

**SPECIAL PERMIT
AND SITE PLAN
APPROVAL**

**Grafton Wastewater
Treatment Plant (WWTP)**

Prepared for:
Town of Grafton

Prepared by:
CDM SMITH INC.
75 STATE STREET
BOSTON, MA 02109

June 16, 2015





75 State Street, Suite 701
Boston, Massachusetts 02109
tel: 617 452-6000
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June 16, 2015

Planning Board
Grafton Memorial Municipal Center
30 Providence Road
Grafton, Massachusetts 01519

Subject: Site Plan Approval and Special Permit Application: Grafton Wastewater Treatment Plant (WWTP) Improvements
Applicant: Town of Grafton, Sewer Department

Dear Planning Board Members:

On behalf of the Town of Grafton (the Town), CDM Smith Inc. (CDM Smith) submits this Application for Site Plan Approval and Special Permit for the Grafton Wastewater Treatment Plant (WWTP) Improvements. The property is identified as ID 110/124.0-0000-0063.0 on the Town of Grafton assessor's maps. The upgrades to this facility are needed to comply with the more stringent National Pollutant Discharge Elimination System (NPDES) permit recently issued by the U.S. Environmental Protection Agency (EPA) for the facility to protect and improve water quality of the Blackstone River. The proposed plant improvements include constructing a new building and new process structures, fill within the 100-year floodplain to support those structures, excavation to provide compensatory flood storage, an outfall replacement, and a solar photovoltaic (PV) array. The PV array is included to provide a source of renewable electrical power to reduce the WWTP's dependence on non-renewable power and to aid in the global effort to reduce greenhouse gas emissions.

The WWTP is located within a Residential (R20) zoning district south of the junction of Depot Street and Providence Road and is also within a Flood Plain District (FPD) and a Water Supply Protection Overlay District (WSPOD). In accordance with the Use Regulation Schedule regarding Public Utility Uses in section 3.2.3.1 of the Town of Grafton Zoning By-law, a special permit is required for all Public Water Utility Uses within R20 Districts. Further, in accordance with sections 6.4 and 7.4.D of the Grafton Zoning Bylaw, special permits are required for projects within FPD and WSPOD, respectively. The purpose of this Application to provide the required application materials, to document the measures that will be taken to comply with the regulations governing the issuance of a special permit, and to request a Site Plan Approval so that a Zoning Permit and a Building Permit may be issued for the WWTP Improvements.





Planning Board
June 16, 2015
Page 2

Please find enclosed in this application package twenty five (25) copies of the Special Permit and Site Plan Approval Application as well as twenty five (25) copies of Attachments A – D and F (listed below under Enclosures). These are being sent to the Town of Grafton Planning Department for distribution to other Town departments. Please note that limited copies of Abutters Information (1 copy) and Stormwater Report (2 copies) are being sent to the Town of Grafton Planning Department for limited distribution as determined by the Planning Department.

Please advertise this project for your next scheduled Planning Board meeting which we understand to be July 13, 2015. If you have any questions regarding this Site Plan Approval and Special Permit Application submittal, please do not hesitate to call me at (617) 452-6784 or William Dana Green, P.E. at (617) 452- 6639. We look forward to working with you on this project.

Very truly yours,


Alexandra H. Kleyman, AICP
Planner
CDM Smith Inc.

cc: Paul Cournoyer, Superintendent of Sewers

Enclosures:

- Application for Special Permit and Site Plan Approval
- Attachment A: Project Narrative
- Attachment B: Certification of Flood Storage Impacts
- Attachment C: Figures
- Attachment D: Project Plans
- Attachment E: Abutters Information
- Attachment F: Request for Waiver of Requirement for Certificate of Good Standing
- Attachment G: Stormwater Report
- Check for application submittal fee of \$250
- Check for application review fee of \$1,000
- Check for public hearing notice of \$128

Table of Contents

Application for Special Permit and Site Plan Approval

Attachment A – Project Narrative

1.0	Introduction	A-1
2.0	Existing Conditions and Zoning By-Law Analysis.....	A-1
2.1	Grafton WWTP Background	A-1
2.2	Applicable Zoning Districts Requiring a Special Permit.....	A-2
2.2.1	Section 3: Use and Intensity Regulations	A-2
2.2.2	Section 6: Flood Plain Districts	A-3
2.2.3	Section 7: Water Supply Protection Overlay District.....	A-3
3.0	Compliance with Regulations.....	A-3
3.1	Compliance with Section 3- Use and Intensity Regulations.....	A-4
3.1.1	Conclusion	A-5
3.2	Compliance with Section 4 - General Regulations	A-5
3.3	Compliance with Section 5 - Special Regulations.....	A-5
3.4	Compliance with Section 6 - Flood Plain Districts	A-5
3.4.1	Compliance with Encroachments Clause	A-6
3.4.1.1	Fills and Compensatory Flood Storage Excavations	A-7
3.4.1.2	Solar PV Arrays	A-7
3.4.1.5	Replacement Outfall.....	A-8
3.4.2	Conclusion	A-8
3.5	Compliance with Section 7- Water Supply Protection Overlay Districts.....	A-9
3.5.1	Special Permit Criteria	A-9
3.5.2	Design and Operations Criteria	A-10
3.5.3	Conclusion	A-12
3.6	Compliance with Section 8 - Traffic Control.....	A-12
4.0	Summary	A-13

Attachment B – Certification of Flood Storage Impacts

Attachment C – Figures

Figure 1 – U.S.G.S Topographical Map of Project Location

Figure 2 – FEMA Flood Insurance Rate Map

Attachment D – Project Plans

Sheet C-1: Civil/Site Legend, Notes, and Abbreviations

Sheet C-2: Overall Site Plan

Sheet C-2A: Abutters and Property Boundary Plan

Sheet C-3: Existing Conditions, Removals and Erosion and Sedimentation Control Plan

Sheet C-4: Boring Location Plan

Sheet C-5: Site Layout and Materials Plan I

Sheet C-6: Site Layout and Materials Plan II

Sheet C-7: Site Grading and Drainage Plan I

Sheet C-8: Site Grading and Drainage Plan II

Sheet C-20: Site Details I

Sheet C-21: Site Details II

Sheet C-22: Site Details III

Sheet SD-E-04: Electrical Miscellaneous Details IV

(All Plans prepared by CDM Smith and stamped by William Dana Green, PE on 6/16/2015)

Attachment E – Abutters Information

Attachment F – Request for Waiver of Requirement for Certificate of Good Standing

Attachment G – Stormwater Report



TOWN OF GRAFTON
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 www.grafton-ma.gov

PLANNING BOARD

APPLICATION FOR SITE PLAN APPROVAL

Application No. _____

APPLICANT NAME: CDM Smith

STREET 75 State St. CITY/TOWN Boston

STATE MA ZIP 02109 TELEPHONE 617-452-6000

PROPERTY OWNER NAME: Town of Grafton Sewer Department, Attn: Paul Cournoyer

STREET 9 Depot St. CITY/TOWN South Grafton

STATE MA ZIP 01560 TELEPHONE 508-839-8526

Deed recorded in the Worcester District Registry of Deeds Book 36504 Page 327

CONTACT PERSON'S NAME: Alexandra Kleyman, AICP

TELEPHONE 617-452-6784

SITE INFORMATION:

STREET AND NUMBER 9 Depot St.

ZONING DISTRICT Residential (R20) ASSESSOR'S MAP 124 LOT #(S) 63

LOT SIZE 11.53 acres FRONTAGE 48.7 feet

CURRENT USE Grafton Wastewater Treatment Plant

PLAN INFORMATION:

PLAN TITLE See Attachment D: Project Plans

PREPARED BY CDM Smith, Attn: William Dana Green, PE

DATE PREPARED 6/16/15 REVISION DATE _____

Describe proposed changes / additions: _____

Improvements to the WWTP include the construction of a new building and new structures and the installation of new process filters to reduce nutrient discharge.

TO THE GRAFTON PLANNING BOARD:

The undersigned, being the APPLICANT named above, hereby applies for approval of the above entitled SITE PLAN by the Planning Board and certifies that, to the best of APPLICANT'S knowledge and belief, the information contained herein is correct and complete and that said PLAN conforms with the requirements of the Zoning By-Law of the Town of Grafton.

Applicant's Signature Alexandra Kleyman Date: 6/16/15

Property Owner's Signature (if not Applicant) Paul Cournoyer Date: 6/16/15



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PLANNING BOARD

APPLICATION FOR SPECIAL PERMIT

Application No. _____

APPLICANT & PROPERTY OWNER INFORMATION

NAME CDM Smith
STREET 75 State St. CITY/TOWN Boston
STATE MA ZIP 02109 TELEPHONE 617-452-6000
NAME OF PROPERTY OWNER (if different from Applicant) Town of Grafton Sewer Dept., Attn: Paul Cournoyer
Deed recorded in the Worcester District Registry of Deeds Book 36504 Page 327

SITE INFORMATION:

STREET AND NUMBER 9 Depot St.
ZONING DISTRICT Residential (R20) ASSESSOR'S MAP 124 LOT #(S) 63
LOT SIZE 11.53 acres FRONTAGE 48.7 feet
CURRENT USE Grafton Wastewater Treatment Plant

PROJECT/PLAN INFORMATION:

PLAN TITLE See Attachment D: Project Plans
PREPARED BY (name/address of PE/Architect) CDM Smith, Attn: William Dana Green, PE
DATES 6/16/15

Use for which Special Permit is sought: (refer to § 3.2.3.1 of the Zoning Bylaw - Use Regulation Table):

Communications, Transportation, Public Utility Uses: 10. All Public Water Utility Uses (Water Treatment Facility); Projects in Flood Plain District; Projects in Water Supply Protection Overlay District

Cite all appropriate sections of the Zoning By-Law which pertain to this Application, Use and Site:

Section 3, Section 6, Section 7, Section 8

TO THE GRAFTON PLANNING BOARD:

The undersigned, being the APPLICANT named above, hereby applies for a SPECIAL PERMIT to be granted by the Planning Board and certifies that, to the best of APPLICANT'S knowledge and belief, the information contained herein is correct and complete.

Applicant's Signature *William Dana Green* Date: 6/16/15
Property Owner's Signature (if not Applicant) *Paul Cournoyer* Date: 6/16/15

Attachment A
Project Narrative

Attachment A

Project Narrative

1.0 Introduction

Under the proposed project, several new structures will be constructed, including a third secondary clarifier, a third aeration tank, a D-box and flume, a disinfection and phosphorus removal building, and a generator pad. A bypass structure will also be added to the process and control building. Other major facility improvements include:

- Extending the Headworks Area Building including installation of new bypass and influent channel screens;
- Replacing the existing grit removal system equipment;
- Constructing a septage receiving box and replacing pneumatic ejectors and associated piping with new vortex (recessed impeller) septage pumps and piping;
- Replacing the primary influent valve chamber with valve operators accessible from grade;
- Replacing the clari-thickener tank equipment;
- Modifying the secondary treatment system to create a Bardenpho system for nitrogen removal;
- Constructing a new Parshall flume and flow distribution box upstream of the three aeration tanks;
- Replacing all secondary clarifier tank equipment and constructing a third secondary clarifier;
- Replacing existing and adding new waste activated sludge and RAS pumps;
- Constructing a new tertiary treatment system;
- Replacing the existing effluent disinfection system;
- Constructing an intermediate pump station;
- Modifying the existing outfall manhole structure;
- Installing a new gravity belt thickener for secondary sludge thickening;
- Replacing the primary and thickened sludge pumps;
- Installing a new dry polymer system for the gravity belt thickeners;

- Replacing the existing ferric acid chloride storage and feed system;
- Replacing the existing lime make-up, storage, and feed systems;
- Replacing aging or inoperable laboratory and shop equipment;
- Updating aging office spaces and staff facilities in the Process and Control Building;
- Removing abandoned sludge dewatering vacuum filters; and,
- Replacing the standby generator.

Additionally, the Town of Grafton Sewer Department plans to install an array of five hundred and seventy two (572) solar photovoltaic (PV) panels to reduce energy costs at the WWTP and to aid in the global effort of reducing greenhouse gas emissions.

The proposed improvements (Improvements) to the existing Grafton Wastewater Treatment Plant (WWTP) at 9 Depot Street are driven by a new National Pollutant Discharge Elimination System (NPDES) permit issued by the U.S. Environmental Protection Agency (EPA) that limits nutrient concentrations discharged into the Blackstone River to protect and improve water quality of the Blackstone River and other down-river receiving waters. Nutrient discharge limitation will be accomplished by implementing additional nutrient removal processes and a number of baseline improvements to the WWTP to meet the lower discharge concentrations in the new NPDES permit.

The proposed Improvements will require the issuance of a Special Permit for Utility Use within a Residential (R20) District, a Flood Plain (FP) District, and a Water Supply Protection Overlay (WSPO) District. The purpose of this application is to provide the required application materials, to document the measures that will be taken to comply with the regulations governing the issuance of Special Permits, and to request a Site Plan Approval so that applications for a Zoning Permit and a Building Permit may be submitted for the WWTP Improvements. The following sections address the existing on-site WWTP conditions, proposed work within the R20 District, FP District, and WSPO District, the regulations governing those districts, and the compliance measures to be taken to meet those regulations.

2.0 Existing Conditions and Zoning By-Law Analysis

This section discusses the background of the Grafton WWTP, an overview of the proposed Improvements, and the sections of the Grafton Zoning By-law which will require the issuance of a Special Permit for the Improvements to proceed.

2.1 Grafton WWTP Background

The Town of Grafton (Town) owns and operates a 2.40 million gallon per day (mgd) wastewater treatment plant which began operation in 1979. The plant treats wastewater from a service area spanning approximately 14 square miles throughout much of the western and central portions of Town. The collection system consists of sanitary only sewer pipelines that provide sewer service to approximately 60% of the Town's residential, commercial, and industrial sources. The plant also treats septage from within the Town of Grafton.

The treatment plant discharges to the Blackstone River which flows into the Seekonk River, which joins the Providence River and discharges into Narragansett Bay and the Atlantic Ocean. In August of 2013, the U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MassDEP) issued a NPDES permit, requiring further reduction of the nitrogen and phosphorus discharged from the plant. The existing facility has received minimal capital improvements since 1979 and, as a result, the treatment plant as is cannot meet these new permit limits. The EPA issued an Administrative Consent Order requiring the facility be able to meet these limits by April 1, 2018. The project, while driven by a new NPDES permit resulting in the addition of a new process (disk filters) for phosphorus reduction, also includes a number of “baseline improvements” to bring the facility up to current codes and standards of practice as well as replacing aging systems.

The WWTP Improvements discussed herein were identified and approved by the MassDEP as the best alternative to meet the more recent stringent state and federal regulations including nutrient limit requirements of a NPDES Permit and aging equipment associated with the WWTP.

2.2 Applicable Zoning Districts Requiring a Special Permit

The WWTP property is located within a Residential (R20) zoning district south of the junction of Depot Street and Providence Road and is also within a Flood Plain (FP) District and a Water Supply Protection Overlay (WSPO) District. In accordance with sections 3, 6, and 7 of the Grafton Zoning By-law, Special Permits are being sought for the WWTP Improvements in the R20 District, FP District, and WSPO District, respectively.

2.2.1 Section 3: Use and Intensity Regulations

Section 3.2.3.1 of the Grafton Zoning By-law identifies approved uses within the various town districts. Item 10 of Section 3.2.3.1. *Principal Uses that include Communications, Transportation and Public Utility Uses* states that “all Public Water Utility Uses to include wells, treatment facilities, storage tanks and accessory uses” within R20 districts require the issuance of a Special Permit.

As the Grafton Zoning By-law only dates back to 1989 and the WWTP was originally constructed in 1979, it is believed that no Special Permit has been issued to the WWTP for its use in an R20 District. If such a Special Permit is required for modifications to the WWTP, and as the WWTP is within the R20 District and is a treatment facility, a Special Permit is being sought for the Improvements.

Item 7 in the same section (3.2.3.1: *Principal Uses that include Communications, Transportation and Public Utility Uses*) identifies that “electric generating or distribution station or substation” uses within R20 districts require the issuance of a Special Permit. While the Improvements include the installation of a solar PV array, the electricity generated will only be used on-site to power on-site equipment, and electricity generation is not a primary use but an accessory use. It is our understanding that as an accessory use, the solar PV array does not require the issuance of a Special Permit.

2.2.2 Section 6: Flood Plain Districts

Section 6 of the Grafton Zoning By-law details the regulations governing projects in FP District. Specifically, Section 6.4 states:

“6.4. No structure or building shall be erected, constructed, substantially improved, or otherwise created or moved; no earth or other materials dumped, filled, excavated, or transferred, unless a special permit is granted by the Planning Board.”

As the Grafton Zoning By-law only dates back to 1989 and the WWTP was originally constructed in 1979, it is believed that no Special Permit has been issued to the WWTP for uses in a FP District. As the WWTP is within an FP District identified by the Grafton Planning Board (FEMA FIRM 25027C0841E; Figure 1) and Improvements include actions listed in Section 6.4, a Special Permit is being sought for the Improvements.

2.2.3 Section 7: Water Supply Protection Overlay District

Section 7 of the Grafton Zoning By-law details the regulations governing projects in WSPO District. Specifically, Section 7.4.D and subsection 7.4.D.6 state:

“7.4.D. Within the Water Supply Protection Overlay District, the following uses shall be allowed only upon receipt of a special permit, issued in accordance with the provisions of Section 1.5.5 of this Zoning By-Law and subsections E-H below. Due to the nature of these uses, particular attention must be given to protecting the integrity of the aquifer area. Inability to conclusively demonstrate that no contaminants will come into contact with the ground, potentially compromising the integrity of the aquifer, shall cause the special permit to be denied and such uses(s) shall not be conducted.

[...]

7.4.D.6. Municipal sewage treatment facilities with on-site disposal of primary or secondary treated effluent.”

As the Grafton Zoning By-law only dates back to 1989 and the WWTP was originally constructed in 1979, it is believed that no Special Permit has been issued to the WWTP for uses in a WSPO District. As the WWTP is a municipal sewage treatment facility with on-site surface water disposal of treated effluent, a Special Permit is being sought for the Improvements.

3.0 Compliance with Regulations

This section discusses the Grafton Zoning By-law regulations governing work in R20, FP, and WSPO Districts, and the compliance measures that will be taken to conform to the regulations. Applicable regulations are presented below in italics, with responses presented in non-italicized font.

3.1 Compliance with Section 3: Use and Intensity Regulations

Section 3.1 of the Grafton Zoning By-law details the various Grafton Zoning Districts, their identification within the Zoning Map, and their Intent and Purposes. For R20 Districts, FP Districts, and WSPO Districts, the Intent and Purposes are as follows:

“3.1.5.3. Medium Density Residential (R-20): To provide sites for medium density residential development with respect to the existing character of the neighboring homes and properties, including compatible, related home-oriented activities and pursuits in a small village

environment. The above purposes are, however, mitigated by the overriding goal of protecting the town's ground water resources.

[...]

3.1.5.9. Flood Plain (FP): To insure the minimization of flood damage and to minimize any impediment to the natural flow of flood waters.

3.1.5.10. Water Supply Protection Overlay District (WSPO): To protect Grafton's ground-water supplies.”

The WWTP Improvements were designed with similar Intents and Purposes to ensure protection of the Town’s community, environment, and water resources.

