ramps to Jerome Ave.

P LIS CRP WQ CSO

- Van Cortlandt Park has natural areas and athletic facilities
- Indian Field and natural lands in proximity
- This area has multi-use paths
- Urban park surrounded by highways
- Roadway owned by NYCDOT
- Exit ramp has grade separated multi-use path along it and then passing under it to continue through park; could serve to improve connections between sides of park

Bronx

Van Cortlandt Park
Mosholu Parkway over multi-use path

P LIS CRP WQ CSO

- Van Cortlandt Park has natural areas and athletic facilities
- Golf course in proximity
- Urban park with highway running through
- Roadway owned by NYCDOT
- Bridge is highway/roadway over multi-use path

Brooklyn

Verrazano-Narrows Bridge Ramps/Shore Road Park + Parkway
I-278 over John Paul Jones Park, Shore Park and Parkway

P LIS CRP WQ CSO

- John Paul Jones Park has monuments and turf
- Shore Park has athletic fields and the parkway promenade
- Urban park surrounded by highways and residential neighborhoods
- Roadway is owned by NYSDOT
- Bridge is over narrows of Hudson Bay

Staten Island

Verrazano-Narrows Bridge Ramps/Fort Wadsworth
I-278 over Fort Wadsworth-Gateway National Recreation Area

P LIS CRP WQ CSO

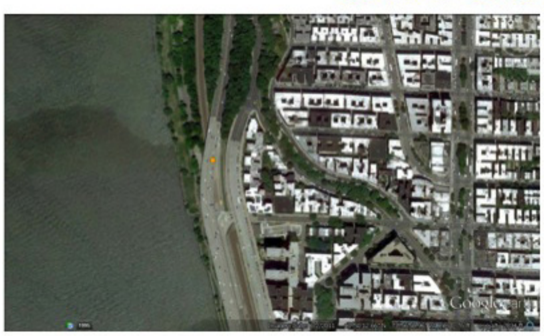
- Fort Wadsworth is one of the oldest military installations in the nation. The park is over 200 acres.
- Part of the Gateway National Recreation Area
- Urban park surrounded by highways and residential neighborhoods
- Roadway is owned by NYSDOT
- Ramps cross over parkland, roadways, and pedestrian paths
- Bridge is over Narrows of New York Harbor

Manhattan

Hudson River Greenway
Henry Hudson Parkway over Riverside Drive over Railroad tracks at W. 158th St.

P LIS CRP WQ CSO

- Longest greenway in Manhattan
- Area has layered roadways, Riverside Drive and the Henry Hudson Parkway
- Tunnels under roadways connect neighborhood to greenway
- Roadway owned by NYCDOT
- Bridge crosses other roadway, railroad tracks



Queens

Forest Park

Jackie Robinson Parkway over/under other roadways

P LIS CRP WQ CSO

- Forest Park has a combination of natural paths and athletic fields
- Western two sites adjacent to golf course
- Large urban park surrounded by highways and residential neighborhoods
- Roadway owned by NYCDOT
- Bridges over local roadways
- Pedestrian access for the two western bridges is a sidewalk along a roadway through a tunnel

Queens

Alley Pond Park

Grand Central Parkway Exit Ramp over Vanderbilt Parkway /Motor Trail

P LIS CRP WQ CSO

- Alley Pond Park has wetlands, conservation areas in addition to sports fields
- Near natural walking paths, Motor Trail
- Large urban park surrounded by highways and residential neighborhoods
- Roadway owned by NYSDOT
- Bridge over Motor Trail

Smithtown

Sunken Meadow State Park

Sunken Meadow Parkway over Sunken Meadow Road

P LIS CRP WQ CSO

- Sunken meadow State Park has golfing, Sound beaches, and trails; tidal wetlands/marshes too
- At edge of park, near golf course. Sidewalks cross under bridge; use is likely limited
- Roadway owned by NYSDOT
- Bridge over Sunken Meadow Road

Manhattan

Fort Tryon Park

Margaret Corbin Drive over Park Drive, at the Cloisters

P LIS CRP WQ CSO

- Fort Tryon Park has mostly natural areas and lawns
- Area near the Cloisters
- Roadway owned by NYCDOT
- Bridge crosses another roadway

Sunken Meadow State Park

Sunken Meadow Parkway over Sunken Meadow Creek

P LIS CRP WQ CSO

- Sunken Meadow State Park has golfing, Sound beaches, and trails; tidal wetlands/marshes
- Bridge connects parking area with golfing area; walking paths on both sides, although they hug the roadway (no trails under bridge)
- Roadway owned by NYSDOT
- Bridge over Sunken Meadow Creek

Appendix II Top Sites

Connecticut Water + Ecological Sites

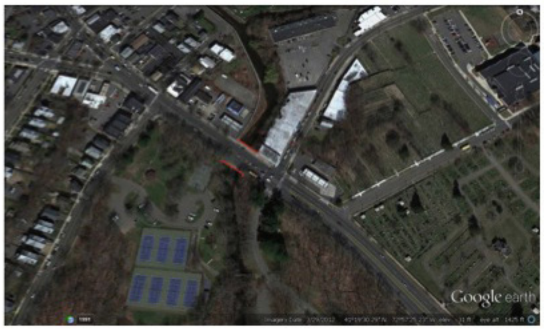
- P Pedestrian access (imagery survey)
- LIS Long Island Sound Stewardship Area (LISS)
- RS Long Island Sound Habitat Restoration Site (CT DEEP)
- WQ 303(d) Total Maximum Daily Load, due to Urban and/or CSO runoff (CT DEEP)
- CSO Combined Sewer Service Area with known overflow issues (LISS)

New Haven

West River Open Space/Pond Lily Nature Preserve
East Ramsdell St. at CT-63, over West River

P LIS RS WQ CSO

- Open Space to the east, Nature Preserve to the west
- Commercial and residential land uses in proximity
- Roadway owned by ConnDOT
- Bridge over West River



New Haven

Wilbur Cross HS, East Rock Park athletic fields
Willow St. over Mill River

P LIS RS WQ CSO

- High School athletic fields
- Park is on the National Register of Historic Places and features trails, bird watching
- Bridge over section of city canoe/ kayak trail
- Light commercial but mostly residential in proximity
- Roadway owned by New Haven
- Bridge over Mill River

Norwalk

Oyster Shell Park
I-95 over Norwalk River

P LIS RS WQ CSO

- Park has received recent attention for redevelopment, with native plantings and a rain garden
- Parkland on an old landfill
- Roadway owned by ConnDOT
- Bridge over Norwalk River

Stamford

Mill River Park
Broad Street near Washington Blvd

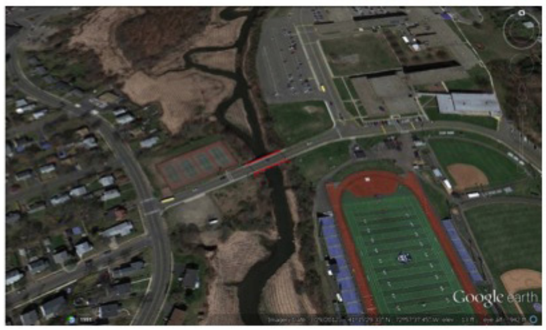
P LIS RS WQ CSO

- Mill River Cooperative formed to build and sustain the Mill River Park and Greenway
- Working currently to restore native plants
- Roadway owned by Stamford
- Bridge over West Branch of the Wippowam River

West Haven

Painter Park (NE), West Haven HS (SE)
Educational Way over Cove River

P LIS RS WQ CSO

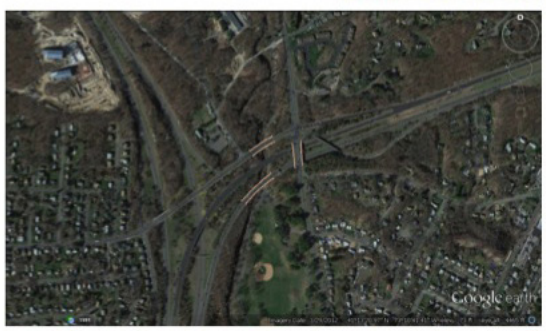


- Park on the west side and High School on the east side
- Pedestrian access uncertain from imagery
- Roadway owned by West Haven
- Bridge over Cove River