Section 3.2 details the Use Regulations- General and Special Rules governing projects within all districts. The only applicable subsection to the WWTP Improvements is 3.2.2.4, which states,

“3.2.2.4 Outside bulk storage, contractor's yard, disposal area or open storage related to manufacturing, processing, warehousing, wholesale trade or a public utility facility shall be screened from an adjacent residential use, a residential district or street by a solid stockade fence six (6) feet in height or densely planted trees or shrubs six (6) feet or more in height, or be equivalently obscured by natural vegetation.”

The existing WWTP has an existing vegetated perimeter which will not be lost due to the improvements.

The Grafton WWTP Improvements will comply with Intensity Regulations and Supplementary Requirements detailed in Section 3.3 including the provisions governing R20 Districts, as detailed in Section 3.2.3.2 Intensity of Use Schedule. The Intensity of Use Schedule and the complying measurements of the existing and proposed conditions are presented in Table A, below. For measurements of existing structures that do not conform to the Intensity of Use Schedule (i.e., Maximum Building Height), it should be noted that Section 3.4.2 of the Grafton By-Law states that,

“A lawfully existing structure which does not conform to the requirements of this By-Law may continue.”

Thus, only proposed facilities must comply with the Intensity of Use Schedule in Table A.

Table A
Intensity of Use Schedule

Zoning District	Minimum Area (sq. ft.)	Minimum Frontage/Lot Width (ft.)	Minimum Yards			Maximum Building Coverage (% of Lot)	Maximum Building Height (ft.)
			Front (ft.)	Side (ft.)	Rear (ft.)		
R-20	20,000	125	30	15	15	30	35
WWTP	478,305	N/A* ¹	N/A* ²	N/A* ²	N/A* ²	2.8%* ³	N/A* ⁴

Table A: Intensity of Use Schedule for R20 Districts, compared with Intensity of Use for the WWTP.

*1 – Frontage of Providence Road is approx. 49 lf and is not used for existing or proposed access

*2 – Min. Yards to existing Process/Control (P/C) bldg. = 156 lf

Min. Yards to proposed Phosphorus (Ph.) bldg. = 251 lf

Min. Yards to existing Headworks (H/W) bldg. = 131 lf

Min. Yards to proposed secondary clarifier no. 3 = 110 lf

*3 – Existing bldgs. (P/C and H/W bldg.): 2.2% + Proposed bldgs. (Ph. bldg.): 0.6% = 2.8%

*4 – Existing process and control building = 39.33 ft. (from 1st floor el. to highest point)

Proposed Ph. bldg. = 32.67' (from landing el. to highest point)

No Supplementary Requirements in section 3.3.2 or Special Cases in section 3.3.3 are applicable.

3.1.1 Conclusion

We conclude that the Grafton WWTP Improvements will comply with regulations governing Use and Intensity for projects in R20 Districts detailed in Section 3 of the Grafton Zoning By-law.

3.2 Compliance with Section 4: General Regulations

It is presumed that the proposed improvements to the WWTP will not alter the Plant's current compliance with the General Regulations outlined in Section 4 of the Grafton Zoning By-law.

3.3 Compliance with Section 5: Special Regulations

No Special Regulations are applicable to the Grafton WWTP Improvements.

3.4 Compliance with Section 6: Flood Plain Districts

The WWTP property is partially located within a FP District (FEMA FIRM 25027C0841E, Figure A). Proposed work within the flood plain includes the construction of one new building and new structures, fills to support new structures and excavation to provide compensatory flood storage, the installation of solar PV arrays, and the replacement of an existing drainage outfall.

Section 6.3 of the Grafton Zoning By-law details the regulations governing FP Districts. This section mentions several additional regulatory documents that require compliance with regulations governing work in flood plains:

“6.3. Regulations: The Floodplain District is established as an overlay district to all other districts. All development in the district, including structural and non-structural activities, whether permitted by right or by special permit must be in compliance with Chapter 131, Section 40 of the Massachusetts General Laws and with the following:

1. “Section of the Massachusetts State Building code which addresses floodplain and coastal high hazard areas (currently 780 CMR 120.G, “Flood Resistant Construction and Construction in Coastal Dunes”);”

All new structures were designed in compliance with the state building code.

2. “Wetlands Protection Regulations, Department of Environmental Protection (DEP) (currently 310 CMR 10.00);”

Not applicable: no work is proposed in on-site wetlands.

3. “Inland Wetlands Restriction, DEP (currently 310 CMR 13.00);”

A Notice of Intent (NOI) was submitted to the Grafton Conservation Commission that documents compliance with state and Town regulations governing Inland Wetlands and flood plains. The construction of compensatory flood storage will prevent any increase in flood plain elevation.

4. “Minimum Requirements for the Subsurface Disposal of Sanitary Sewage, DEP (currently 310 CMR 15, Title 5); Any variances from the provisions and requirements of the above referenced state regulations may only be granted in accordance with the required variance procedures of these state regulations. (TM 05-09-11)”

Not applicable: no sewage will be disposed to the subsurface.

3.4.1 Compliance with Encroachments Clause

Grafton Zoning By-Law section 6.4 item c) states:

“6.4.C. All encroachments, including fill, new construction, substantial improvements to existing structures, and other developments are prohibited unless certification by a registered professional engineer is provided by the applicant demonstrating that such encroachment shall not result in any increase in flood levels during the occurrence of the one hundred (100) year flood.”

In accordance with this section, a narrative of the various encroachments proposed within the 100-year storm elevation of 276.9 feet NGVD 29, and the calculations to support the assertion that such encroachments will not result in increased flood levels, are provided below. A certification of these findings signed and stamped by a registered professional engineer is included as Attachment B.

3.4.1.1 Fills and Compensatory Flood Storage Excavations

Proposed work includes the construction of a new building and process structures (a building for phosphorus removal and disinfection and a pad for a generator on the easterly section of the WWTP; an aeration tank, a secondary clarifier tank, and a secondary clarifier distribution box on the westerly). All new structures will require fill to support the foundations and such fills will result in a loss of flood storage. To account for and reverse the effect of such a loss of flood storage, the project design includes excavating uplands adjacent to the floodplain to provide on-site flood storage on an incremental basis per 310 CMR 10.57 (4)(a). Such excavation will be in volume greater than or equal to the volume of the fills added, resulting in a net gain of compensatory flood storage (see Table B).

Table B
Compensatory Flood Storage Accounting

Contour (el. ft.)	Fill (c.f.)	Compensatory Flood Storage (c.f.)	Change (c.f.)
273-274	1568	1646	+78
274-275	7168	7526	+358
275-276	9335	9801	+466
276-277	9752	10239	+487
Total	27283	29212	+1389

Table B: Comparison of fill volume with excavation volume to ensure net gain of flood storage below 100-year storm elevation, 276.9 feet NGVD 29.

3.4.1.2 Solar PV Arrays

Also proposed within the FP District is the installation of an array of 572 solar PV panels of 20.86 square feet apiece, at a combined area of 11,932 square feet (see Project Plans Sheet SD-E-04: Electrical Miscellaneous Details IV). The minimum elevation of the leading edge of the solar panels is at el. 276.9 feet NGVD 29, i.e. two or more feet above the 100-year floodplain elevation. This elevates the PV panels above the 100-year floodplain to avoid additional loss of flood storage, although seventy two (72) support beams will be placed in the floodplain and their combined volume below the floodplain elevation will add to the loss of flood storage. Space-efficient I-beams are expected to support the panels, but for conservative estimating we assumed 6-inch diameter posts will be used instead. Based on that conservative assumption, supports could displace up to 30.2 cubic feet below the 100-year floodplain elevation. Subtracting this displaced volume from the flood storage gained by excavation- presented in the table above- the net change in flood storage would be slightly reduced to +1358.8 cubic feet, still a net gain in flood storage capacity, and based on the conservative assumption of 6-inch diameter support posts. Photographs 1 and 2 are example PV arrays during and following construction of similar work done by CDM Smith at the North Conway, NH WWTP.



Photograph 1: PV array during construction, North Conway, NH WWTP.



Photograph 2: PV array following construction, North Conway, NH WWTP.

3.4.1.3 Replacement Outfall

An existing outfall in the northeast corner of the WWTP will be replaced to accommodate drainage system improvements (see Project Plans Sheet C-20: Site Details 1; Detail 8). The replaced outfall will feature a riprap stilling basin with an area of 44.4 square feet. The basin will require excavations below the 100-year floodplain resulting in no loss of flood storage.

3.4.2 Conclusion

We conclude that the Grafton WWTP Improvements will comply with regulations governing projects in FP Districts detailed in Section 6 of the Grafton Zoning By-law.

3.5 Compliance with Section 7- Water Supply Protection Overlay Districts

3.5.1 Special Permit Criteria

Special Permit Criteria for projects in WSPO Districts with which the Grafton WWTP Improvements will comply are detailed in Grafton Zoning By-law section 7.4.G, and are as follows:

“7.4.G. Special Permit Criteria. Special permits under this Section shall be granted only if the SPGA determines, in conjunction with the town agencies as specified above, that ground water quality resulting from on-site waste disposal, recharge of runoff from impervious surfaces, and other on-site operations will not fall below federal or state standards (314 C.M.R. 6.00) for drinking water at the down gradient property boundary; and that the design complies with the applicable criteria specified in Section 7.5.”

In accordance with sections 7.4.H, required information is presented below:

“7.4.H. Submittals. In applying for a special permit required by this section, the information listed below shall be submitted:”

“7.4.H.1. A complete list of chemicals, pesticides, herbicides, fertilizers, fuels and other potentially toxic or hazardous materials to be used or stored on the premises in quantities greater than those associated with normal household use, accompanied by a description of measures proposed to protect all storage containers facilities from vandalism, corrosion and leakage, and to provide for control of spills.”

Table C presents the chemicals and the volume of their storage tanks to be stored on the premises. This list does not include the chemicals presently being used whose use will be discontinued during the Improvements.

Table C
All Chemicals to Be Stored On-site

Chemical Type	Tank Size (gal)	Tank Quantity	Total Volume (gal)
Magnesium hydroxide	4515	2	9,030
Sodium Hypochlorite	55	1 (drum for intermittent use)	55
Ferric Chloride	5,050	2	10,100
Diesel fuel for Generator	2,000	1	2,000

“7.4.H.2. A description of potentially toxic or hazardous wastes to be generated, indicating storage and disposal methods.”

Not applicable: no toxic or hazardous wastes are to be generated on-site.

“7.4.H.3. Evidence of approval by the Massachusetts Department of Environmental Protection of any industrial waste treatment or disposal system or any wastewater treatment system over 15,000 gallons per day capacity.”

The NPDES permit issued by the U.S. EPA and the MassDEP stands as evidence of approval of the Grafton WWTP.

“7.4.H.4. Projections of down gradient concentrations of nitrogen, phosphorus, and other relevant chemicals to be disposed of on-site, at property boundaries and other locations deemed pertinent by the Planning Board, prepared by a hydro geologist or Registered Professional Engineer possessing experience and education in Water Supply Protection and Hydrology.”

In compliance with the NPDES permit, projected effluent concentrations to be disposed into the surface water of the Blackstone River will be within the permitted range, and are presented in Table D.

Table D
Projected Effluent Concentrations

Parameter	Permitted Concentration
Flow	2.4 mgd
CBOD	20 mg/L
TSS	20 mg/L
Ammonia Nitrogen	5 mg/L
Total Nitrogen (May 1-Oct 31)	8 mg/L
Total Phosphorus (May 1-Oct 31)	0.2 mg/L
Total Lead	1.8 ug/L
Enterococci	153 cfu/100 mL

3.5.2 Design and Operations Criteria

In accordance with section 7.5 of the Grafton Zoning By-law, the Grafton WWTP Improvements will comply with the Design and Operations Criteria for projects in the WSPO District:

“7.5 Design and Operations Criteria: For all uses within the Water Supply Protection Overlay District the following design and operation criteria shall be satisfied where applicable:

7.5.A. Safeguards: Provision shall be made to protect against toxic hazardous materials discharge or loss resulting from corrosion, accidental damage, spillage or vandalism through measures such as: spill control provisions in the vicinity of chemical or fuel delivery points; secured storage areas for toxic or hazardous materials; and indoor storage provisions for corrodible or dissolvable materials. For operations which allow the evaporation of toxic or hazardous materials into the interiors of any structures, a closed vapor recovery system shall be provided for each such structure to prevent discharge of contaminated condensate into the ground water.”

All chemicals have spill containment. For ferric chloride, spill containment is designed for 125% of both of the two tanks because the tanks are hydraulically interconnected. For magnesium hydroxide,

spill containment is designed for 125% of one of the two tanks because the tanks are not hydraulically connected; each tank has separate fill pipes and discharge pipes. For sodium hypochlorite, 55-gallon drums will be stored on purchased containment pad for intermittent use. Diesel fuel for the generator will be stored within a double contained “belly” tank integral with the generator.

“7.5.B. Location: Where the premises are partially outside of the Water Supply Protection Overlay District, potential pollution sources such as on-site waste disposal systems shall be located outside the District to the extent feasible.”

Not applicable: no portion of the premises are outside WSPO District.

“7.5.C. Disposal: For any toxic or hazardous wastes to be produced in quantities greater than those associated with normal household use, the applicant must demonstrate the availability and feasibility of disposal methods which are in conformance with G.L. c. 21C.”

Not applicable: hazardous wastes will not be produced on-site. The surface water disposal methods for effluent are permitted by the NPDES permit.

“7.5.D. Ground Water Recharge: Maximum ground water recharge shall be attained without risking ground water contamination. All runoff from impervious surfaces shall be recharged on the site, by being diverted toward upland areas covered with vegetation for surface infiltration to the extent possible, or as otherwise directed by the Grafton Department of Public Works and Conservation Commission. Dry wells shall be used only where other methods are infeasible, and where used shall be preceded by oil, grease, and sediment traps to facilitate removal of contaminants. No discharge directly into surface waters or wetlands without intervening mitigation measures will be allowed. All recharge areas shall be maintained in full working order by the owner. An annual maintenance plan shall be submitted to the Inspector of Buildings and Town Engineer to assure that the methods used for on-site recharge and infiltration shall remain effective.”

Provisions to maintain groundwater recharge are outlined in the Stormwater Report (Attachment E).

“7.5.E. Limitation on Impervious Material: Within the Water Supply Protection Overlay District, not more than 25%, or five thousand (5000) square feet, whichever is greater, of any lot area shall be rendered impervious; the remainder shall be retained as unoccupied space free of all buildings, parking, pavement, including street access drives and walks, and other conditions rendering the land surface impervious; except that the Inspector of Buildings may, after consultation with the Town Engineer and the Conservation Commission, allow up to 75% of the lot area to be rendered impervious, provided that techniques satisfying the requirements set forth above are used to maximize groundwater recharge without risking groundwater contamination. All required unoccupied areas shall be landscaped or stabilized with plant material (except as may be otherwise set forth in Section 5.2.2.3 as pertaining to multi-family dwellings).”

Provisions to limit impervious material are outlined in the Stormwater Report (Attachment E).

3.5.3 Conclusion

We conclude that the Grafton WWTP Improvements will comply with regulations governing projects in WSPO Districts detailed in Section 7 of the Grafton Zoning By-law.

3.6 Compliance with Section 8 - Traffic Control

Section 8.2 of the Town of Grafton Zoning Regulations stipulate that a Traffic Study is required for all applications for Special Permits, with the expectation that Special Permit applications generate additional traffic on the roadway system. However, based on the review of traffic data conducted for the application, the proposed Grafton WWTP improvements will not result in an increase in traffic and there would be no adverse impacts to site access or circulation on the surrounding roadways. These conclusions are explained in more detail below.

The treatment plant improvements are anticipated to result in a net reduction of site generated vehicle trips based upon the provided truck generation information (Table E). The reduction in site generated vehicle trips will reduce the existing demand placed on the surrounding roadways and thereby allow additional roadway capacity for other growth or development. In the absence of other growth or development, the proposed treatment plant improvements will likely improve the currently available roadway capacity in the vicinity of the treatment plant.

Specifically, the proposed treatment plant improvements project will streamline facility trucking operations. As shown in Table E, the current facility generates 3,548 truck trips annually. Those trips are expected to reduce to 2,466 annual truck trips upon completion of the project in 2018. This represents an anticipated decrease for 2018 operations of approximately 1,082 annual truck trips (30%) from existing operations. Future operations projections estimate that the site will generate approximately 3,058 truck trips annually in the year 2038. This future 2038 projection represents a decrease of approximately 490 annual truck trips (14%) from existing operations.

Table E
Projected Site Generated Truck Trips

Truck Contents	Trips		
	Existing Facility Design	Immediately Upon Startup (2018)	Future Design (2038)
Sludge	15/week	19/week	27/week
Sodium Hypochlorite	4/year	4/year	6/year
Lime	4/year	0	0
Garbage	3/week	3/week	3/week
Leachate	25/week	0	0
Septage	25/week	25/week	28/week
Magnesium Hydroxide	0	6/year	1/month
Ferric Chloride	4/year	1/month	2/month
TOTAL	3,548/year	2,466/year	3,058/year
TRIP REDUCTION¹	-	1,082	490
PERCENT REDUCTION¹	-	30%	14%

¹Reduction relative to Existing Facility Design.

The proposed treatment plant improvements will require the facility to increase personnel from six to seven total persons. The one added employee vehicle trip will have a negligible impact to roadway capacity regardless of any other trip reductions. Considering the trucking operation trip reductions, however, the site will show an overall net reduction of site generated vehicle trips. The net reduction in site generated vehicle trips will reduce roadway vehicle demand and improve the available roadway capacity in the vicinity of the plant.

The beneficial traffic impacts anticipated due to the proposed application not only adhere to, but enhance all applicable objectives stated under Grafton Zoning By-law Section 8 – Traffic Control.

Therefore, the Grafton WWTP Improvements fully comply with the objectives governing special permit projects detailed in section 8 of the Grafton Zoning By-law.

4.0 Summary

The proposed Grafton WWTP improvements are designed as a response to the NPDES permit and will require the issuance of a Special Permit for Utility Use within a Residential District, a Flood Plain District, and a Water Supply Protection Overlay District. This Application contains all necessary material for consideration of such Special Permit issuance, including Use and Intensity documentation, documentation of compliance with Flood Plain Restrictions and Water Supply Protection standards, and the inclusion of a Traffic Study. In addition to updating the facility to protect and improve the water quality of the Blackstone River by reducing nutrient discharge, the applicant proposes to use solar PV to self-generate renewable energy and reduce greenhouse gas emissions. A Special Permit is not being sought for the solar PV array as it will not be a primary use but an accessory use, and will only be use for on-site power purposes.

Attachment B
Certification of Flood Storage Impacts



75 State Street, Suite 701
 Boston, Massachusetts 02109
 tel: 617 452-6000
 fax: 617 345-3901

June 16, 2015

Planning Board
 Grafton Memorial Municipal Center
 30 Providence Road
 Grafton, Massachusetts 01519

Subject: Site Plan Approval and Special Permit Application: Grafton Wastewater Treatment Plant (WWTP) Improvements
 Applicant: Town of Grafton, Sewer Department

Dear Planning Board Members:

This statement is to certify that the proposed project, the Grafton Wastewater Treatment Plan (WWTP) Improvements Project, will not result in any increase in flood levels in the vicinity of the WWTP.

In accordance with Section 6.4.C of the Grafton Zoning By-Law, construction of new structures and associated fill will not result in long-term loss of flood storage. To account for and reverse the effect of required fills to support the foundation of new buildings, uplands adjacent to the floodplain will be excavated to provide on-site flood storage on an incremental basis per 310 CMR 10.57 (4)(a). As stated in Attachment A, Project Narrative, such excavation will be in volume greater than or equal to the volume of the fills added, resulting in a net gain of compensatory flood storage. The table below summarizes these conditions.

Compensatory Flood Storage Accounting

Contour (el. ft.)	Fill (c.f.)	Compensatory Flood Storage (c.f.)	Change (c.f.)
273-274	1568	1646	+78
274-275	7168	7526	+358
275-276	9335	9801	+466
276-277	9752	10239	+487
Total	27283	29212	+1389

Comparison of fill volume with excavation volume to ensure net gain of flood storage below 100-year storm elevation, 276.9 feet NGVD 29.





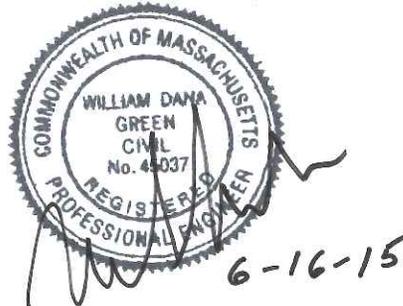
Planning Board
June 16, 2015
Page 2

Some loss of flood storage will occur from the volume below the 100-year floodplain displaced by the seventy two (72) support beams for the solar PV array. Space-efficient I-beams are expected to support the panels, but for conservative estimating we assumed 6-inch diameter posts will be used instead. Based on that conservative assumption, supports could displace up to 30.2 cubic feet below the 100-year floodplain elevation. Subtracting this displaced volume from the flood storage gained by excavation -- presented in the table above -- the net change in flood storage would be slightly reduced to +1358.8 cubic feet, still a net gain in flood storage capacity, and based on the conservative assumption of 6-in diameter support posts.

Please call me at (617) 452- 6639 if you have any questions regarding this Site Plan Approval and Special Permit Application submittal. We look forward to working with you on this project.

Very truly yours,

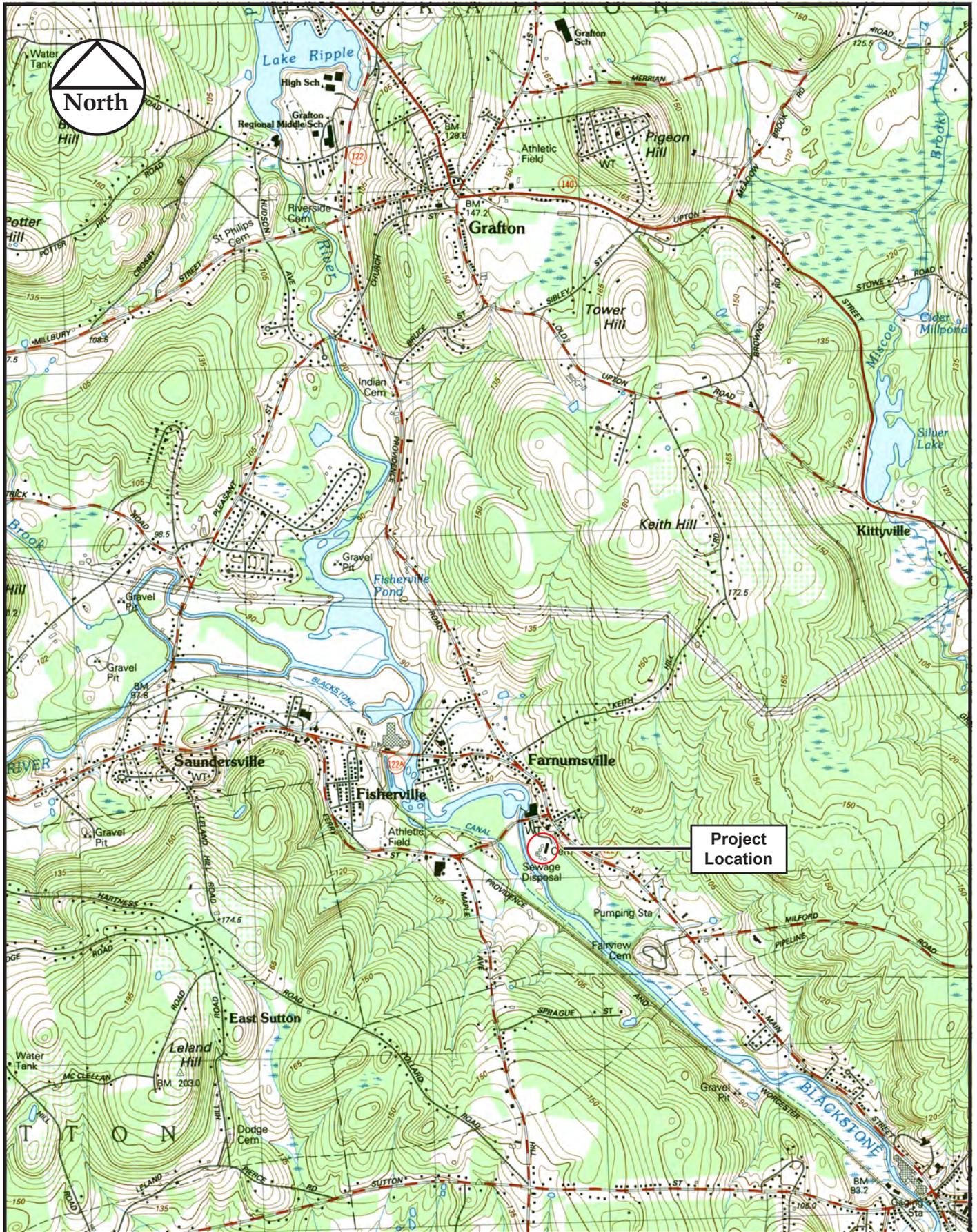
William Dana Green, P.E.
Senior Project Manager
CDM Smith Inc.



cc: Paul Cournoyer, Superintendent of Sewers

Attachment C

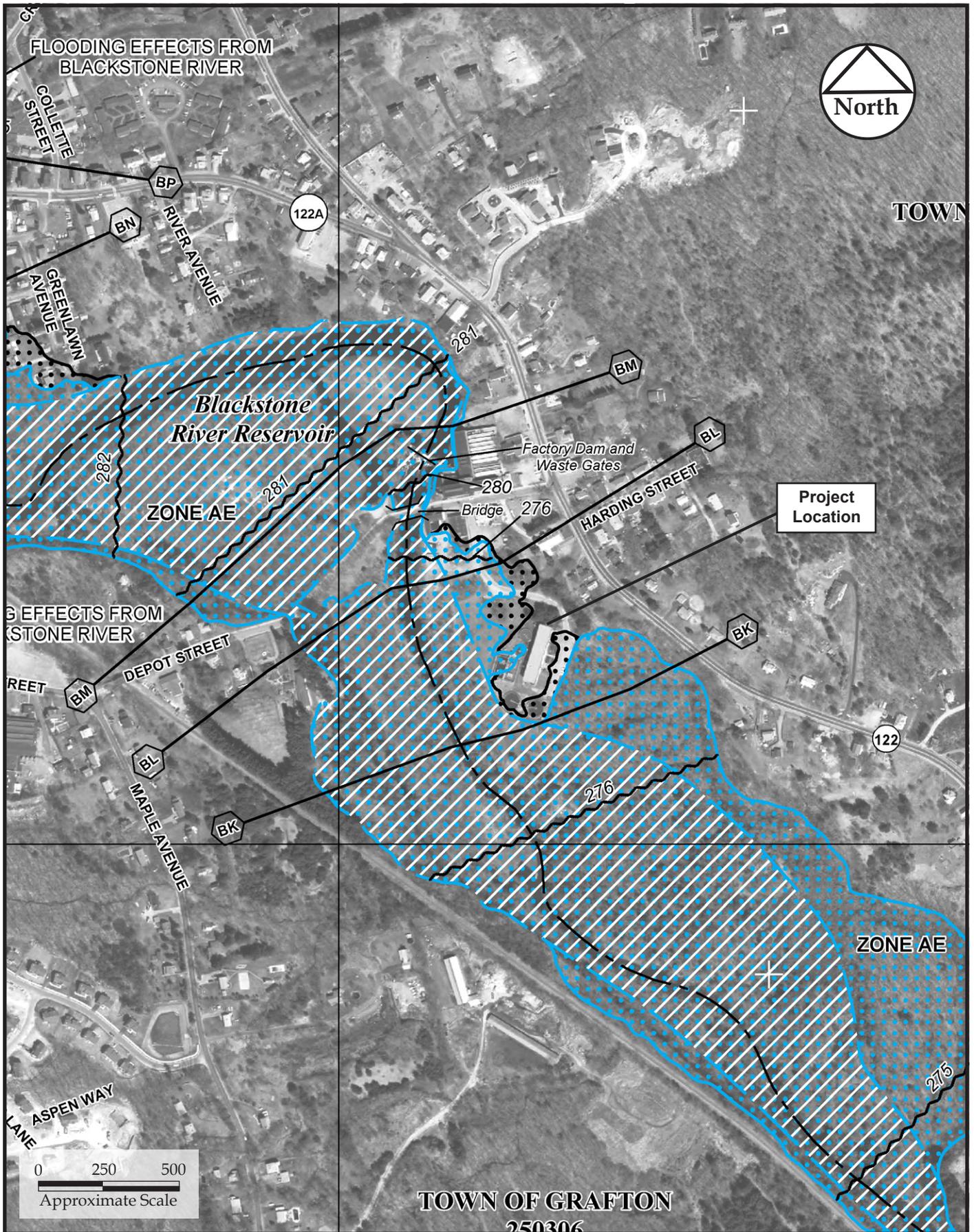
Figures



0 2000 4000
 Scale in Feet

Town of Grafton, Massachusetts
 Grafton Wastewater Treatment Facility

Figure 1
 Project Location Map



Source: FEMA Flood Insurance Rate Map
Community Panel 25027C0841E

Town of Grafton, Massachusetts
Grafton Wastewater Treatment Facility

Attachment D
Project Plans

Plot Stamp - ProjectWise Project: 0291-105608 GRAFTON, MA File: C:\CDWXA\PROJECTS\0291-105608\DWG\001\GNA.DWG Saved By: RICCIDIO On: 8-Jun-15 10:03 PM
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LEGEND - EXISTING FEATURES

△	SURVEY CONTROL STATION
STK NAIL	STAKE AND NAIL SET
PK NAIL	PARKER KALON CONCRETE NAIL
FND	FOUND
N/F	NOW OR FORMERLY
W/	WITH
(S)	SURVEY
(R)	RECORD
MISC	MISCELLANEOUS
N.T.S.	NOT TO SCALE
~~~~~	TREE LINE
○ 12"0	DECIDUOUS TREE
○	SHRUB
BWF	BARBED WIRE FENCE
CLF	CHAIN LINK FENCE
=====	CURBING(TYPE)
BIT CONC	BITUMINOUS CONCRETE
GC	GRANITE CURB
CC	CONCRETE CURB
=====	TOP OF CURB
=====	BOTTOM OF CURB
=====	EDGE OF STREAM
=====	EDGE OF VEGETATED WETLAND
WF#4-1	WETLAND FLAG
	MARSH
● GP	GUARD POST (BOLLARD)
CC	CONCRETE CURB
—	SIGN
■ FA	FIRE ALARM BOX
RD	ROOF DRAIN
FF	FINISHED FLOOR
TH	THRESHOLD
□ HH	HANDHOLE
□ LPB	LIGHT POLE BASE
(M)	MARKED
R	RIM
I	INVERT
NPV	NO PIPE VISIBLE
(CU)	CONNECTION UNKNOWN
CMP	CORRUGATED METAL PIPE
RCP	REINFORCED CONCRETE PIPE
CIP	CAST IRON PIPE
PVC	POLYVINYL CHLORIDE
VCP	VITREOUS CLAY PIPE
CPP	CORRUGATED PLASTIC PIPE
AC	ASBESTOS CEMENT
UG	UNKNOWN GATE
PWHDPE	PROFILE WALL HIGH DENSITY POLYETHYLENE
HDPE	HIGH DENSITY POLYETHYLENE
MDPE	MEDIUM DENSITY POLYETHYLENE
CU	COPPER
DI	DUCTIL IRON
SS	STAINLESS STEEL
○ SMH	SANITARY CLEANOUT
○ DMH	SANITARY SEWER MANHOLE
○ GMH	STORM WATER MANHOLE
○ MH	GAS MANHOLE
○ TMH	UNIDENTIFIED MANHOLE
○	TELEPHONE MANHOLE
□ CB	CATCH BASIN
RD	ROOF DRAIN
○ HYD	HYDRANT
◇ WG	WATER GATE VALVE
◇ UG	UNKNOWN GATE
◇ EFW HYD	EFFLUENT FLUSHING WATER HYDRANT
□ GM	GAS METER
— ATE	AERATION TANK EFFLUENT
— ATB	AERATION TANK INFLUENT
— BWW	BACKWASH WATER
— CABL	CABLE TELEVISION LINE
— CLS	CHLORINE SOLUTION
— D	DRAIN LINE
— E	ELECTRIC LINE
— FC	FERRIC CHLORIDE
— FE	FINAL EFFLUENT
— FM	FORCE MAIN
— G	GAS LINE
— HWE	HEADWORKS EFFLUENT
— LPA	LOW PRESSURE AIR
— OC	ODOR CONTROL
— PW	PLANT WATER

— P	POLYMER
— PE	PRIMARY EFFLUENT
— PSC	PRIMARY SCUM
— PSL	PRIMARY SLUDGE
— RWW	RAW WASTEWATER
— RAS	RETURN ACTIVATED SLUDGE
— RL	ROOF LEADER
— SAM	SAMPLE
— SC	SCUM
— SE	SECONDARY EFFLUENT
— SSC	SECONDARY SCUM
— SPT	SEPTAGE
— SW	SERVICE WATER
— S	SEWER LINE
— SHC	SODIUM HYPOCHLORITE
— TKD	TANK DRAIN
— TEL	TELEPHONE LINE
— TW	TEPID WATER
— UD	UNDERDRAIN
— WAS	WASTE ACTIVATED SLUDGE
— W	WATER LINE

⊕	BORING
⊕	TEST PIT
+ 200.15	SPOT ELEVATION
-----	INTERMEDIATE CONTOUR
-----	INDEX CONTOUR
○ TOB	TOP OF BELL
○ BOB	BOTTOM OF BELL
○ CP	CONCRETE PAD
○ CONC	CONCRETE
○ MTL	METAL
○ CL2	CHLORINE
○ COND	CONDUIT
○ ELEC	ELECTRIC
○ RSR	RISER
○ ADJ	ADJUSTABLE
○ LND	TOP OF LAUNDERER
○ V-WEIR	BOTTOM OF V-KNOTCH WEIR
○ TW	TOP OF WALL
○ WEIR	TOP OF WEIR
○ GC	GRANITE CURB
○ BCC	BITUMINOUS CONCRETE CURB
○ SBCC	SLOPED BITUMINOUS CONCRETE CURB
○ AC UNIT	AIR CONDITIONING UNIT

**CIVIL/SITE LEGEND - NEW FEATURES**

SYMBOL	DESCRIPTION
△	SECTION SYMBOLS
○	SEWER OR DRAIN MANHOLE
□	CATCH BASIN
— x — x — x —	CHAIN LINK FENCE
—   —   —   —   —	GUARDRAIL
~~~~~	TREE LINE
+ 300.00	SPOT ELEVATION
-----	INDEX CONTOUR
-----	INTERMEDIATE CONTOUR
▨	CRUSHED STONE
	SEDIMENT FENCE
△	OUTLET PROTECTION
▨	STABILIZED CONSTRUCTION ENTRANCE
▨	BITUMINOUS CONCRETE PAVEMENT
▨	CONCRETE PAVEMENT
TC	TOP OF CURB
BB	BATCHMENT CURB
MR	MATERIAL
FB	FILTER FABRIC
CH	CRUSHED STONE
CS	CRUSHED STONE

LAYOUT NOTES:

- FOR LAYOUT PURPOSES AND TO ESTABLISH THE COORDINATE SYSTEM SEE SURVEY NOTES.
- CONTRACTOR SHALL VERIFY ALL PROPERTY AND SURVEY INFORMATION.
- CONTRACTOR SHALL BE RESPONSIBLE TO IDENTIFY AND PROTECT ALL ON-SITE STRUCTURES AND VEGETATION TO BE RETAINED ON THE SITE THROUGHOUT THE CONSTRUCTION PROJECT.
- CONTRACTOR SHALL MAINTAIN VEHICULAR ACCESS AND ALL UTILITY SERVICES TO THE EXISTING TREATMENT PLANT AND ASSOCIATED FACILITIES THROUGHOUT THE DURATION OF THE CONTRACT, UNLESS OTHERWISE SPECIFIED.
- LOCATIONS OF BURIED UTILITIES, VAULTS AND CONCRETE PADS ARE APPROXIMATE ONLY. FINAL LOCATIONS SHALL BE DETERMINED IN THE FIELD AFTER STAKING BY THE CONTRACTOR BASED ON ACTUAL SITE CONDITIONS AS APPROVED BY THE ENGINEER.
- ALL DISTURBED AREAS NOT COVERED WITH PAVEMENT, PADS, CURB, MULCH, RIPRAP, PLANTINGS, CRUSHED STONE OR STRUCTURES SHALL RECEIVE 6" LAYER OF LOAM AND SEED AS SPECIFIED, UNLESS NOTED OTHERWISE.
- BUILDING DIMENSIONS ARE TO COLUMN LINE INTERSECTION OR OUTSIDE FACE OF WALL AS SHOWN ON THE DRAWINGS. DIMENSIONS FOR TANKS ARE TO OUTSIDE FACE OF WALL. DIMENSIONS TO CONCRETE PADS ARE TO EDGE OF PAD.
- ALL ITEMS TO BE REMOVED, UNLESS OTHERWISE INDICATED ON THE DRAWINGS, SHALL BE DISPOSED OFF SITE IN A LEGAL MANNER.
- ITEMS SLATED FOR RE-USE SHALL BE STORED IN A CLEAN, DRY PLACE, PRIOR TO RELOCATION ON SITE.