Bridgeport

Edge of Beardsley Park
CT-8 Eastbound over Beardsley Park path

P LIS RS WQ CSO

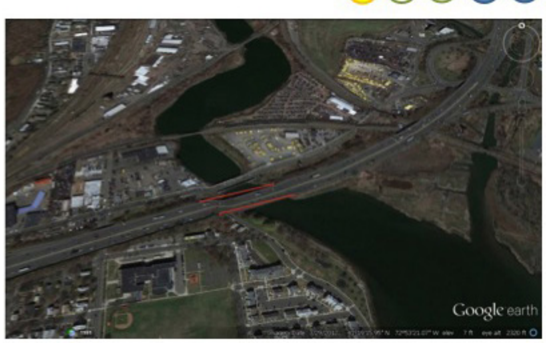


- Beardsley Park is designed by F.L. Olmsted
- Park contains Beardsley Zoo, baseball fields, and paths, along the Pequonnock River
- Cul-de-sacs with residential (east) and commercial (west) uses
- Roadway owned by CTDOT
- Bridge over multi-use path

New Haven

I-91 over Quinnipiac River
I-91 over Quinnipiac River

P LIS RS WQ CSO



- "Protected open space" – not a park, although there are benches
- Mostly industrial/warehousing and ball fields nearby
- Roadway owned by ConnDOT
- Bridge over Quinnipiac River

New York Water + Ecological Sites

- P — Pedestrian access (imagery survey)
- LIS — Long Island Sound Stewardship Area (LISS)
- CRP — Comprehensive Restoration Plan Site (NY-NJ Harbor Estuary Program)
- WQ — 303(d) Total Maximum Daily Load, due to Urban and/or CSO runoff (CT DEEP)
- CSO — Combined Sewer Service Area with known overflow issues (LISS)

Bayville-Millneck

Bayville Bridge, Oyster Bay National Wildlife Refuge
Bayville Bridge/W. Shore Rd. over Mill Neck Creek

P LIS CRP WQ CSO

- Small section of land along Shore Rd on the Millneck side is part of refuge, open space on Bayville side.
- Whole water body is part of Oyster Bay National Wildlife Refuge
- Roadway owned by Nassau County
- Bridge over Mill Neck Creek

Bronx

Pelham Bay Park/Landfill
I-95 over Bronx and Pelham Parkway

P LIS CRP WQ CSO

- Park is the largest in the 5 boros
- Natural and athletic areas, walking paths directly under bridge
- Urban park surrounded by highways
- Roadway owned by NYSDOT
- Bridge over another roadway

Queens

Alley Pond Park
I-495 and ramps over I-295/Cross Island Pkwy

P LIS CRP WQ CSO

- Alley Pond Park has wetlands, conservation areas, athletic fields
- Near ball fields
- Walking path goes beneath elevated portions of roadways
- Large urban park surrounded by highways and residential neighborhoods
- Roadway owned by NYSDOT
- Bridge over I-295

High Bridge Park

Hamilton & Washington Bridges, bridge and ramps

P LIS CRP WQ CSO

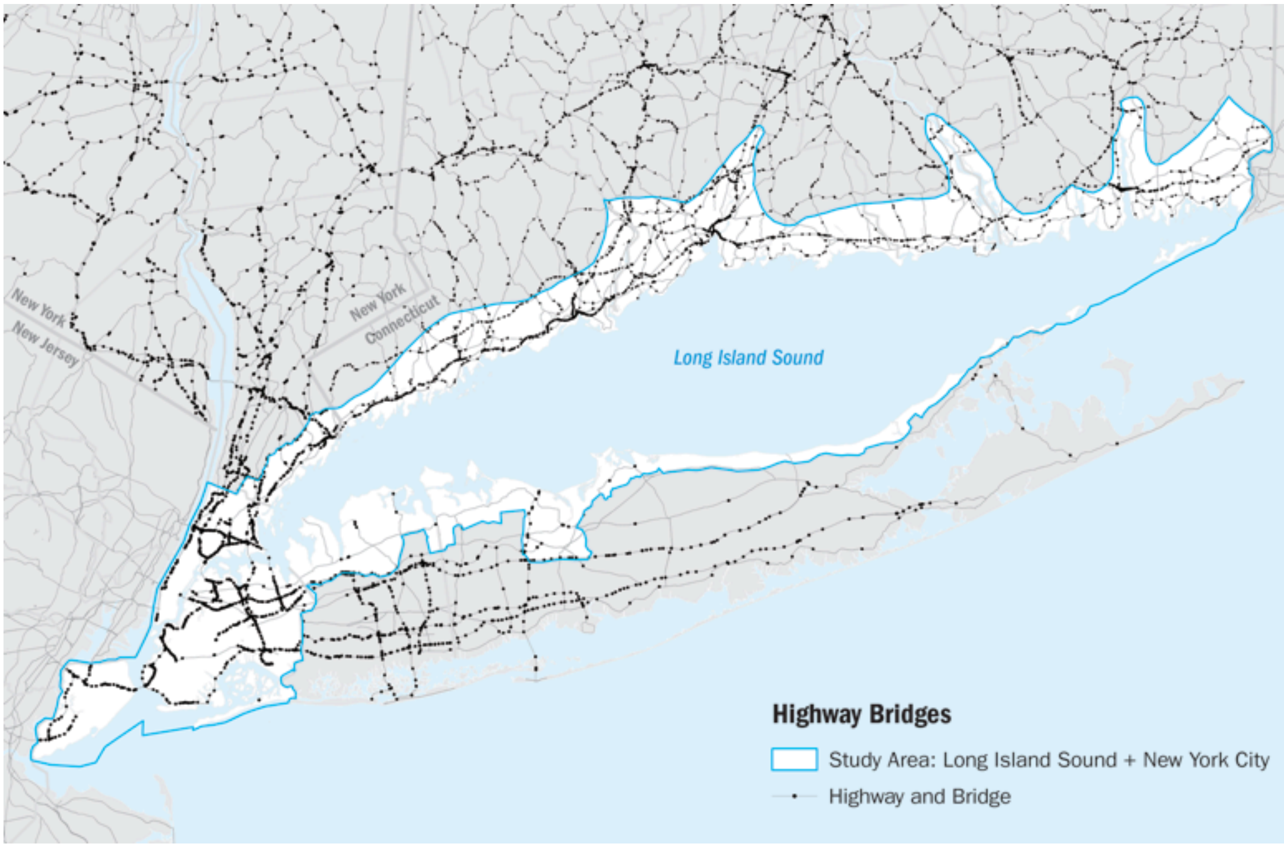
- High Bridge Park features natural areas and athletic facilities
- Multi-use paths cross under elevated roadways
- Roadway owned by NYSDOT
- Bridge crosses other roadways, East River
- High Bridge undergoing rehabilitation to re-open historic pedestrian/bike access, connecting Manhattan and Bronx; park closed until 2014

Appendix III Methodology

Base Criteria

New Haven

1. Bridges, for which GIS files are from CT DOT (2011) and NYS DOT (2009), within 100 meters to highways (GIS files are from U.S. Census TIGER Line Products 2010) were selected as highway bridges where storm water runs off through scuppers.



Since the Connecticut Bridge GIS file contains lines that represent the actual crossovers, while New York file includes only dots representing the point location of the bridges, lengths of the CT bridges were calculated (Table 1) in ArcGIS and applied the average length to estimate lengths of NY bridges (Table 2). Please note that for all tables, in Connecticut, the length is based on actual bridge length. In New York, the length is based on the average identified in Table 1.