GENERAL NOTES

- EXISTING SITE CONDITIONS SHOWN AT THE TREATMENT PLANT SITE ARE BASED ON A SURVEY CONDUCTED BY SURVEYING AND MAPPING CONSULTANTS (SMC) OF BRAINTREE, MASSACHUSETTS, DATED DECEMBER 2013 AND UPDATED MARCH 2015. TOPOGRAPHIC SURVEY WAS PERFORMED AT A SCALE OF 1"=20'.
- FOR BORING AND TEST PIT INFORMATION AND LOCATIONS AT THE TREATMENT PLANT SITE SEE DRAWING C-4 AND APPENDIX TO SPECIFICATIONS.
- THE CONTRACTOR SHALL PREPARE AN EROSION AND SEDIMENT CONTROL PLAN AND STORMWATER POLLUTION PREVENTION PLAN (SWPPP) AS SPECIFIED IN SECTION 01050 AND 02290, TO PROTECT THE SITES FROM EROSION AND PREVENT THE MOVEMENT OF SEDIMENT AND DEBRIS.
- ALL AREAS OUTSIDE THE LIMIT OF DISTURBANCE SHALL BE PROTECTED AT ALL TIMES UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
- ALL MATERIALS TO BE REMOVED WITHIN THE LIMIT OF DISTURBANCE SHALL BE REMOVED TO A LOCATION ARRANGED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER. THE LOCATION OF STOCKPILED TOPSOIL SHALL BE IN AREAS APPROVED BY THE ENGINEER.
- THE CONTRACTOR SHALL COORDINATE WORK TO ENSURE CONTINUED ACCESS TO ALL EXISTING FACILITY STRUCTURES. SEE SPECIFICATION SECTION D1810 FOR ADDITIONAL INFORMATION.
- REMOVE AND DISPOSE OF EXISTING PAVEMENT WITHIN LIMITS SHOWN ON DRAWINGS TAKING CARE NOT TO DAMAGE EXISTING WALLS, BUILDINGS OR UTILITY STRUCTURES.
- CONTRACTOR SHALL PROVIDE SITE SECURITY THROUGHOUT CONSTRUCTION PERIOD.
- STRIP EXISTING VEGETATION AND 6" LAYER TOPSOIL UNLESS OTHERWISE SHOWN TO BE PROTECTED WITHIN LIMIT OF DISTURBANCE. GRIND ANY STUMPS TO A MINIMUM OF ONE FOOT BELOW FINISH GRADE AND BACKFILL IN COMPACTED LAYERS AS SPECIFIED.
- WHEN EXCAVATING AROUND EXISTING STRUCTURES, EXCAVATE SOILS UNIFORMLY AROUND THE STRUCTURE UNLESS INDICATED OTHERWISE. CONTROL EXCAVATION LEVELS AROUND THE ENTIRE PERIMETER OF THE STRUCTURE SUCH THAT THE GRADE DIFFERENTIAL DOES NOT EXCEED 3 FT.
- WHEN BACKFILLING AROUND STRUCTURES, BRING UP BACKFILL UNIFORMLY AROUND STRUCTURE UNLESS INDICATED OTHERWISE. CONTROL BACKFILL LEVELS AROUND THE ENTIRE PERIMETER OF THE STRUCTURE SUCH THAT THE GRADE DIFFERENTIAL DOES NOT EXCEED 3 FT.
- DURING CONSTRUCTION AND UNTIL THE SITE IS STABILIZED, A TEMPORARY STORMWATER BASIN SHALL FUNCTION AS A SETTLING BASIN TO PREVENT SILTATION FROM ENTERING THE RIVER. PRIOR TO USE AS A SETTLING BASIN, PROTECT THE NATIVE SOIL FROM BEING CONTAMINATED BY FINES BY ADDING A LAYER OF FILTER FABRIC ON THE BOTTOM. THE CONTRACTOR SHALL INSTALL A RISER PIPE TO DRAIN THE BASIN AT MAX HOLDING CAPACITY. UPON COMPLETION OF CONSTRUCTION AND FINAL SITE STABILIZATION, THE BASIN SHALL BE CLEANED OF ANY FINE SILTS OR SOIL ACCUMULATION, THE FILTER FABRIC SHALL BE REMOVED, AND THE FINAL TOPOGRAPHY SHALL BE CONSTRUCTED AS DETAILED.

YARD PIPING NOTES

- THE LOCATION OF EXISTING UTILITIES AND OTHER UNDERGROUND STRUCTURES SHOWN ON THE DRAWINGS IS APPROXIMATE, AND THEIR ACTUAL LOCATIONS MAY VARY FROM THAT SHOWN. FURTHER, IT IS NOT WARRANTED THAT ALL UNDERGROUND UTILITIES AND STRUCTURES ARE SHOWN. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT LOCATION OF ALL UNDERGROUND FEATURES THAT MAY BE AFFECTED BY THE WORK.
- PRIOR TO STARTING CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY ALL PUBLIC AND PRIVATE UTILITIES THAT COULD BE AFFECTED BY THE WORK. ADDITIONALLY, NOTIFY DIG SAFE (888-DIG-SAFE (344-7233)).
- NEW WATER MAINS SHALL HAVE A MINIMUM COVER OF 5 FEET UNLESS OTHERWISE INDICATED AND SHALL PASS UNDER EXISTING UTILITIES AS NECESSARY TO MEET THIS REQUIREMENT.
- ALL NEW WATER PIPES, INCLUDING FIRE PROTECTION LINES, AND OTHER PRESSURE PIPES INCLUDING FORCE MAINS, SHALL HAVE RESTRAINED JOINTS AS SPECIFIED.
- TEST PITS SHALL BE DUG TO LOCATE EXISTING PIPES TO WHICH NEW PIPES ARE TO BE CONNECTED, AND WHERE NECESSARY TO DETERMINE EXACT LOCATIONS OF EXISTING UTILITIES.
- CONTRACTOR SHALL BE RESPONSIBLE FOR MAKING ALL FINAL CONNECTIONS TO PIPES INSTALLED BY PLUMBING SUBCONTRACTOR.
- FOR ADDITIONAL DETAILS OF EXISTING BURIED PROCESS PIPING SEE YARD PIPING DRAWINGS.
- ABANDONED PIPES, VALVES AND APPURTENANCES ENCOUNTERED DURING CONSTRUCTION MAY BE REMOVED AS REQUIRED. PIPES LEFT IN PLACE SHALL BE PLUGGED AND ABANDONED AS SPECIFIED AND AS APPROVED BY THE ENGINEER.
- WALKWAYS AND PAVEMENTS DISTURBED BY CONSTRUCTION ACTIVITIES SHALL BE RESTORED.
- SEE YARD PIPING PLANS FOR EXISTING SUBSURFACE UTILITIES.

GRADING NOTES

- BENCHMARK CHISELED SQUARE IN CONCRETE WALL EL. 298.97, SEE SHEET C-3. NOTIFY THE ENGINEER OF OBSTRUCTIONS ENCOUNTERED DURING THE CONSTRUCTION OF PAVEMENTS, UTILITIES, FOUNDATIONS AND PADS.
- CONTRACTOR IS RESPONSIBLE FOR CONFIRMING GRADES AND LOCATION OF UTILITIES. MAJOR DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER.
- TO ESTABLISH PROPER GRADES, CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLATION AND MAINTENANCE OF GRADE STAKES. THE NUMBER AND LOCATION SHALL BE DETERMINED IN THE FIELD AND APPROVED BY THE ENGINEER.
- ALL AREAS DISTURBED BY CONTRACTOR'S OPERATIONS SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE IN A MANNER APPROVED BY THE ENGINEER.

SURVEY NOTES

- COORDINATES, IN U.S. SURVEY FEET, ARE REFERENCED TO THE MASSACHUSETTS COORDINATE SYSTEM, MAINLAND ZONE, REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD 83), AS DETERMINED BY SMC'S OBSERVATIONS OF THE KeyNet GPS VIRTUAL REFERENCE SYSTEM (VRS), MADE OCTOBER 22, 2013, USING TRIMBLE GNSS GPS RECEIVERS.
- ELEVATIONS, IN U.S. SURVEY FEET, ARE REFERENCED TO NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29) AS DETERMINED USING THE REFERENCED BENCHMARK.
- SUBSURFACE UTILITY LINES, AS SHOWN HEREON, WERE COMPILED ACCORDING TO AVAILABLE RECORD INFORMATION FROM THE REFERENCED COMPANIES AND PUBLIC AGENCIES, AND THEIR LOCATIONS ARE APPROXIMATE ONLY. ACTUAL LOCATIONS MUST BE DETERMINED IN THE FIELD. SMC ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN.
- GENERALLY THE LINES IN THE PUBLIC AND PRIVATE WAYS ARE SHOWN AND THE LATERAL CONNECTIONS SERVING INDIVIDUAL USERS ARE NOT SHOWN. BEFORE DESIGNING FUTURE CONNECTIONS, THE APPROPRIATE UTILITIES MUST BE CONSULTED.
- BEFORE CONSTRUCTION, ALL UTILITIES, PUBLIC AND PRIVATE MUST BE NOTIFIED (SEE MASSACHUSETTS GENERAL LAWS, CHAPTER 82 SECTION 40.) CALL "DIG SAFE" 1 (888) 344-7233 HTTP://WWW.DIGSAFE.COM.



REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.	0001LGN
DESIGNED BY:	J.RICCIDIO
DRAWN BY:	J.RICCIDIO
SHEET CHK'D BY:	B.HICKEY
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE 2015

CDM Smith
 75 State Street, Suite 701
 Boston, MA 02109
 Tel: (617) 452-6900

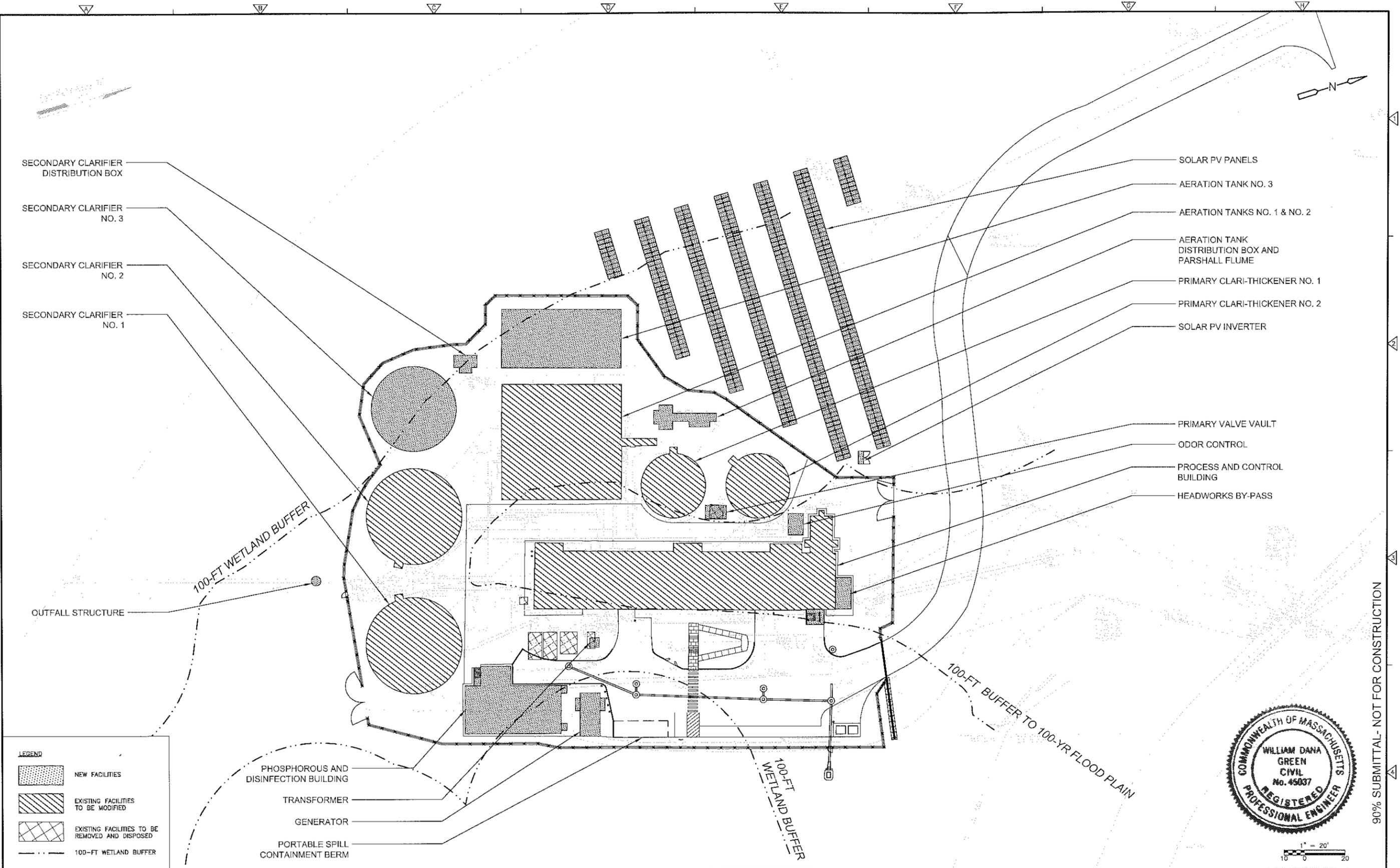
GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

CIVIL/SITE LEGEND, NOTES AND ABBREVIATIONS

PROJECT NO. 0291-105808
ShL X of XXX
C-1

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SECONDARY CLARIFIER
DISTRIBUTION BOX

SECONDARY CLARIFIER
NO. 3

SECONDARY CLARIFIER
NO. 2

SECONDARY CLARIFIER
NO. 1

SOLAR PV PANELS

AERATION TANK NO. 3

AERATION TANKS NO. 1 & NO. 2

AERATION TANK
DISTRIBUTION BOX AND
PARSHALL FLUME

PRIMARY CLARI-THICKENER NO. 1

PRIMARY CLARI-THICKENER NO. 2

SOLAR PV INVERTER

PRIMARY VALVE VAULT

ODOR CONTROL

PROCESS AND CONTROL
BUILDING

HEADWORKS BY-PASS

LEGEND

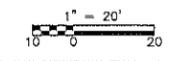
- NEW FACILITIES
- EXISTING FACILITIES TO BE MODIFIED
- EXISTING FACILITIES TO BE REMOVED AND DISPOSED
- 100-FT WETLAND BUFFER

PHOSPHOROUS AND
DISINFECTION BUILDING

TRANSFORMER

GENERATOR

PORTABLE SPILL
CONTAINMENT BERM



REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO. C020251PL
 DESIGNED BY: J.LOICOTT
 DRAWN BY: J.HEIL
 SHEET CHK'D BY: _____
 GROSS CHK'D BY: _____
 SCALE: AS NOTED
 APPROVED BY: _____
 DATE: JUNE 2015



GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990

**GRAFTON WASTEWATER TREATMENT PLANT
 IMPROVEMENTS**

OVERALL SITE PLAN

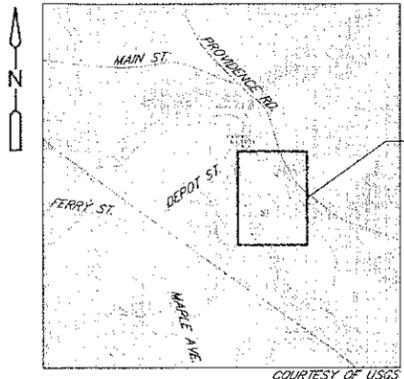
PROJECT NO.
0291-105808

Sht. X of XXX

C-2

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Plot Stamp - ProjectWise Project: 0291-105808 GRAFTON, MA File: G:\CDMA\HEILUR\171645\002ASTPL.DWG Saved by: HEILUR On: 15-Jun-15 Plotted on: 15-Jun-15 1:46 PM
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LOCUS MAP
1" = 1,000'

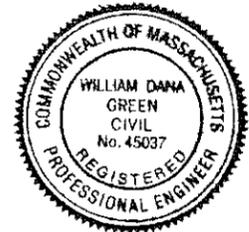
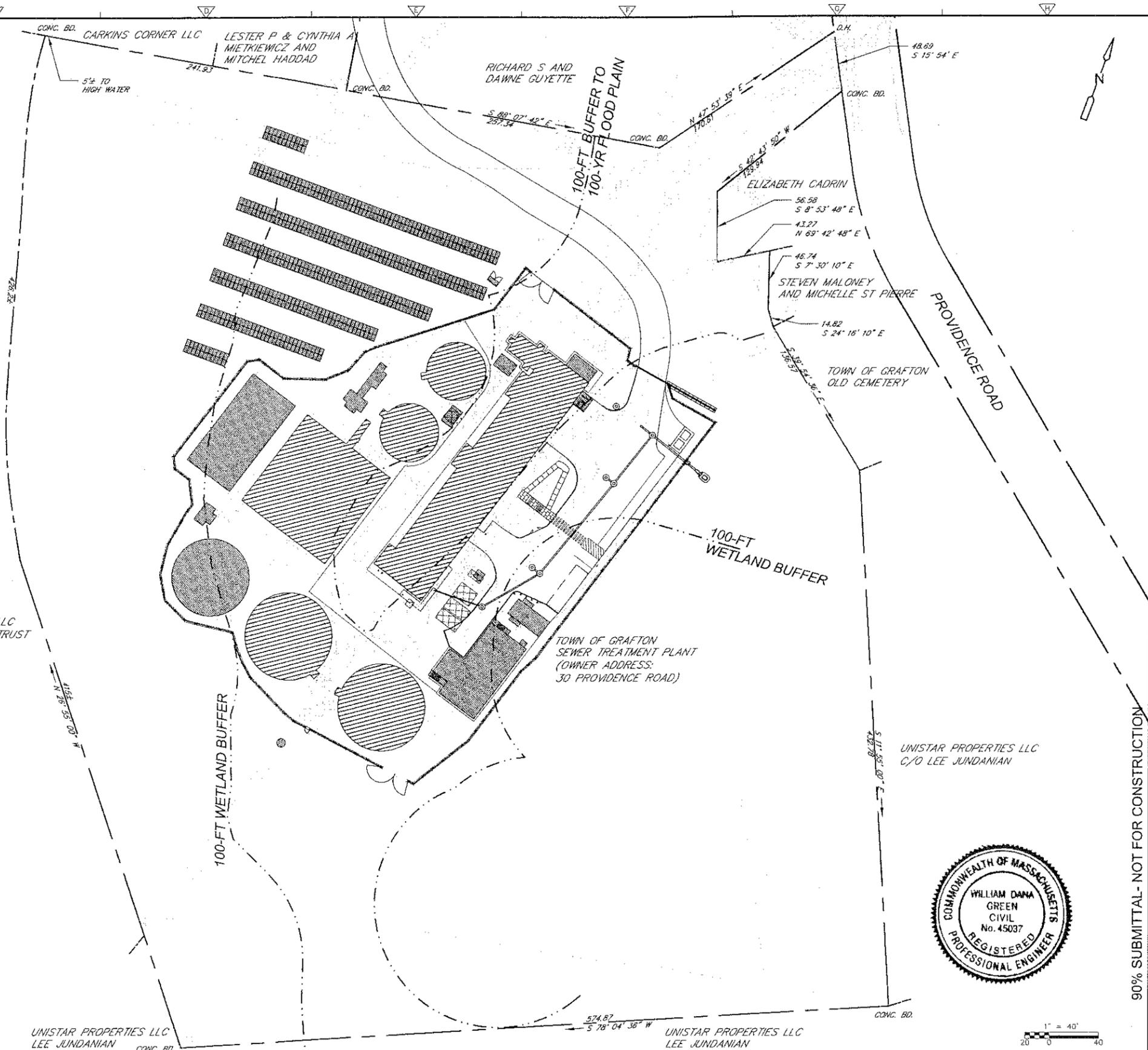
APPROXIMATE PROJECT LOCATION

COURTESY OF USGS

- NOTES:**
1. MEETS AND BOUNDS INFORMATION OBTAINED FROM SITE AND BORING PLAN, SHEET G-1, OF TOWN OF GRAFTON SEWAGE WORKS IMPROVEMENTS PROJECT BY CAMP DRESSER & MCKEE INC DATE DEC. 1975
 2. ABUTTER INFORMATION OBTAINED FROM ASSESSORS OFFICE, TOWN OF GRAFTON ON APRIL 2, 2015.
 3. THERE IS AN ESTIMATED TOTAL AREA OF 170,237 SF (34% OF THE TOTAL LOT AREA) AND TOTAL VOLUME OF 254,202 CF EXPECTED TO BE DISTURBED BY EXCAVATION, GRADING OR OTHER CONSTRUCTION ACTIVITIES.
 4. ZONING DISTRICT OF PROPERTY: THE GRAFTON WWTP IS LOCATED WITHIN RESIDENTIAL (R20), FLOODPLAIN (FP), AND WATER SUPPLY PROTECTION OVERLAY (WSPO) DISTRICTS.

LEGEND

- [Solid Grey Box] NEW FACILITIES
- [Hatched Box] EXISTING FACILITIES TO BE MODIFIED
- [Grid Box] EXISTING FACILITIES TO BE REMOVED AND DISPOSED
- [Dashed Line] 100-FT WETLAND BUFFER



1" = 40'
20 0 40

90% SUBMITTAL- NOT FOR CONSTRUCTION

REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO. 0002ASTPL
 DESIGNED BY: J.OLCOTT
 DRAWN BY: J. HEIL
 SHEET C-K'D BY: _____
 CROSS CHK'D BY: _____
 SCALE: AS NOTED
 APPROVED BY: _____
 DATE: JULY 2015

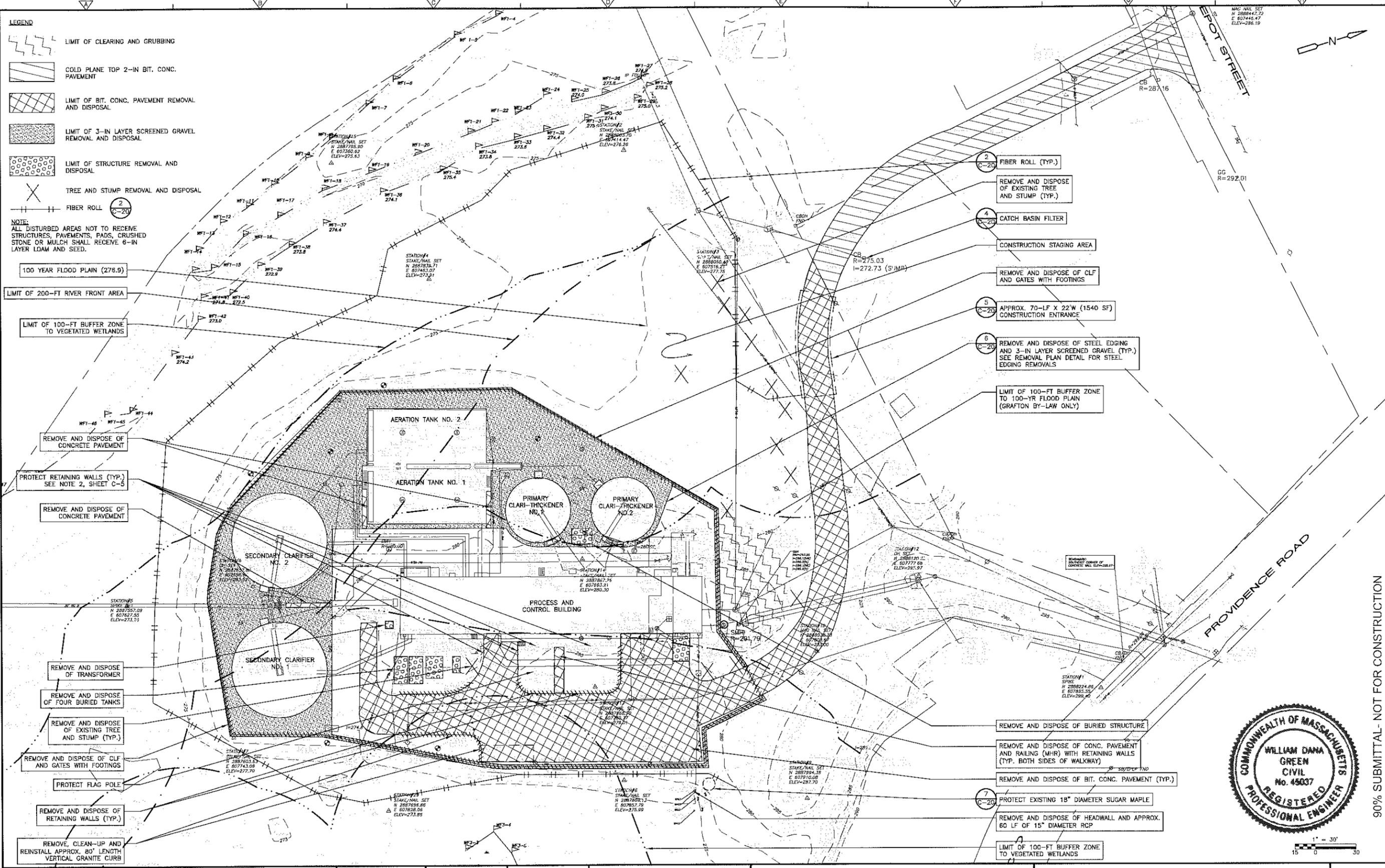
CDM Smith
 75 State Street, Suite 701
 Boston, MA 02109
 Tel: (617) 452-6000

GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

ABUTTERS AND PROPERTY BOUNDARY PLAN FOR 9 DEPOT STREET
 ASSESSORS MAP: 124 LOT: 63
C-2A

PROJECT NO. 0291-105808
 Sht. x of xxx
 C-2A

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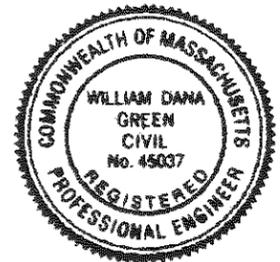
- LEGEND**
- LIMIT OF CLEARING AND GRUBBING
 - COLD PLANE TOP 2-IN BIT. CONC. PAVEMENT
 - LIMIT OF BIT. CONC. PAVEMENT REMOVAL AND DISPOSAL
 - LIMIT OF 3-IN LAYER SCREENED GRAVEL REMOVAL AND DISPOSAL
 - LIMIT OF STRUCTURE REMOVAL AND DISPOSAL
 - TREE AND STUMP REMOVAL AND DISPOSAL
 - FIBER ROLL

NOTE:
 ALL DISTURBED AREAS NOT TO RECEIVE STRUCTURES, PAVEMENTS, PADS, CRUSHED STONE OR MULCH SHALL RECEIVE 6-IN LAYER LOAM AND SEED.

- 100 YEAR FLOOD PLAIN (275.9)
- LIMIT OF 200-FT RIVER FRONT AREA
- LIMIT OF 100-FT BUFFER ZONE TO VEGETATED WETLANDS

- REMOVE AND DISPOSE OF CONCRETE PAVEMENT
- PROTECT RETAINING WALLS (TYP.) SEE NOTE 2, SHEET C-5
- REMOVE AND DISPOSE OF CONCRETE PAVEMENT
- REMOVE AND DISPOSE OF TRANSFORMER
- REMOVE AND DISPOSE OF FOUR BURIED TANKS
- REMOVE AND DISPOSE OF EXISTING TREE AND STUMP (TYP.)
- REMOVE AND DISPOSE OF CLF AND GATES WITH FOOTINGS
- PROTECT FLAG POLE
- REMOVE AND DISPOSE OF RETAINING WALLS (TYP.)
- REMOVE, CLEAN-UP AND REINSTALL APPROX. 80' LENGTH VERTICAL GRANITE CURB

- 2 FIBER ROLL (TYP.)
- REMOVE AND DISPOSE OF EXISTING TREE AND STUMP (TYP.)
- 4 CATCH BASIN FILTER
- CONSTRUCTION STAGING AREA
- REMOVE AND DISPOSE OF CLF AND GATES WITH FOOTINGS
- 5 APPROX. 70'-LF X 22'-W (1540 SF) CONSTRUCTION ENTRANCE
- 6 REMOVE AND DISPOSE OF STEEL EDGING AND 3-IN LAYER SCREENED GRAVEL (TYP.) SEE REMOVAL PLAN DETAIL FOR STEEL EDGING REMOVALS
- LIMIT OF 100-FT BUFFER ZONE TO 100-YR FLOOD PLAIN (GRAFTON BY-LAW ONLY)
- REMOVE AND DISPOSE OF BURIED STRUCTURE
- REMOVE AND DISPOSE OF CONC. PAVEMENT AND RAILING (MHR) WITH RETAINING WALLS (TYP. BOTH SIDES OF WALKWAY)
- REMOVE AND DISPOSE OF BIT. CONC. PAVEMENT (TYP.)
- 7 PROTECT EXISTING 18" DIAMETER SUGAR MAPLE
- REMOVE AND DISPOSE OF HEADWALL AND APPROX. 60 LF OF 15" DIAMETER RCP
- LIMIT OF 100-FT BUFFER ZONE TO VEGETATED WETLANDS



REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.	0003EXPL
DESIGNED BY:	J.OLCOTT
DRAWN BY:	J.HELUR
SHEET CHK'D BY:	
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE 2015



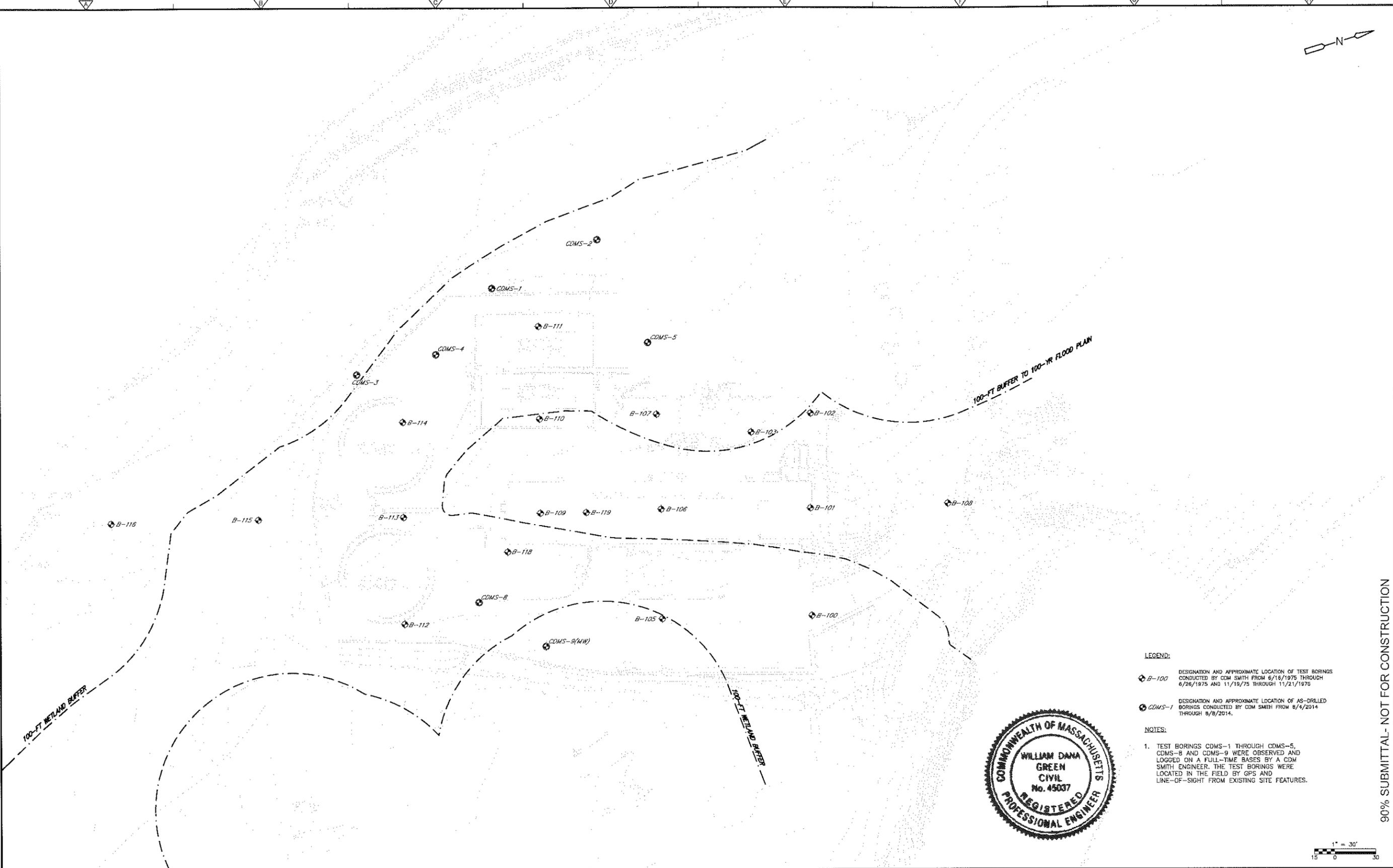
GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

EXISTING CONDITIONS, REMOVALS, AND EROSION AND SEDIMENTATION CONTROL PLAN

PROJECT NO. 0291-105808
 Sht. X of XXX
 C-3

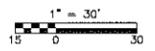
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- LEGEND:**
- ◆ B-100 DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS CONDUCTED BY CDM SMITH FROM 6/16/1975 THROUGH 6/26/1975 AND 11/19/75 THROUGH 11/21/1975
 - CDMS-1 DESIGNATION AND APPROXIMATE LOCATION OF AS-DRILLED BORINGS CONDUCTED BY CDM SMITH FROM 6/4/2014 THROUGH 9/8/2014.

- NOTES:**
1. TEST BORINGS CDMS-1 THROUGH CDMS-5, CDMS-8 AND CDMS-9 WERE OBSERVED AND LOGGED ON A FULL-TIME BASES BY A CDM SMITH ENGINEER. THE TEST BORINGS WERE LOCATED IN THE FIELD BY GPS AND LINE-OF-SIGHT FROM EXISTING SITE FEATURES.



REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.: CD04STPL
 DESIGNED BY: _____
 DRAWN BY: _____
 SHEET CHK'D BY: _____
 CROSS CHK'D BY: _____
 SCALE: AS NOTED
 APPROVED BY: _____
 DATE: JUNE 2015

CDM Smith
 75 State Street, Suite 701
 Boston, MA 02109
 Tel: (617) 452-0090

GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3890
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

BORING LOCATION PLAN

PROJECT NO.
 0291-105808
 Sht. X of XXX
C-4
 Acc #

90% SUBMITTAL- NOT FOR CONSTRUCTION

PLANT LIST

QTY.	SYM.	BOTANICAL NAME	COMMON NAME	SIZE
3	AR	ACER RUBRUM 'OCTOBER GLORY'	OCTOBER GLORY RED MAPLE	1.5/2" CAL.
3	QP	QUERCUS PHELLOS	WILLOW OAK	1.5/2" CAL.
6	PS	PINUS STROBUS	EASTERN WHITE PINE	10', 3" CAL.
5	TP	THUJA PLICATA 'GREEN GIANT'	GREEN GIANT ARBORVITAE	10', 3" CAL.

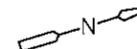
LEGEND

- NEW BITUMINOUS CONCRETE PAVEMENT
- NEW 2" TOP COURSE BITUMINOUS CONCRETE PAVEMENT
- CRUSHED STONE
- PERVIOUS CONCRETE

NOTES:

1. ALL DISTURBED AREAS NOT TO RECEIVE STRUCTURES, PAVEMENTS, PADS, CRUSHED STONE OR MULCH SHALL RECEIVE 6" LAYER LOAM AND SEED.
2. FURNISH COMPLETE CLEANING OF EXISTING EXTERIOR CONCRETE TO BE PROTECTED INCLUDING:
 - EXPOSED SIDES OF THE EXISTING SITE ENTRANCE SIGN MONOLITH, AND
 - EXPOSED SIDES OF THE EXISTING RETAINING WALLS ON THE EAST SIDE OF THE BUILDING.

MATCHLINE - SEE SHEET C-6



SOLAR PV PANELS - SEE ELEC DRAWINGS

113" x 45" CONCRETE PAD FOR INVERTER - SEE ELEC. DRAWINGS

5 (C-21) 6' HIGH BLACK VINYL CHAIN LINK FENCE (TYP.)

9 (C-21) 24' WIDE DOUBLE LEAF BLACK VINYL CLF SWING GATE

1 (C-21) NEW BITUMINOUS CONCRETE PAVEMENT, MATCH EXISTING WIDTH (TYP.)

18" WIDE (MIN.) CRUSHED STONE MOW STRIP (TYP.)