Table 1: Average Highway Bridge Length from CT Bridge File

Number of Bridges	4,744
Length (Ft)	662,844
Average Length (Ft)	140

Table 2: Estimates of Highway Bridges in Study Area

	Number of Bridges	Length (Ft)
CT within Study Area	1,270	217,824
NY within Study Area	1,289	180,102
Total within Study Area	2,559	397,927

2. Of the highway bridges from step 1, those intersecting protected open space were selected as potential sites to install the bioretention system. Protected open space is defined as a composite of the following:

a. Secured open space from The Nature Conservancy;

b. In the Open Space layer from NYC DOITT, the category of "Recreational Areas over 2 acres;"

c. Federal, State, County and Municipal recreational areas From NYS DEC;

d. Municipal open space layer from CT DEP; and

e. Layers of parks, protect land by conservation easement, and protected land by fee from Scenic Hudson (lands protected by conservation easement or fee but not accessible to the public were removed).

Table 3: Estimates of Highway Bridges over Protected Open Space in Study Area

	Number of Bridges	Length (Ft)
CT within Study Area	104	23,838
NY within Study Area	111	15,509
Total within Study Area	215	39,347

Filter Criteria

Water quality

- Within Tier One combined sewage drainage basins, which intersect city-designated Tire One combined sewer out falls.
- Within half a mile to EPA 303(d) impaired waters (2010) due to urban runoff, stormwater, and/or CSO, in both CT and NY
- Within sewer service area in Bridgeport, New Haven, Norwich, and Hartford, Connecticut (these cities have been identified as having CSO issues).

	Number of Bridges w/CSO	Number of Bridges w/303(d)	Length (Ft) CSO	Length (Ft) 303(d)
CT within Study Area	28	76	7,393	43,472
NY within Study Area	24	80	3,360	11,200
Total within Study Area	**52**	**156**	**10,753**	**54,672**

Habitat

- Within Long Island Sound Inaugural Stewardship Areas
- Within a quarter mile to Connecticut Restoration Sites (all, including completed, in-progress and potential sites; these sites have a buffer because the shapefile is points and not polygons) (Connecticut sites only)
- Within Harbor Estuary Program Restoration or Acquisition Sites (New York sites only).

	Number of Bridges w/LISS	Number of Bridges w/HEP (NY)/CRS (CT)	Length (Ft) LISS	Length (Ft) HEP/CRS)
CT within Study Area	5	22	2,035	8,889
NY within Study Area	16	32	2,240	4,480
Total within Study Area	**21**	**54**	**4,275**	**13,369**

Sites that achieve habitat and water quality priorities:

	Number of Bridges	Length (Ft)
CT within Study Area	25	2,189
NY within Study Area	33	4,620
Total within Study Area	**58**	**6,809**