7 (C-21) 30' WIDE OP'G MANUAL SLIDING CANTILEVER GATE WITH KNOX BOX AS SPECIFIED

PROTECT EXISTING SIGN SEE NOTE 2, THIS SHEET

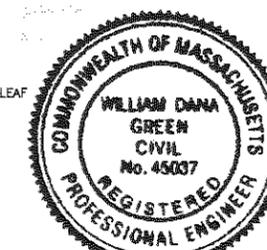
8 (C-21) STEEL BOLLARD

3 (C-21) 46" x 4' CONCRETE WALKWAY UNDER SLIDING GATE

20' x 10' CONC. PAD FOR RELOCATED DUMPSTERS

6 (C-21) 4' WIDE BLACK VINYL SINGLE LEAF SWING PEDESTRIAN GATE

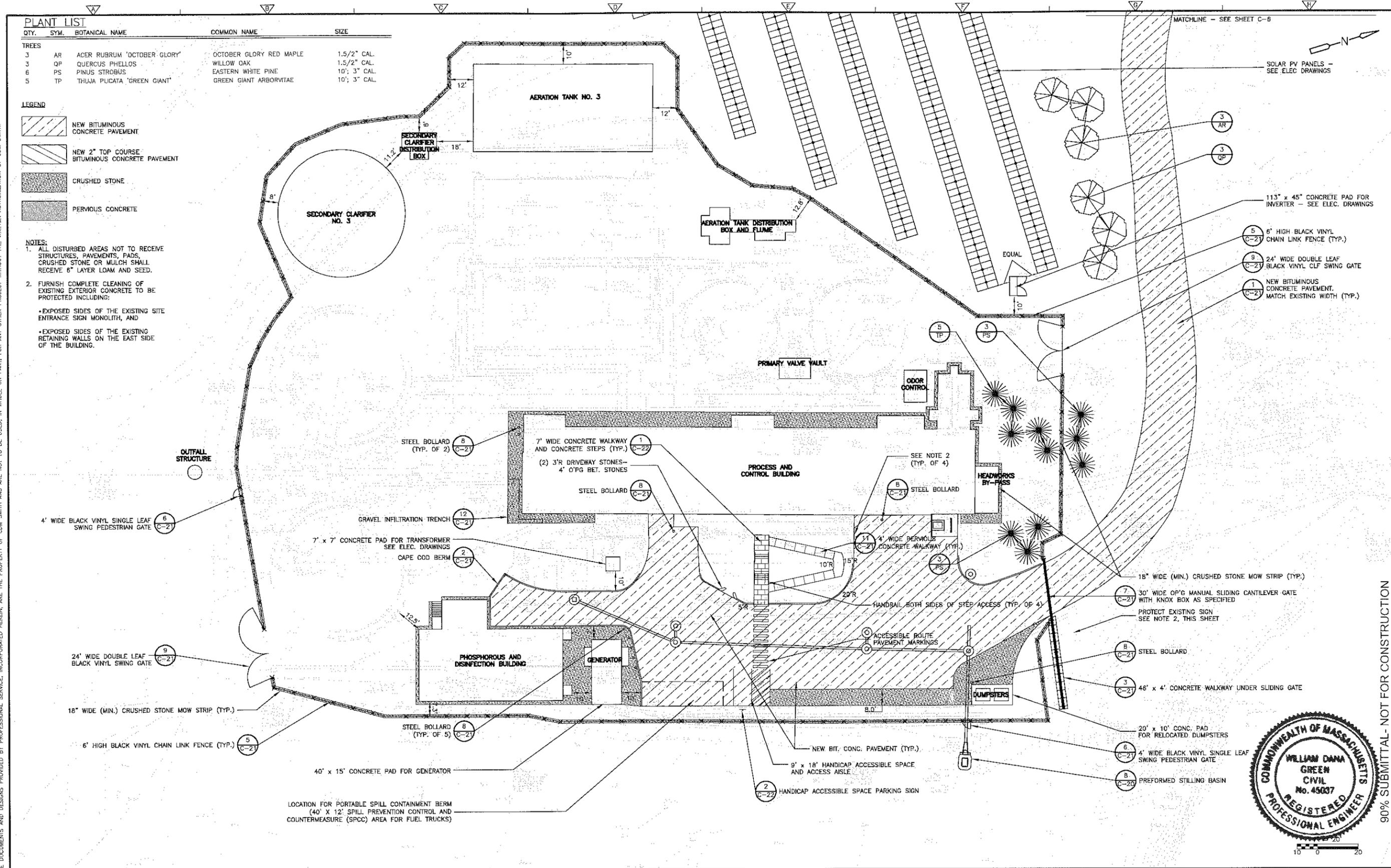
8 (C-20) PREFORMED STILLING BASIN



10 0 20

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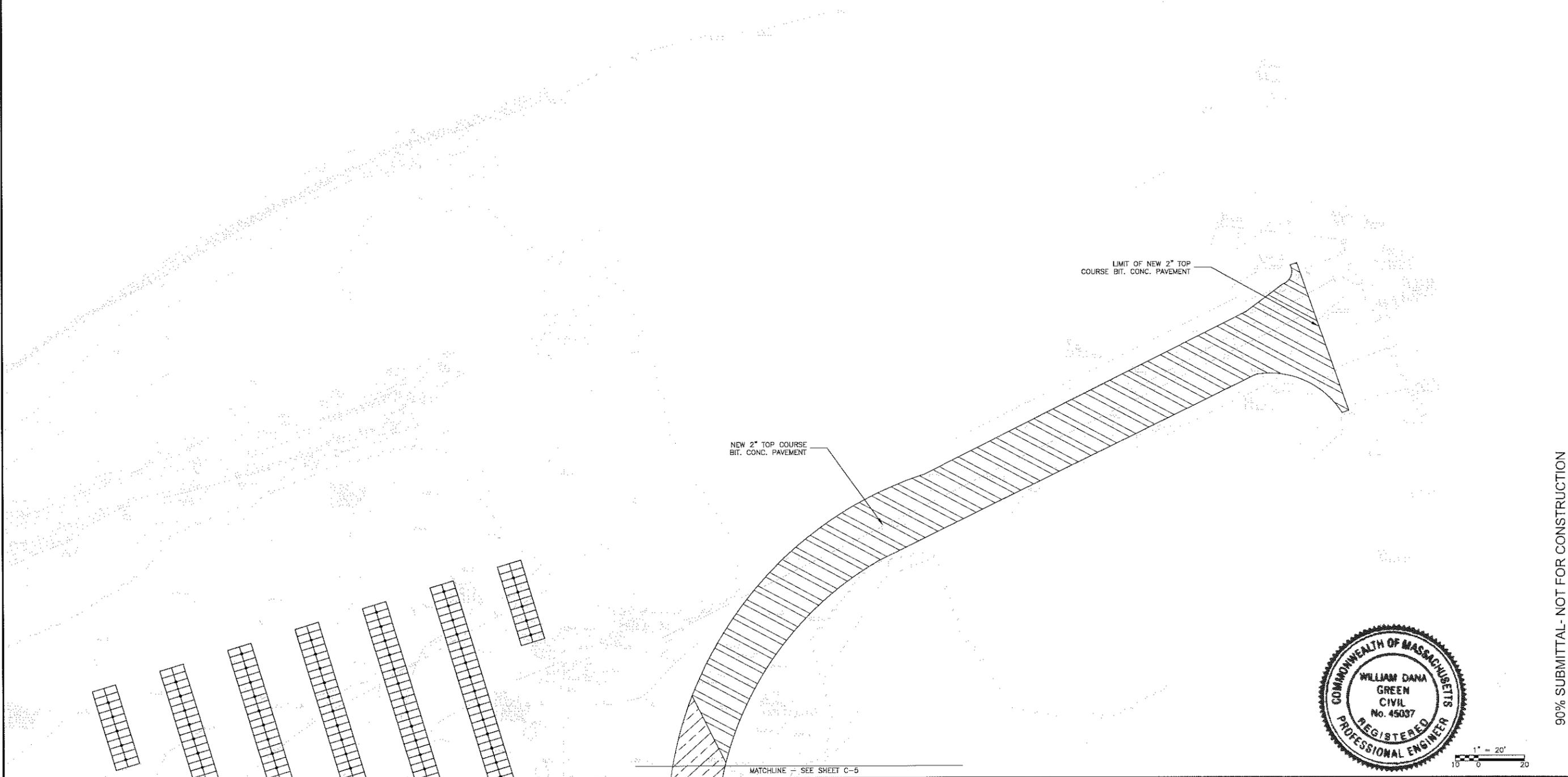
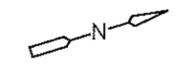
DADD FILE NO.: CO05STPL DESIGNED BY: J.LOICOTT DRAWN BY: J.HILL SHEET CHK'D BY: _____ CROSS CHK'D BY: _____ SCALE: AS NOTED APPROVED BY: _____ DATE: JUNE 2015		75 State Street, Suite 701 Boston, MA 02109 Tel: (617) 452-8000	GRAFTON, MASSACHUSETTS CONTRACT No. 21 CWSRF 3990 GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS	PROJECT NO. 0291-105808 Sht. x of XXX C-5
REV. NO. DATE DRWN CHKD REMARKS	Acc #			

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LEGEND

	NEW BITUMINOUS CONCRETE PAVEMENT
	NEW 2" TOP COURSE BITUMINOUS CONCRETE PAVEMENT
	CRUSHED STONE

NOTE:
 ALL DISTURBED AREAS NOT TO RECEIVE STRUCTURES, PAVEMENTS, PADS, CRUSHED STONE OR MULCH SHALL RECEIVE 6-IN LAYER LOAM AND SEED.



1" = 20'
 10 0 20

90% SUBMITTAL - NOT FOR CONSTRUCTION

REV. NO.	DATE	DRWN	CHKD	REMARKS	CADD FILE NO. CO655TPI DESIGNED BY: J.OLCOTT DRAWN BY: J.HEIL SHEET CHK'D BY: CROSS CHK'D BY: SCALE: AS NOTED APPROVED BY: DATE: JUNE 2015	 75 State Street, Suite 701 Boston, MA 02109 Tel: (617) 452-9090	GRAFTON, MASSACHUSETTS CONTRACT No. 21 CWSRF 3990	GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS	SITE LAYOUT AND MATERIALS PLAN II	PROJECT NO. 0291-105808 Sht. X of XXX C-6 Acc #

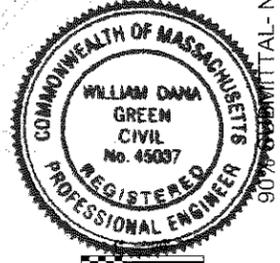
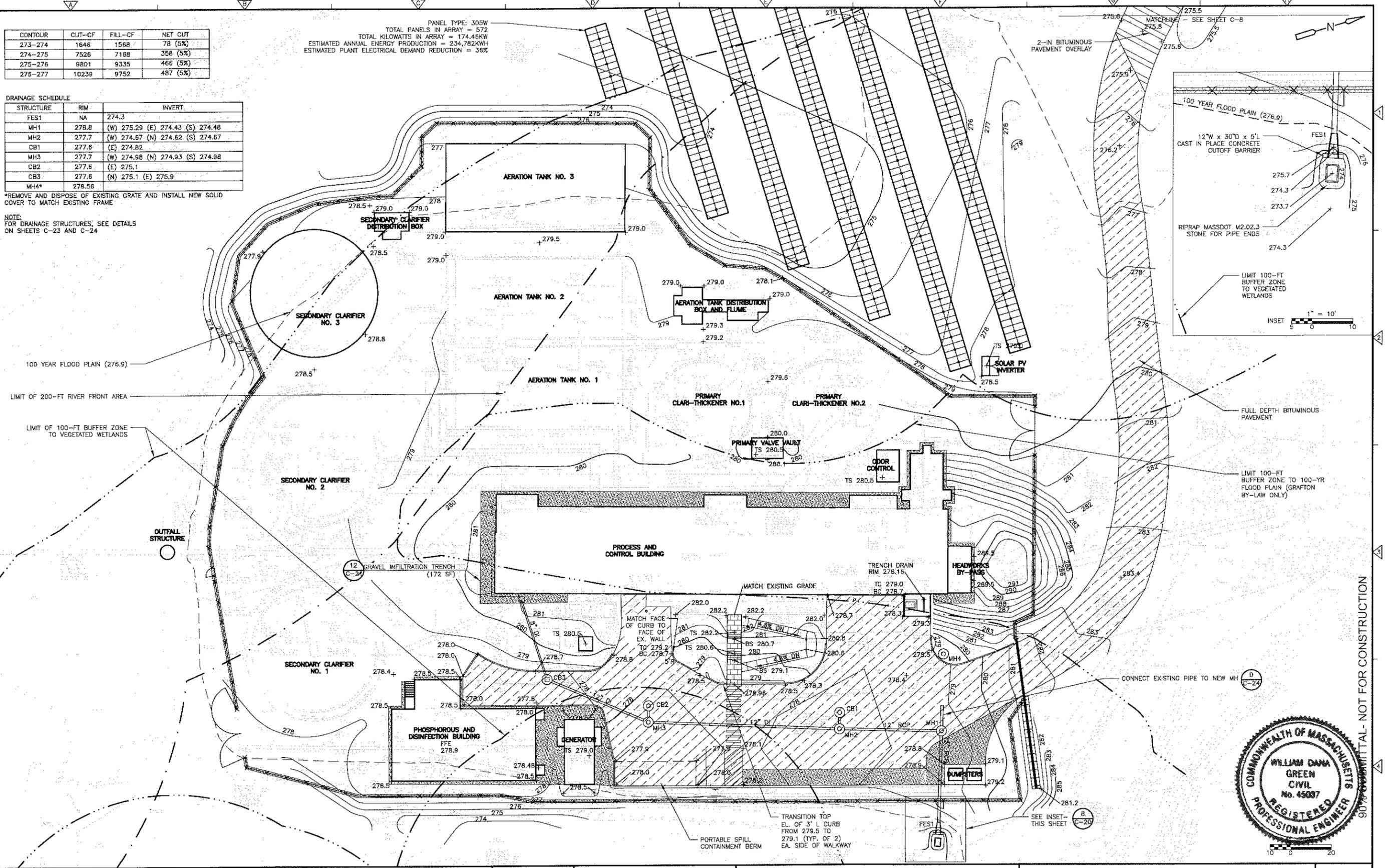
CONTOUR	CUT-CF	FILL-CF	NET CUT
273-274	1646	1568	78 (5%)
274-275	7526	7188	358 (5%)
275-276	9801	9335	466 (5%)
276-277	10239	9752	487 (5%)

STRUCTURE	RIM	INVERT
FES1	NA	274.3
MH1	278.8	(W) 275.29 (E) 274.43 (S) 274.48
MH2	277.7	(W) 274.67 (N) 274.62 (S) 274.67
CB1	277.6	(E) 274.82
MH3	277.7	(W) 274.98 (N) 274.93 (S) 274.98
CB2	277.6	(E) 275.1
CB3	277.6	(N) 275.1 (E) 275.9
MH4*	278.56	

*REMOVE AND DISPOSE OF EXISTING GRATE AND INSTALL NEW SOLID COVER TO MATCH EXISTING FRAME

NOTE:
FOR DRAINAGE STRUCTURES, SEE DETAILS ON SHEETS C-23 AND C-24

PANEL TYPE: 305W
TOTAL PANELS IN ARRAY = 572
TOTAL KILOWATTS IN ARRAY = 174.48KW
ESTIMATED ANNUAL ENERGY PRODUCTION = 234,782KWH
ESTIMATED PLANT ELECTRICAL DEMAND REDUCTION = 36%



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REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.	0007GRPL
DESIGNED BY:	J.OLCOTT
DESIGN BY:	J.HELIL
SHEET CHK'D BY:	
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE 2015

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75 State Street, Suite 701
Boston, MA 02109
Tel: (617) 452-8000

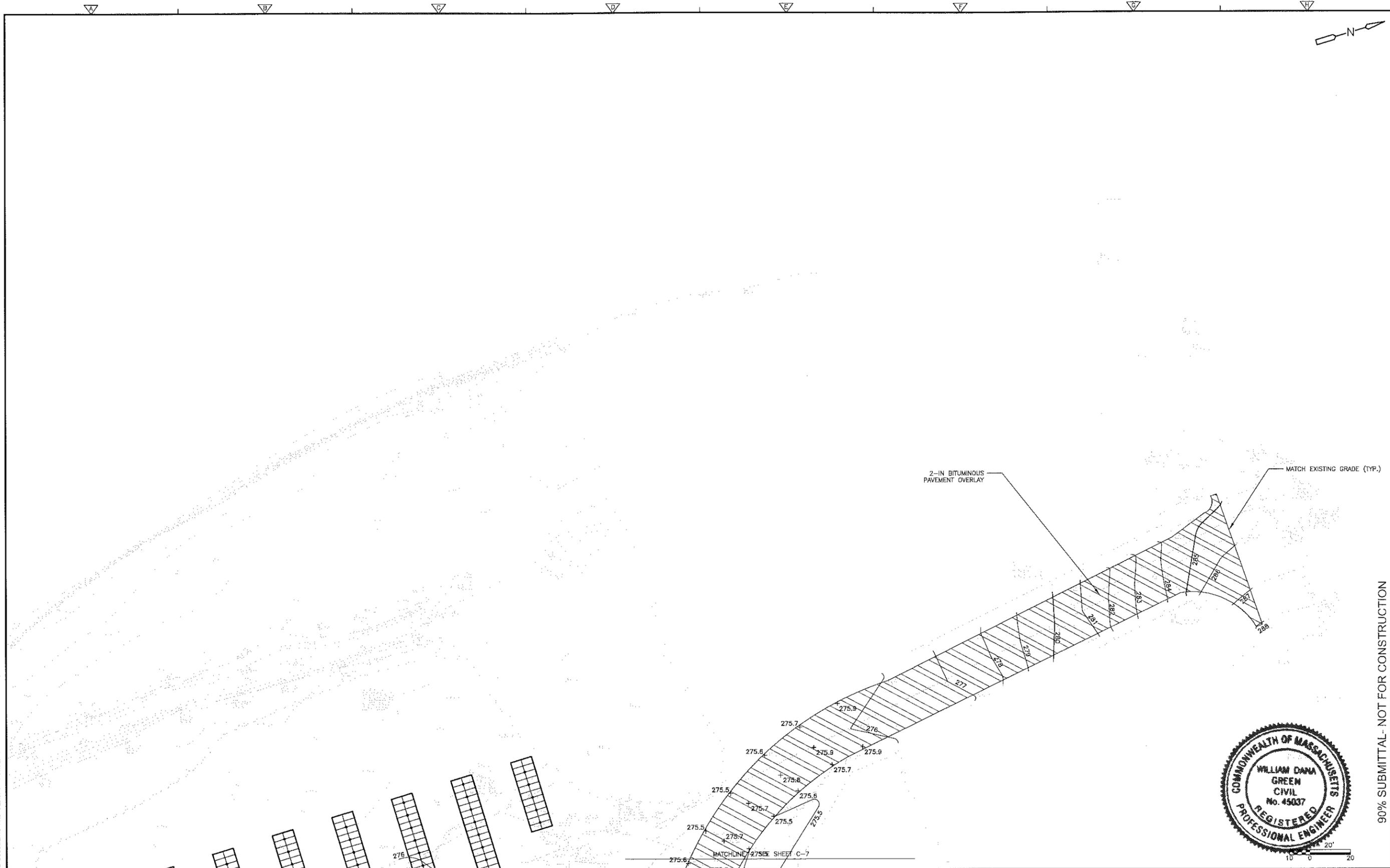
GRAFTON, MASSACHUSETTS
CONTRACT No. 21
CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

SITE GRADING AND DRAINAGE PLAN I

PROJECT NO. 0291-105808
Sht. X of XXX
C-7
Acc #

90% PRELIMINARY - NOT FOR CONSTRUCTION

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REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.:	CD08GRPL
DESIGNED BY:	J.OLCOIT
DRAWN BY:	J.HEIL
SHEET CHK'D BY:	
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE 2015

CDM Smith
 75 State Street, Suite 701
 Boston, MA 02103
 Tel: (617) 452-6000

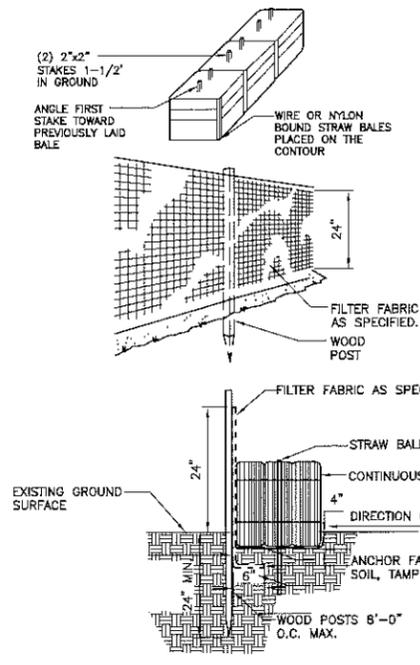
GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

SITE GRADING AND DRAINAGE PLAN II

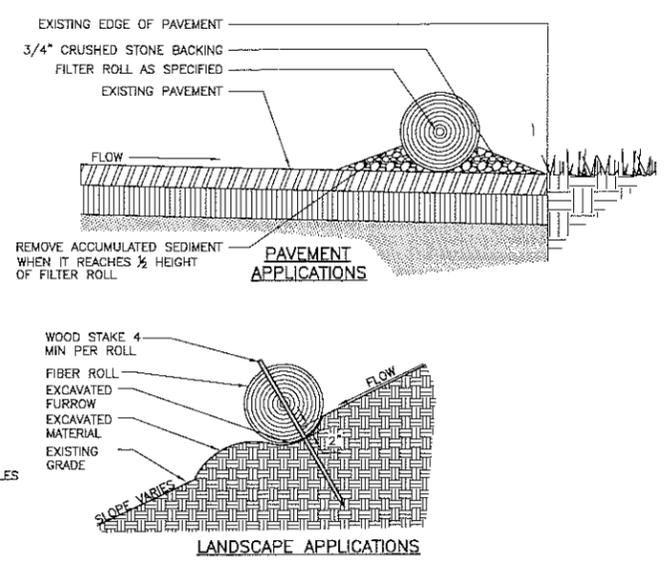
PROJECT NO.
0291-105808
 Sht. X of XXX
C-8
 Acc #

90% SUBMITTAL - NOT FOR CONSTRUCTION

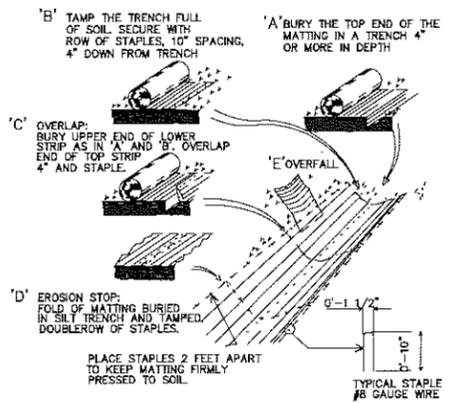
Plot Stamp - ProjectWise Project: 0291-105808 GRAFTON, MA File: C:\CDM\HELLAR\01771645\C020STDT.DWG Saved by: HELLAR On: 9-Jun-15 12:52 PM
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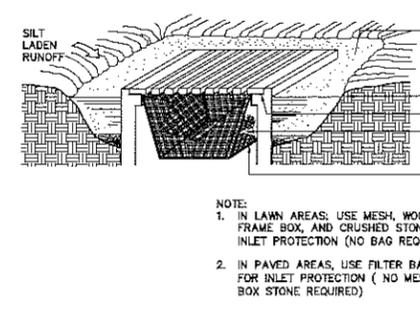
SEDIMENT FENCE WITH HAY BALES
 DETAIL 1
 NOT TO SCALE
 C-20



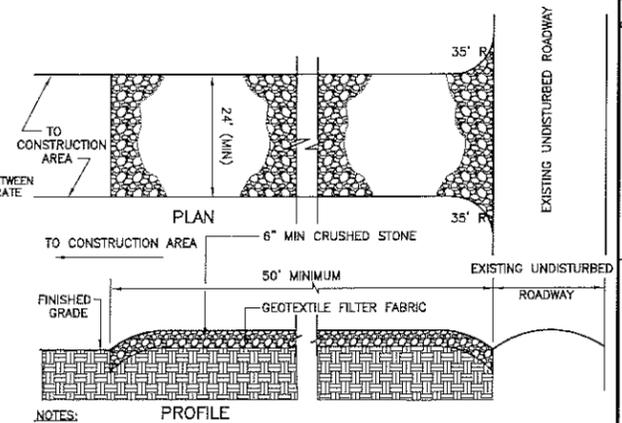
FIBER ROLL
 DETAIL 2
 NOT TO SCALE
 C-20
 NOTE:
 1.) FIBER ROLL MAY BE USED IN PLACE OF HAYBALE SILT FENCE, AS APPROVED BY CONSERVATION AGENT.