HOLD

SYSTEM

FLUSHING BAY

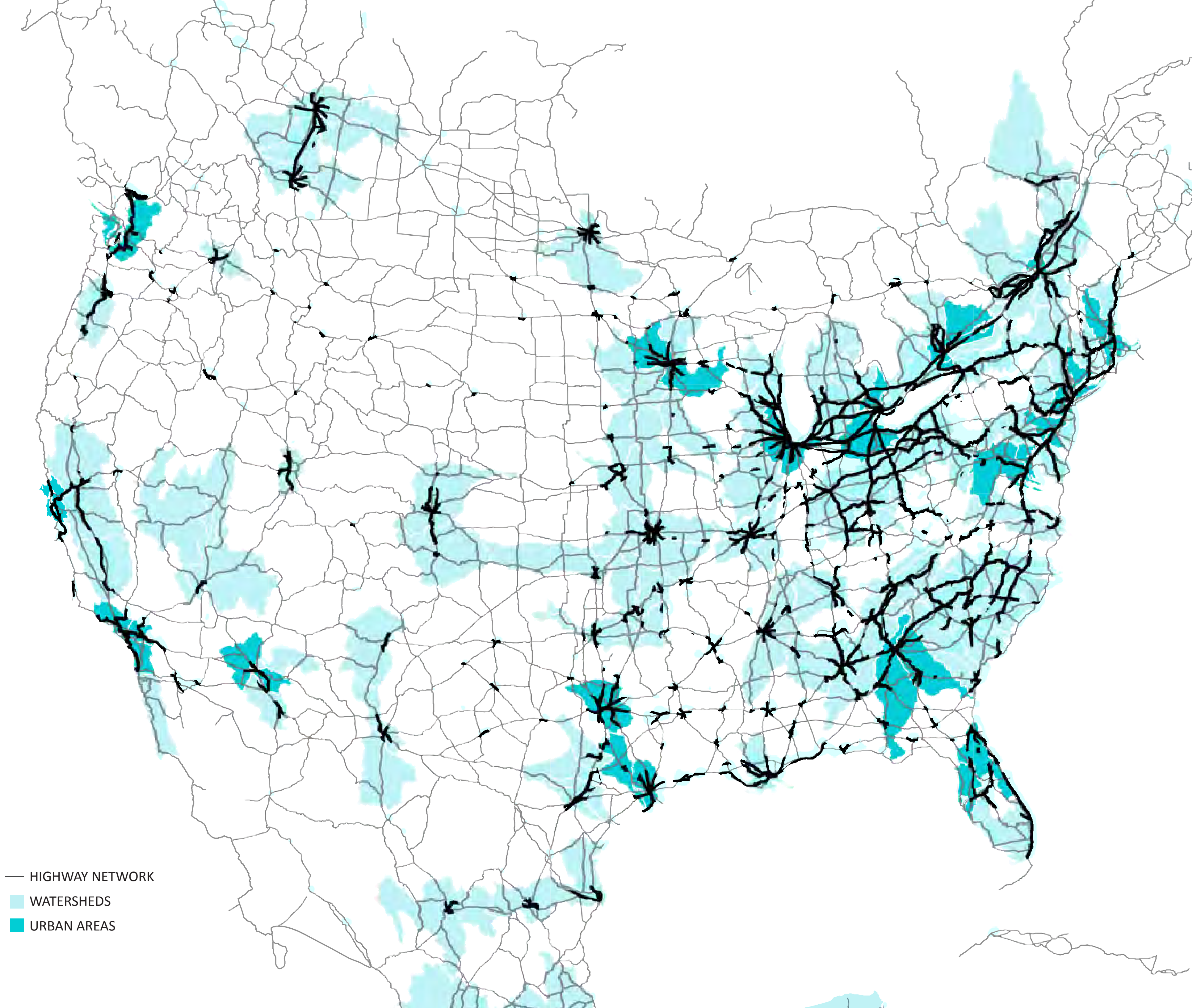
HOLD

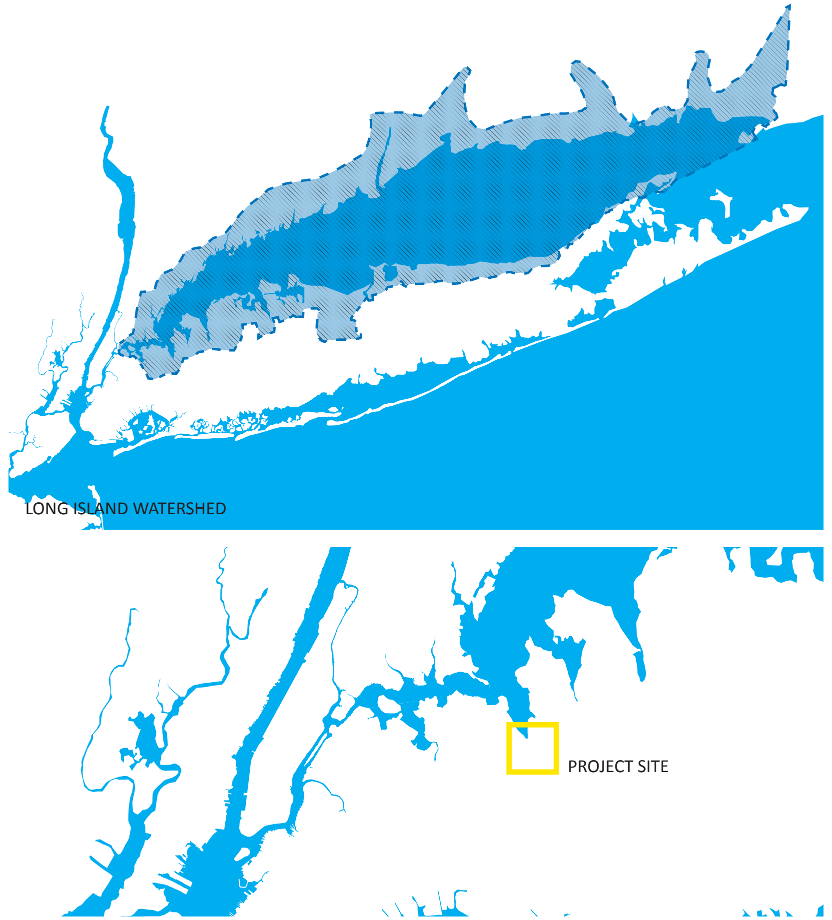
SYSTEM

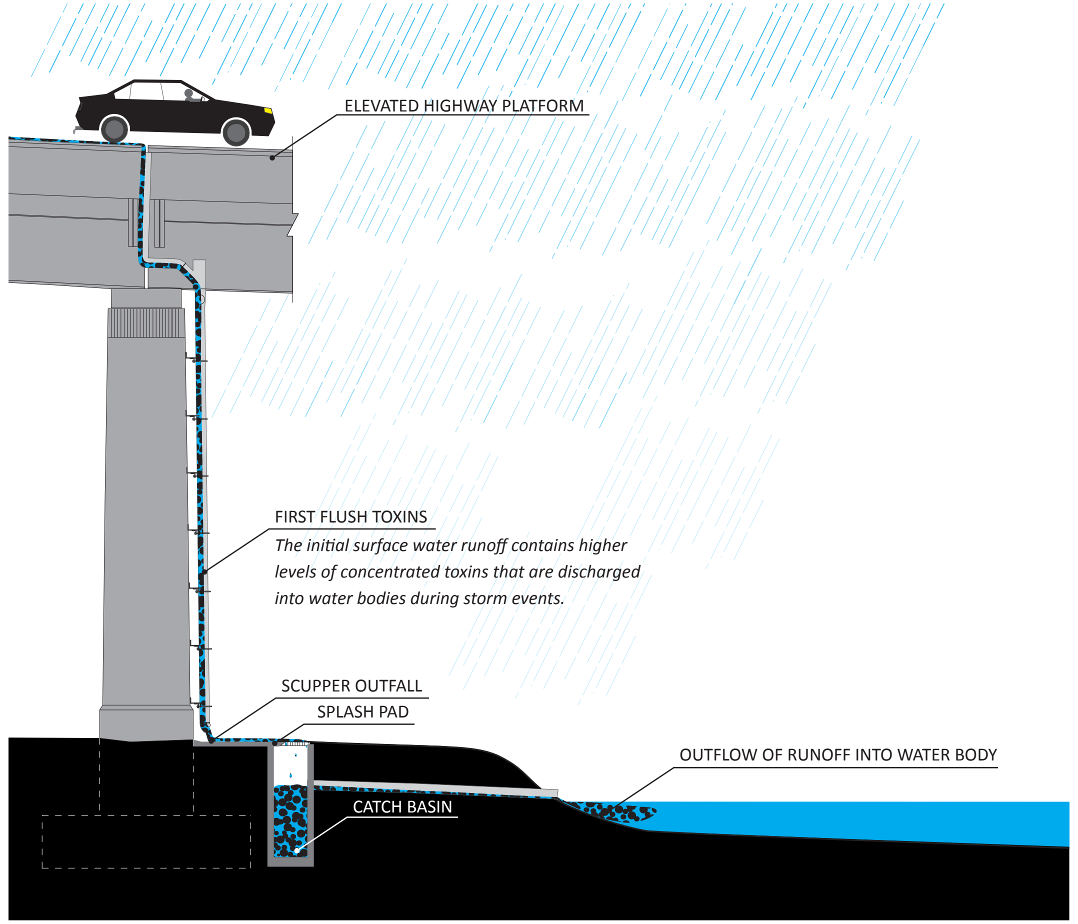
FLUSHING BAY

Regional Plan Association
DLANDSTUDIO architecture + landscape architecture pllc
Weidlinger Associates
Manhattan College
F2 Environmental

This project was undertaken by the New York City Department of Environmental Protection in connection with the settlement of an enforcement action taken by New York State and the New York State Department of Environmental Compliance for violations of New York State law and DEC regulations.



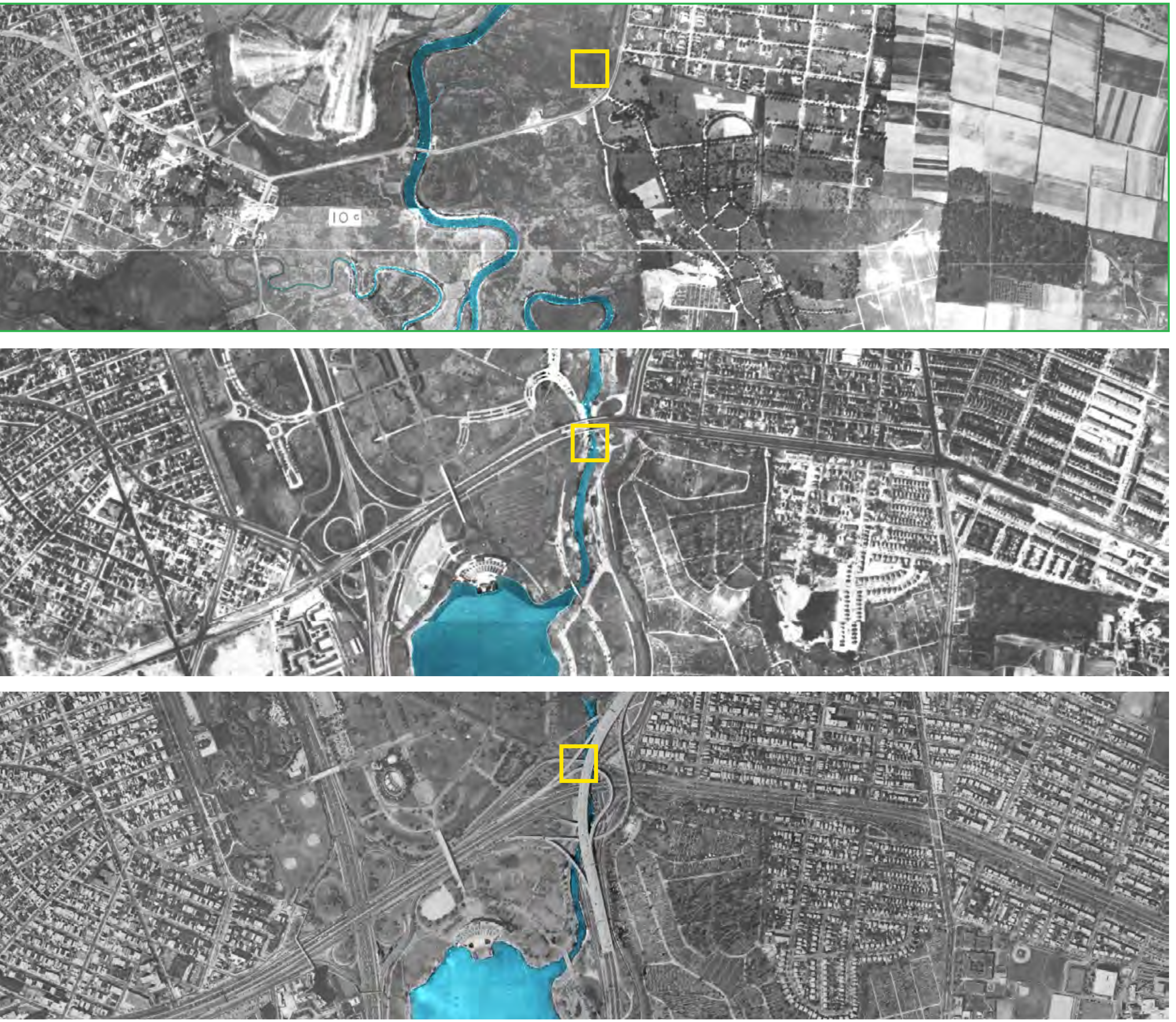




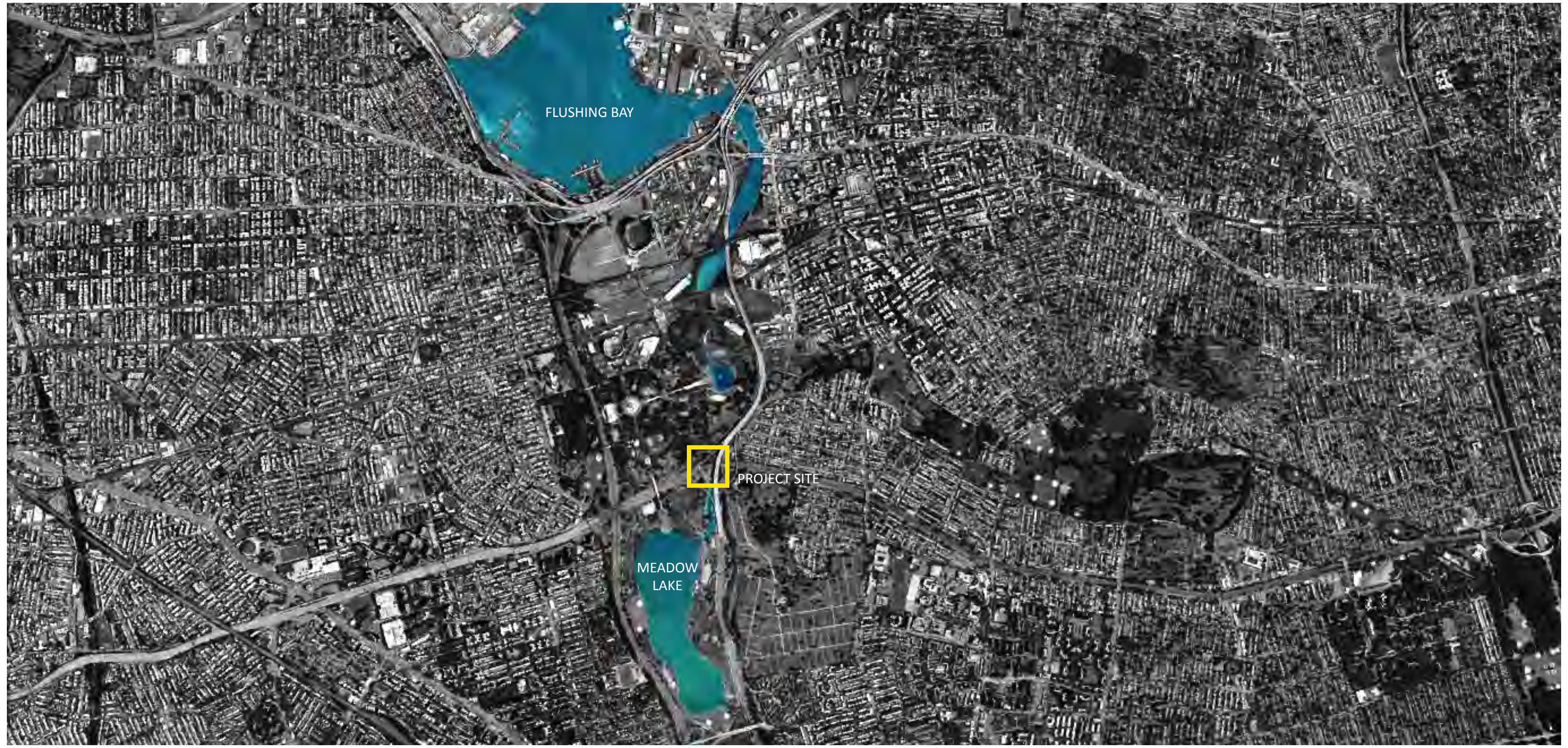
THE ISSUE

There are 7,200 miles of bridges and elevated highways throughout U.S. cities. The majority of these structures are constructed with downspouts that connect to adjacent waterways. These downspouts release first flush toxins and debris into these waterways, polluting the water. The Highway Outfall Landscape Detention System, or HOLD System, redefines this relationship.

The HOLD System redirects the water into a modular treatment area that purifies the water before it can enter the waterway. This system uses planted, modular green infrastructure that absorb and filter pollutants that so often flush into nearby bodies of water. The HOLD System catches unsavory elements such as cigarette butts and other detritus that are left on the highways before the rain event and prevents them from entering larger bodies of water or the drinking water system.