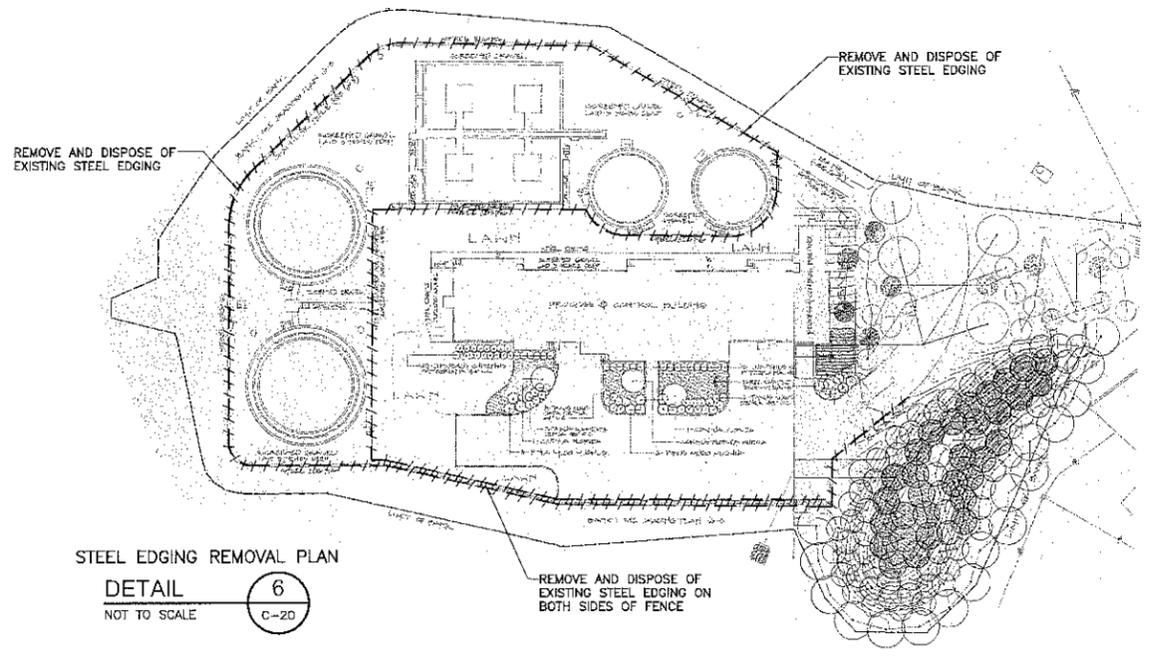
EROSION CONTROL BLANKET
 DETAIL 3
 NOT TO SCALE
 C-20
 NOTE:
 1.) APPLY ON ALL NEW SLOPES 4(H):1(V) OR STEEPER.



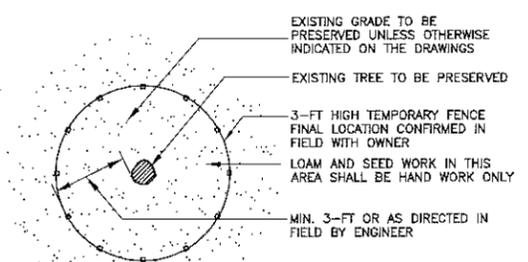
CATCH BASIN FILTER
 DETAIL 4
 NOT TO SCALE
 C-20
 NOTE:
 1. IN LAWN AREAS, USE MESH, WOOD FRAME BOX, AND CRUSHED STONE FOR INLET PROTECTION (NO BAG REQUIRED)
 2. IN PAVED AREAS, USE FILTER BAG FOR INLET PROTECTION (NO MESH, BOX STONE REQUIRED)



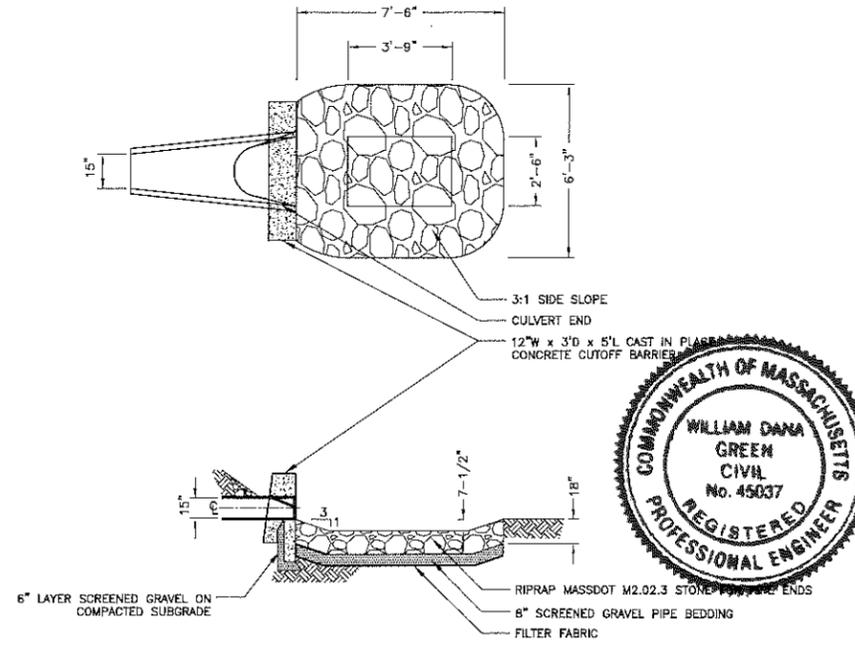
STABILIZED CONSTRUCTION ENTRANCE
 DETAIL 5
 NOT TO SCALE
 C-20
 NOTES:
 PROVIDE APPROPRIATE TRANSITION BETWEEN STABILIZED CONSTRUCTION ENTRANCE AND UNDISTURBED ROADWAY. LIMITS OF STABILIZED CONSTRUCTION ENTRANCE SHALL BE AS DIRECTED BY THE ENGINEER. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO UNDISTURBED ROADWAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDING STONE TO THE LENGTH OF THE ENTRANCE. REPAIR AND CLEANOUT MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO UNDISTURBED ROADWAY SHALL BE REMOVED AS DIRECTED BY THE ENGINEER.



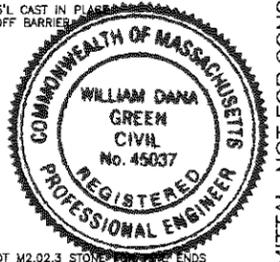
STEEL EDGING REMOVAL PLAN
 DETAIL 6
 NOT TO SCALE
 C-20



TREE PROTECTION
 DETAIL 7
 NOT TO SCALE
 C-20



PREFORMED STILLING BASIN
 DETAIL 8
 NTS
 C-20



REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.	C020STDT
DESIGNED BY:	J. OLCOTT
DRAWN BY:	J. HEIL
SHEET CHK'D BY:	
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE 2015

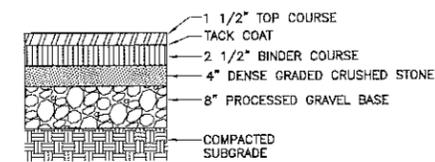
CDM Smith
 75 State Street, Suite 701
 Boston, MA 02109
 Tel: (617) 452-8000

GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

SITE DETAILS I
 PROJECT NO. 0291-105808
 Sht. X of XXX
 C-20
 Acc #

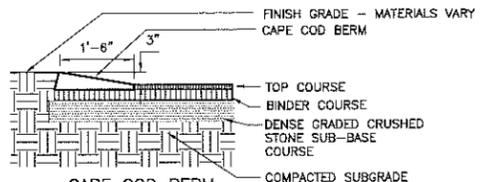
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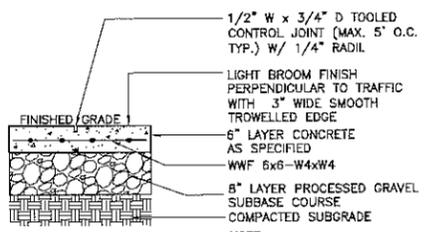


BIT. CONC. PAVEMENT
DETAIL 1
 NOT TO SCALE
 C-21

1.) BASE COURSE SHALL EXTEND 3" MIN. BEYOND EDGE OF PAVEMENT

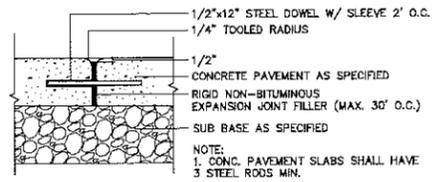


CAPE COD BERM
DETAIL 2
 NOT TO SCALE
 C-21



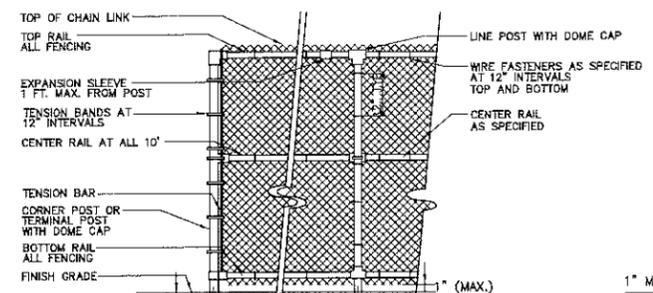
CONCRETE WALKWAY
DETAIL 3
 NOT TO SCALE
 C-21

NOTE: SEE DETAIL 1 THIS SHEET FOR EXPANSION JOINT.

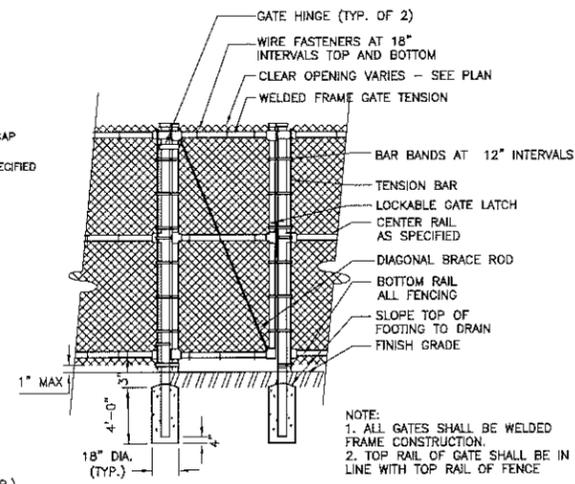


EXPANSION JOINT
DETAIL 4
 NOT TO SCALE
 C-21

NOTE:
 1. CONC. PAVEMENT SLABS SHALL HAVE 3 STEEL RODS MIN.
 2. EXPANSION JOINTS SHALL BE LOCATED 30 FT. MAX. O.C. AND AT THE END OF EACH DAYS POUR.
 3. LOCATE DOWELS MIN. 3-FT. O.C. WHERE CONC. IS PLACED UNDER DOORWAY THRESHOLDS

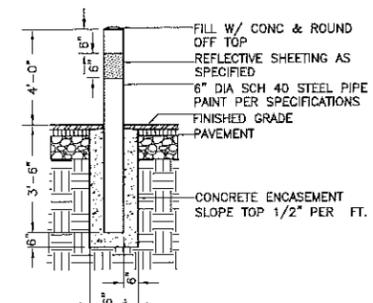


CHAIN LINK FENCE
DETAIL 5
 NOT TO SCALE
 C-21

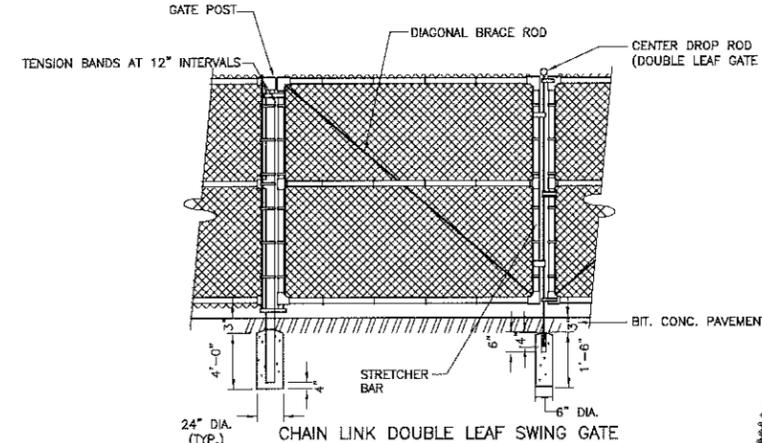


CHAIN LINK FENCE GATE
DETAIL 6
 NOT TO SCALE
 C-21

NOTE:
 1. ALL GATES SHALL BE WELDED FRAME CONSTRUCTION.
 2. TOP RAIL OF GATE SHALL BE IN LINE WITH TOP RAIL OF FENCE



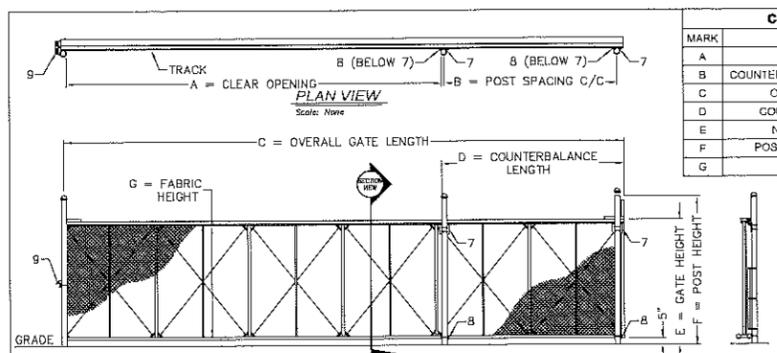
STEEL BOLLARD
DETAIL 8
 NOT TO SCALE
 C-21



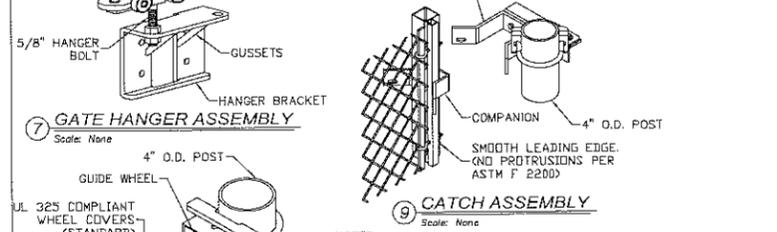
CHAIN LINK DOUBLE LEAF SWING GATE
DETAIL 9
 NOT TO SCALE
 C-21



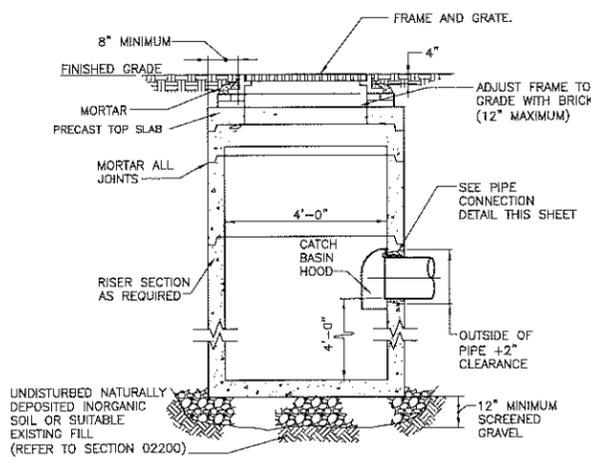
CRITICAL DIMENSION CHART			
MARK	DESCRIPTION	FORMULA	DIM.
A	CLEAR OPENING	A	30'
B	COUNTERBALANCE POST SPACING C/C	(A/2)-11"	-
C	OVERALL GATE LENGTH	A x 1.5	-
D	COUNTERBALANCE LENGTH	A x 0.5	-
E	NOMINAL GATE HEIGHT	E	-
F	POST HEIGHT (W BARB ARMS)	E + 1'-0"	-
G	FABRIC HEIGHT	E - 1'-0"	-



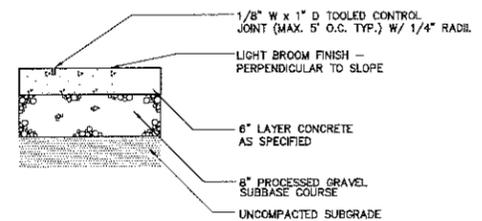
SINGLE LEAF MANUAL SLIDING CANTILEVER GATE
DETAIL 7
 NOT TO SCALE
 C-21



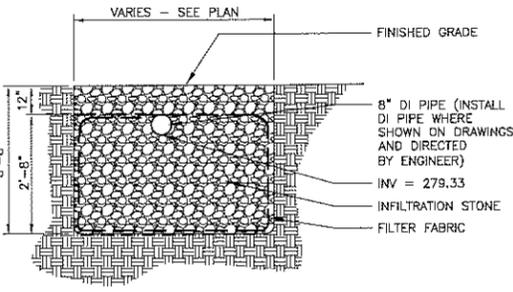
NOTES:
 1. ALL FITTINGS STANDARDLY PROVIDED FOR 4" O.D. POSTS. OTHER SIZES AVAILABLE UPON REQUEST.
 2. FURNISH AND INSTALL KNOX BOX (OR EQUAL) ONTO GATE POST AS DIRECTED BY FIRE DEPT. OR OWNER'S REPRESENTATIVE - SEE SPECIFICATIONS.