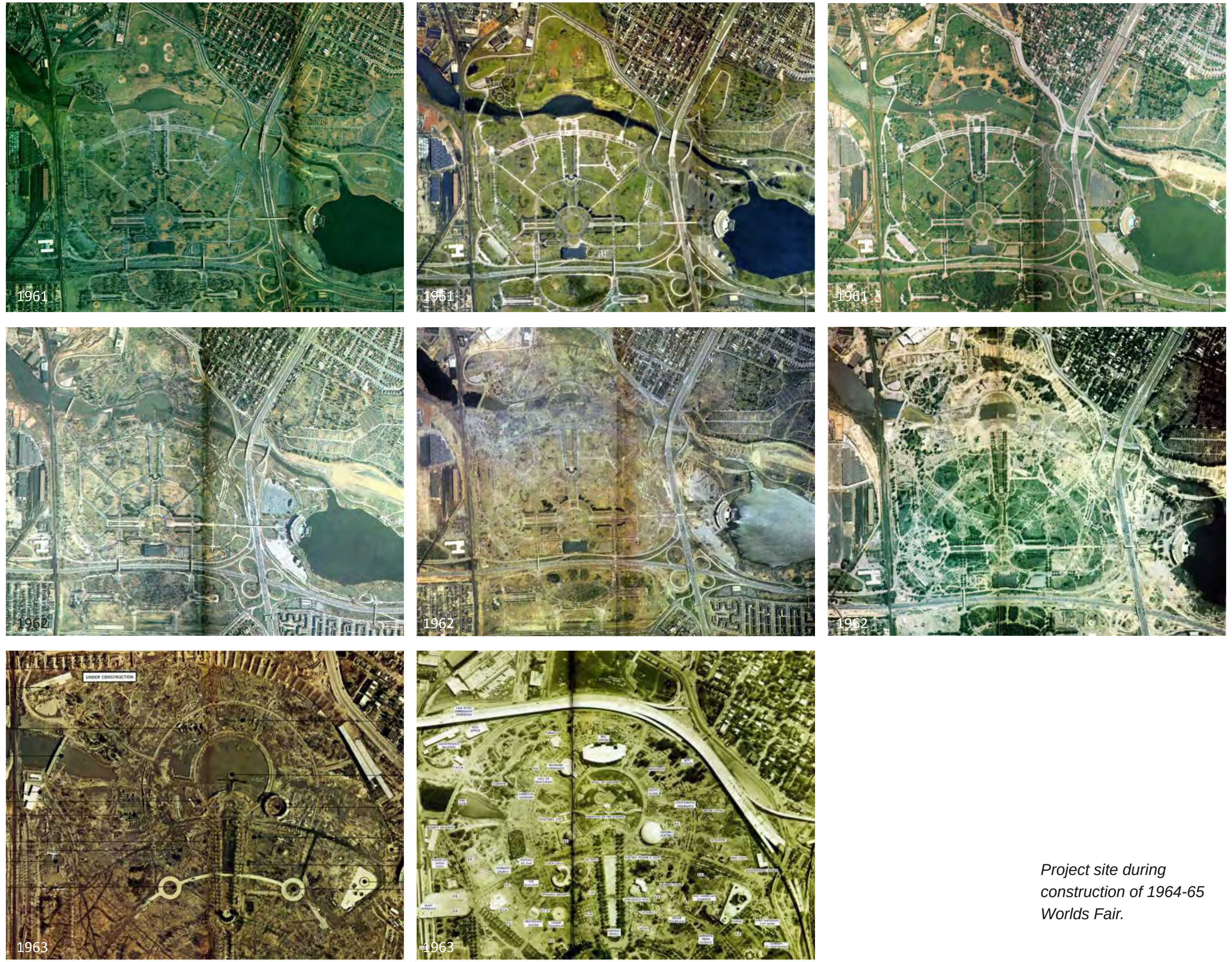


Project site over time from top 1924, 1951 and 1996. Severe alterations to water and transportation infrastructure are apparent in the progression.



THE SITE

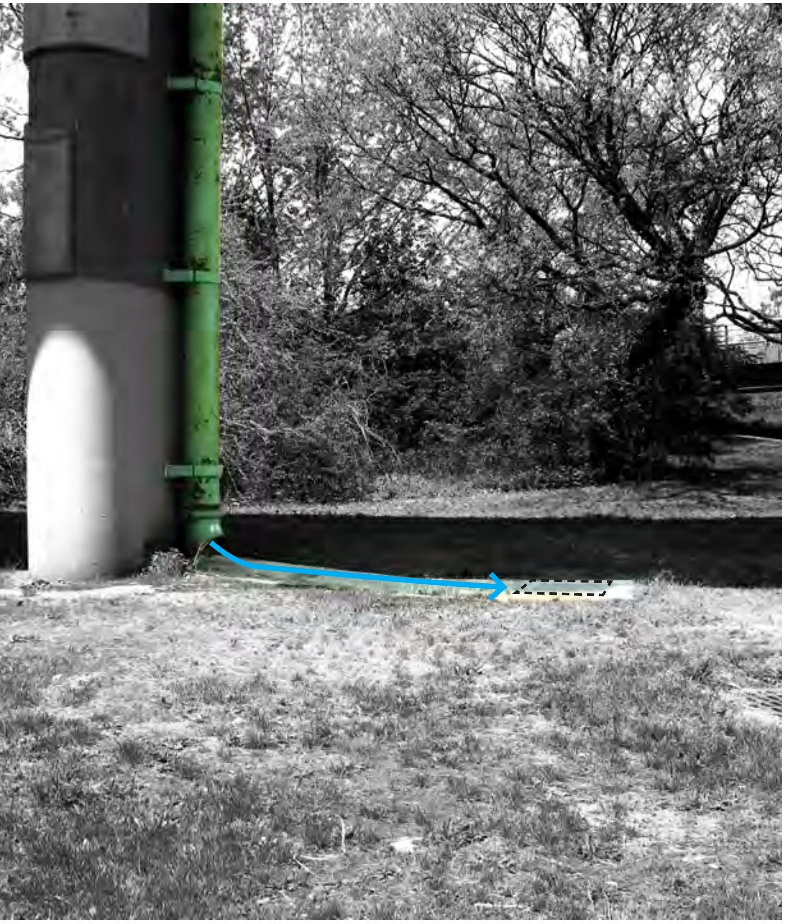
Flushing Meadows Corona Park is located in Queens, New York. The park has a layered history that is reflected in its subsurface condition. The park grounds were originally composed of salt marshland which mitigated hydrological conditions such as drainage and flooding found between the upland areas and Flushing Bay. The hydrology was altered when the park, then called the Corona Ash Dumps, was filled with ash and other garbage during the early 20th century as referenced as "the Valley of the Ashes" in F. Scott Fitzgerald's The Great Gatsby. In 1930 the park was cleaned in one of the first environmental efforts by Parks Commissioner Robert Moses, who relocated more than 50 million cubic tons of garbage in preparation for hosting the World's Fair of 1939. Flushing Meadows Corona Park later hosted the World's Fair of 1964. During these World's Fairs the natural hydrology was modified in many ways. With the addition of fountains as well as underground piping systems, the existing bodies of water were altered.

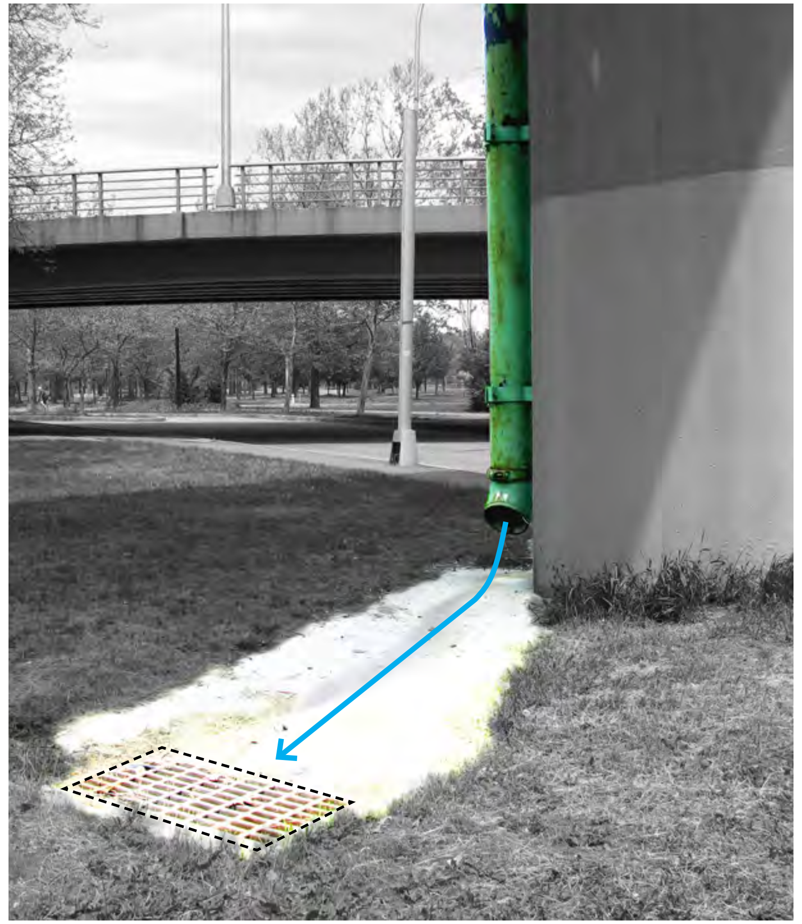


Project site during construction of 1964-65 Worlds Fair.

During the construction of the second World's Fair, part of Flushing Creek was changed from a typical, above-ground waterway to a piped, underground water system. Today, the water features in the park are fed by natural hydrologic systems as well as engineered systems. The Industry Pond Fountain bridges the piped sections of Flushing Creek, with Meadow Lake on one side and Flushing Bay on the other.

Stormwater runoff from the nearby highways has become a serious problem for Flushing Meadows Corona Park; the New York City Department of Parks and Recreation has performed studies showing that excess runoff has led to access problems for park visitors as well as serious eutrophication of the nearby bodies of water. The park also has an excess of hardscapes and impermeable surfaces which contribute to flooding and drainage issues.

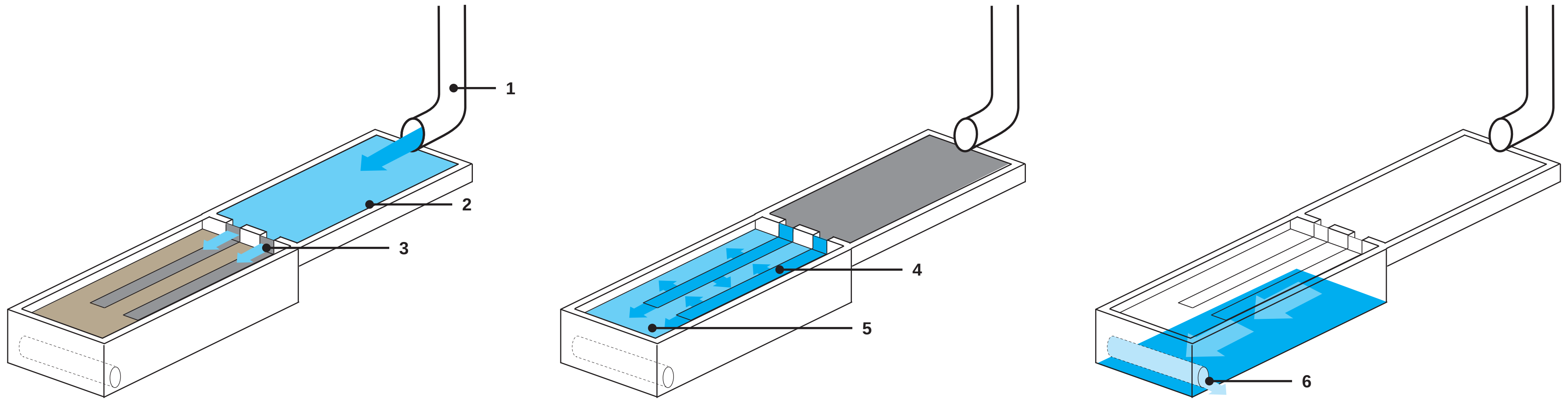




Left to right: Scupper 2 drainage path. Scupper 1 drainage path. Opposite: Scuppers 1 and 2 in context.

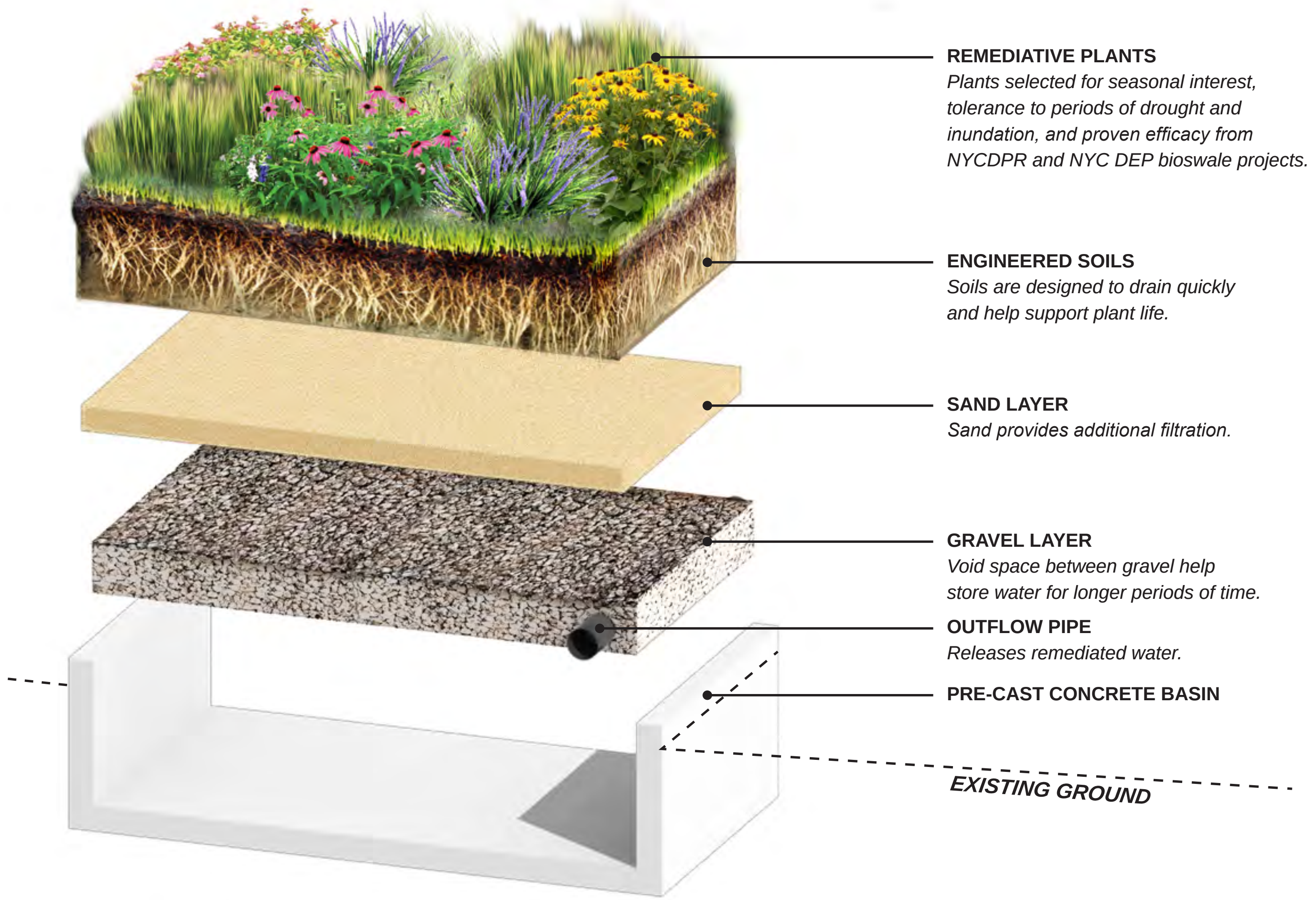
THE CURRENT CONDITIONS

The project site is located at the intersection of the Van Wyck, Horace Harding, and Long Island Expressways near College Point Boulevard. The two downspouts are currently connected to outfalls into Flushing Creek. The sub-grade conditions include a high water table, approximately 5ft bellow grade, as well as many different active and inactive utility lines. The downspouts are currently located in a lawn in a tangle of highways, offering no purification or absorbing qualities for first flush toxins. The water from the highways (mixed with first flush toxins and other flotsam) eventually washes into the Long Island Sound. These disgusting elements can negatively affect the health of the ecosystem as well as those who live near or swim in the bodies of water they flush out into.

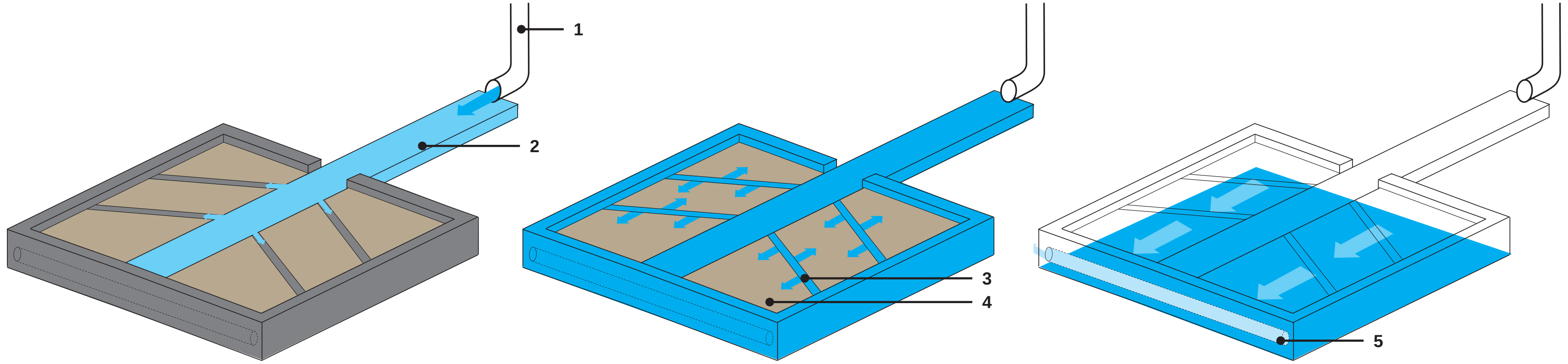


DOWNSPOUT 1

Runoff exits the downspout(1) and enters the sedimentation basin(2). Debris, litter, and sediment are collected in the basin before moving through a screen(3). The water moves into gravel drainage channels(4) that disperse water throughout the planted basin(5). Water percolates through the layers of soil, excess water exits the system through the overflow pipe(6).

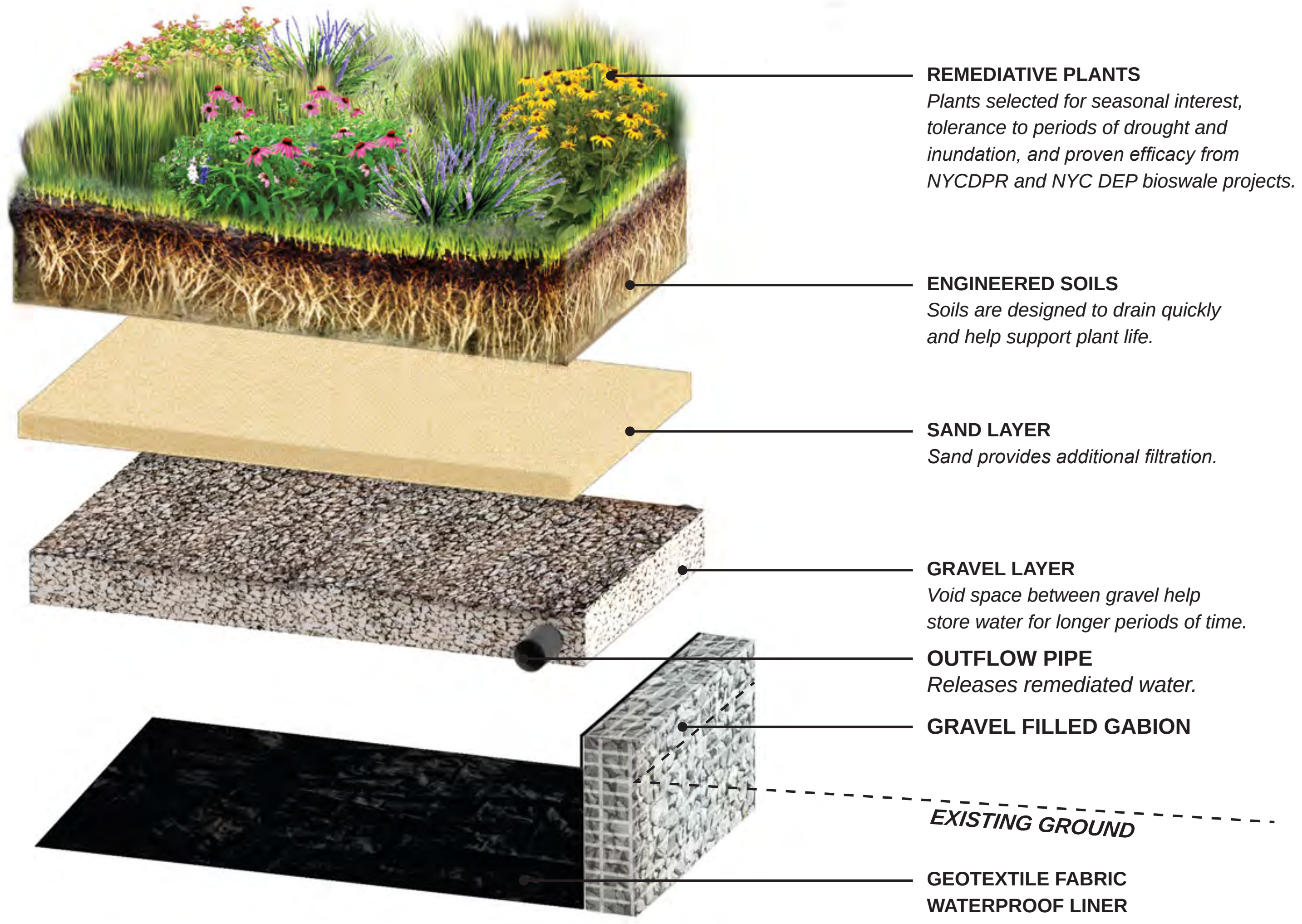


REMEDIATIVE PLANTS
Plants selected for seasonal interest, tolerance to periods of drought and inundation, and proven efficacy from NYCDPR and NYC DEP bioswale projects.
ENGINEERED SOILS
Soils are designed to drain quickly and help support plant life.
SAND LAYER
Sand provides additional filtration.
GRAVEL LAYER
Void space between gravel help store water for longer periods of time.
OUTFLOW PIPE
Releases remediated water.
PRE-CAST CONCRETE BASIN
EXISTING GROUND



DOWNSPOUT 2

Runoff exits the downspout(1) and enters the gravel sedimentation basin(2). Debris, litter, and sediment are collected in the basin before moving into gravel drainage channels(4) that disperse water throughout the planted basin(4). Water percolates through the layers of soil, excess water exits the system through the overflow pipe(5).


REMEDIATIVE PLANTS
Plants selected for seasonal interest, tolerance to periods of drought and inundation, and proven efficacy from NYCDPR and NYC DEP bioswale projects.
ENGINEERED SOILS
Soils are designed to drain quickly and help support plant life.
SAND LAYER
Sand provides additional filtration.
GRAVEL LAYER
Void space between gravel help store water for longer periods of time.
OUTFLOW PIPE
Releases remediated water.
GRAVEL FILLED GABION
EXISTING GROUND
GEOTEXTILE FABRIC
WATERPROOF LINER

Four Queens projects will manage stormwater

by Liz Rhoades | Posted: Thursday, July 15, 2010 12:00 am

Four projects, totaling more than $2 million to manage stormwater runoff in Queens, have been approved by the city Department of Environmental Protection.

Three of the projects are in Flushing and one is in Rego Park. They are expected to be completed within a year.

“The projects we are funding with these grants will test promising techniques to capture stormwater and green the cityscape, and we hope to use them as models throughout the five boroughs,” said DEP Commissioner Cas Holloway.

“Green infrastructure” uses vegetation, soil and other elements to absorb water and to mimic natural areas, such as wetlands.

Manhattan College will install a modular green roof on New York Hospital Queens. It is intended to control runoff from up to 1.5 inches of rain on the half-acre roof. The cost is $660,440.

Cynthia Bacon, NYHQ spokeswoman, said the specific roof to be used in the project has not been made yet. It will not be open to the public.

Columbia University was awarded $389,187 for a Greenstreets stormwater capture system in a small triangle on Queens Boulevard and 102nd Street in Rego Park. The project will remove 2,500 square feet of concrete and replace it with permeable pavement and vegetation.

Regional Plan Association will use $600,000 to construct two retention basins under the Long Island Expressway near the Van Wyck Expressway and Flushing Meadows Park. One will be able to store 34,000 gallons of stormwater and the other will store 170,000 gallons.

The basins will slow down, absorb and filter surface water by allowing it to percolate through the soil and not run directly into a sewer or adjacent body of water.

Unisphere Inc., the fundraising arm of Flushing Meadows Park, will use $386,551 for treating stormwater entering Meadow Lake. Two 5,000-square-foot wetlands will be created that will receive runoff from two one-acre portions of a parking area near the lake. Each treatment system is designed to capture more than 36,000 gallons of water.

Following completion of the projects, the grantee will be required to monitor the results for three years.

The grants came about because of a settlement with the state Department of Environmental Conservation over violations by the city of state law and regulations.