TYPICAL PRECAST CONCRETE CATCH BASIN WITH GRATE
DETAIL 10
 SCALE: NTS
 C-21



PERVIOUS CONCRETE PAVEMENT
DETAIL 11
 NOT TO SCALE
 C-21



GRAVEL INFILTRATION TRENCH
DETAIL 12
 SCALE: NTS
 C-21

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REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.	C021STD1
DESIGNED BY:	J.OLCOTT
DRAWN BY:	J.HELL
SHEET CHK'D BY:	
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE 2015

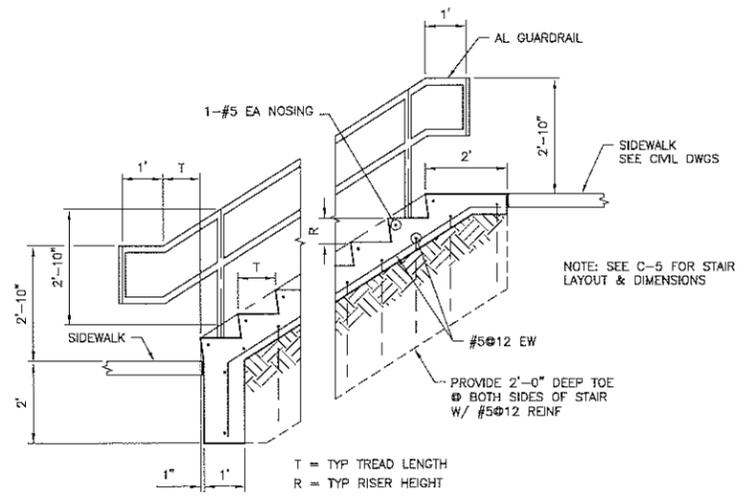
CDM Smith
 75 State Street, Suite 701
 Boston, MA 02109
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GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

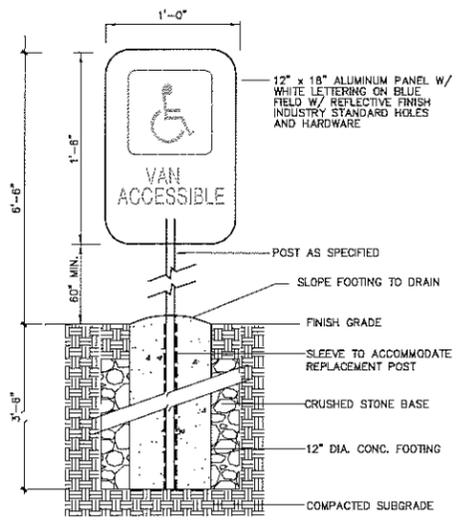
SITE DETAILS II

PROJECT NO.
0291-105808
 Sht. X of XXX
C-21
 Acc #

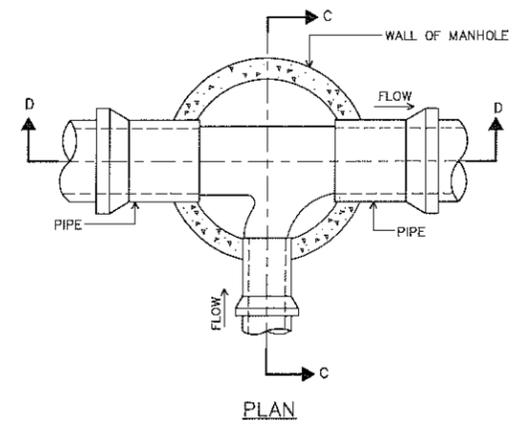
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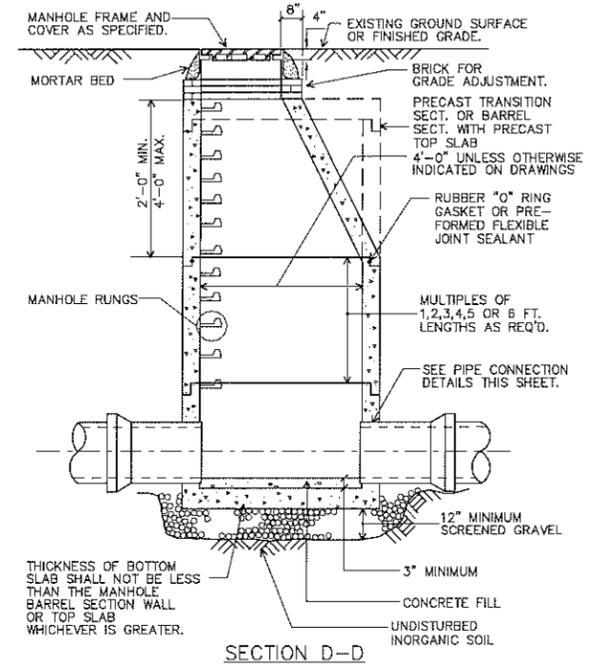
STAIR ON GRADE
 DETAIL 1
 MTS C-22



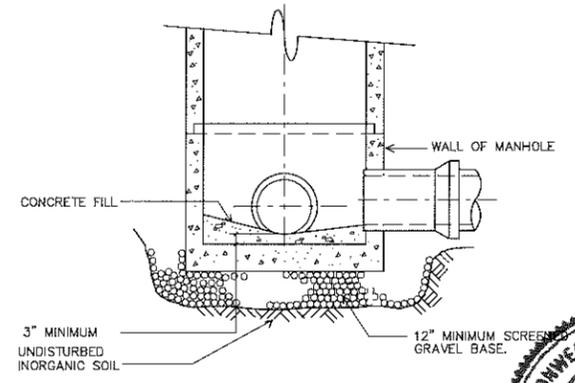
VAN ACCESSIBLE PARKING SIGN
 DETAIL 2
 NOT TO SCALE C-22



PLAN



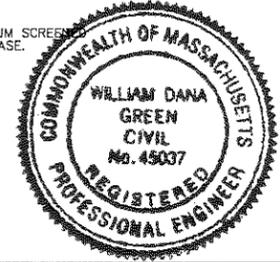
SECTION D-D



SECTION C-C

TYPICAL PRECAST DRAIN MANHOLE

DETAIL 3
 NO SCALE C-22



REV. NO.	DATE	DRWN	CHKD	REMARKS

DADD FILE NO.	C021STD1
DESIGNED BY:	J. OLCOTT
DRAWN BY:	R. FOGG
SHEET CHK'D BY:	
CROSS CHK'D BY:	
SCALE:	AS NOTED
APPROVED BY:	
DATE:	JUNE, 2013



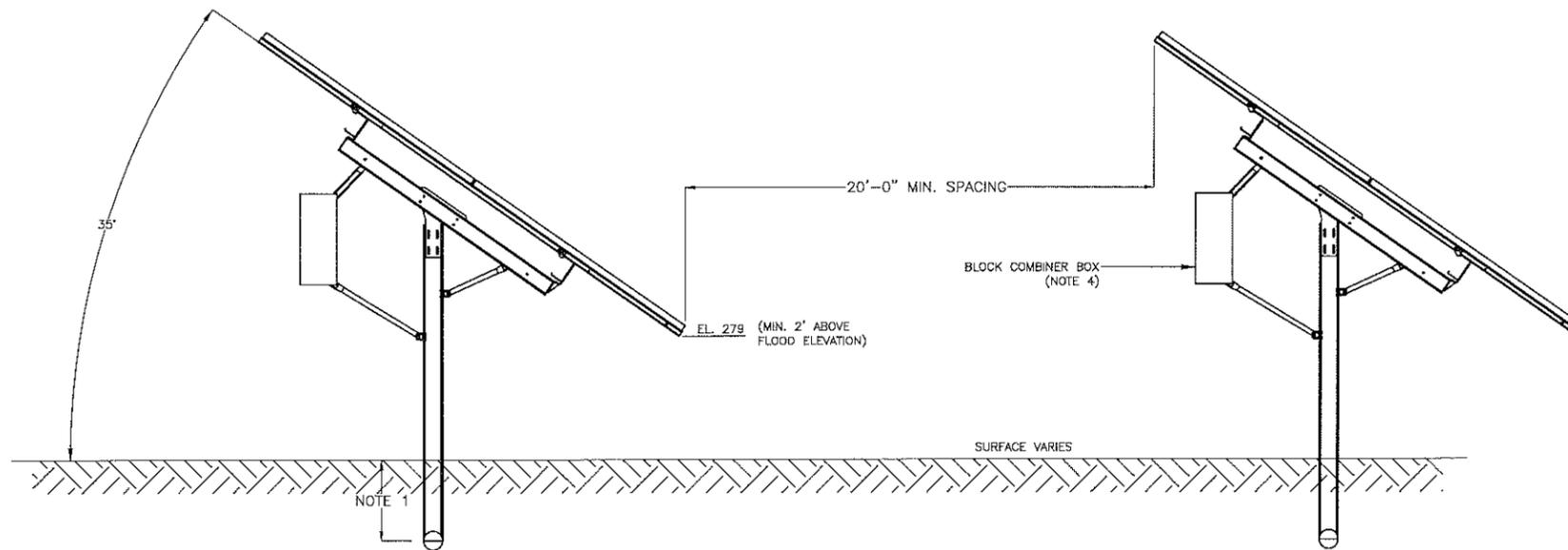
GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
 GRAFTON WASTEWATER TREATMENT PLANT
 IMPROVEMENTS

SITE DETAILS III

PROJECT NO.
 0291-105808
 Sht. X of XXX
 C-22
 Acc #

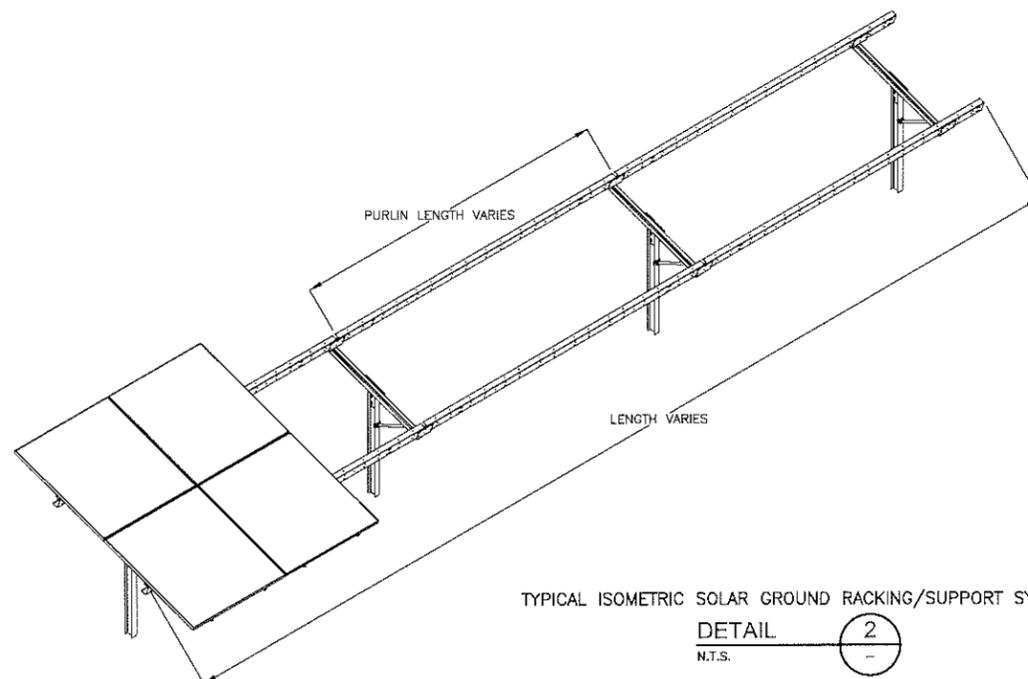
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SIDE VIEW - TYPICAL RACKING

DETAIL 1
N.T.S.

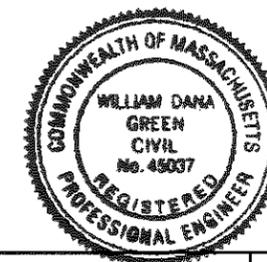


TYPICAL ISOMETRIC SOLAR GROUND RACKING/SUPPORT SYSTEM

DETAIL 2
N.T.S.

NOTES:

1. DRIVEN DEPTH OF RACKING SYSTEM POST SHALL BE AS REQUIRED BY THE MANUFACTURER PULL TESTING AND ANALYSIS OF GEOTECHNICAL DATA. THE MANUFACTURER OF THE SYSTEM SHALL SUBMIT DESIGN DRAWINGS STAMPED BY A REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF MASSACHUSETTS AS A CONSTRUCTION SHOP SUBMITTAL.
2. THE DETAIL OF THE SOLAR GROUND RACKING SYSTEM ON THIS SHEET IS REPRESENTATIVE OF THE SYSTEM TO BE PROVIDED. IT IS THE RESPONSIBILITY OF THE SOLAR GROUND RACKING SYSTEM MANUFACTURER SELECTED TO SUBMIT DETAILED STRUCTURAL PLANS STAMPED AND APPROVED BY A REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF MASSACHUSETTS.
3. THE LEADING EDGE OF THE SOLAR PANEL SHALL BE AT ELEVATION 279.
4. BLOCK COMBINER BOXES SHALL BE MOUNTED ABOVE ELEVATION 279 TO AVOID FLOODING. IF ADEQUATE CLEARANCE CANNOT BE MAINTAINED THEN THE COMBINER BOX SHALL BE STANCHION MOUNTED UNDER THE ARRAY.
5. CORROSION ANALYSIS/CONSIDERATIONS FOR RACKING SYSTEM POSTS SHALL BE ADDRESSED IN CONSTRUCTION AS A DEFERRED SUBMITTAL. IF THE SUBMITTED ANALYSIS RECOMMENDS CATHODIC PROTECTION THE CONTRACTOR SHALL SUBMIT DETAILED PLANS AND DETAILS FOR THE CATHODIC PROTECTION SYSTEM FOR APPROVAL.



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REV. NO.	DATE	DRWN	CHKD	REMARKS

CADD FILE NO.	E0565DDT
DESIGNED BY:	X
DRAWN BY:	D. HASBROUCK
SHEET CHK'D BY:	X
CROSS CHK'D BY:	X
SCALE:	AS NOTED
APPROVED BY:	X
DATE:	JUNE 2015



GRAFTON, MASSACHUSETTS
 CONTRACT No. 21
 CWSRF 3990
 GRAFTON WASTEWATER TREATMENT PLANT
 IMPROVEMENTS

ELECTRICAL
 MISCELLANEOUS DETAILS IV

PROJECT NO.
 0291-105808
 Sht. X of XXX
 SD-E-04
 Acc #

Attachment E
Abutters Information

Attachment F
**Request for Waiver of Requirement for Certificate of
Good Standing**



75 State Street, Suite 701
Boston, Massachusetts 02109
tel: 617 452-6000
fax: 617 345-3901

June 16, 2015

Planning Board
Grafton Memorial Municipal Center
30 Providence Road
Grafton, Massachusetts 01519

Subject: List or Requested Waivers for Site Plan Approval and Special Permit Application:
Grafton Wastewater Treatment Plant (WWTP) Improvements
Applicant: Town of Grafton, Sewer Department

Dear Planning Board Members:

It is our understanding that, as the Grafton Wastewater Treatment Plant (WWTP) Improvements project is a Town project, certain application materials are not necessary. For that reason, on behalf of the Town of Grafton Sewer Department, we are requesting a waiver to the requirement for a Certificate of Good Standing. Please call me at (617) 452-6784 or William Dana Green, P.E. at (617) 452- 6639 if you have any questions.

Very truly yours,

Alexandra H. Kleyman, AICP
Planner
CDM Smith Inc.



Attachment G
Stormwater Report

Grafton Wastewater Treatment Plant Upgrade

Stormwater Management Report

1.0 Existing Conditions

The Town of Grafton owns and operates the Grafton Wastewater Treatment Plant (WWTP). The existing facility was designed in 1975, constructed in the late 1970s, and placed on line in 1979. Stormwater runoff from the treatment plant discharges to the Blackstone River. Wetlands are located to the west, south and east of the WWTP. Primary facilities at the WWTP include two secondary clarifiers, two aeration tanks, two thickeners, a process and control building, and a parking lot with an access drive with approximately 2.8 acres. The total site has approximately 28,000 sf (0.64 acres) of impervious area. Topographic mapping indicates the site is crowned in a northeast to southwest direction; stormwater runoff sheet flows off the site in an easterly and westerly direction. The process and control building has two roof drains that connect to two subsurface drainage systems that discharge to the wetlands on the eastern side of the site. One catch basin, located in a vegetated area, connects to the northern drainage system. Most of the area around the buildings and structures is covered in hard-packed gravel, with some landscaping around the eastern side and woods along the northern side of the process and control building. Figure 1 shows the existing conditions drainage area map.

2.0 Proposed Conditions

Under proposed conditions, several structures will be constructed, including a third secondary clarifier, a third aeration tank, a D-box and flume, a disinfection and phosphorus removal building, and a generator pad. A bypass structure will also be added to the process and control building. Most of these structures are open tanks, or will be located in areas where there is currently a paved surface. Therefore, these proposed improvements will not increase the impervious area at the WWTP. In addition, a solar PV array system will be installed partially in the floodplain to provide power to the WWTP.

The proposed upgrades at the WWTP also include several low impact development measures that will enhance stormwater management at the site. The subsurface drainage system that conveys roof runoff from the southern roof drain will be removed as part of the construction for the disinfection and phosphorus removal buildings and the southern roof drain will be redirected to a gravel infiltration trench. A portion of the disinfection and phosphorus building will have an extensive green roof. A pervious concrete ADA-compliant ramp will be installed at the entrance to the process and control building. A new closed drainage system with deep-sump hood catch basins will be installed in the parking lot and the existing northeastern outfall will be replaced with a flared end that discharges to a stilling basin. Lastly, the hard-packed gravel that currently surrounds most of the structures on the site will be replaced with loam and seed.

Overall, these proposed upgrades at the WWTP will not change existing hydraulic patterns at the site. Because the WWTP is currently developed and there is no increase in impervious area, this project

qualifies as a redevelopment project under the *Massachusetts Stormwater Handbook*. Figure 2 shows the proposed conditions drainage area map.

3.0 Drainage Analysis

CDM Smith performed drainage analyses for the Grafton WWTP for existing and proposed conditions. The drainage analyses determined peak rates of runoff and runoff volumes during 2-, 10-, 25-, and 100-year, 24-hour storm events using HydroCAD, version 10.0. This computer model simulates stormwater runoff flows through drainage areas and stormwater management facilities, and is based on the Soil Conservation Service (SCS) Method.

Following is a summary of the methodology used to perform the drainage analyses.

- Precipitation data for standard storms used in the models were taken from the website, *An Interactive Web Tool for Extreme Precipitation Events* (<http://precip.eas.cornell.edu/>) produced by the Northeast Regional Climate Center (NRCC) at Cornell University. The estimated precipitation depths during the 2-, 10-, 25-, and 100-year 24-hour storms are 3.24, 4.88, 6.18, and 8.84 inches, respectively (see Appendix A). Compared to rainfall depths in Technical Paper No. 40 (*Rainfall Frequency Atlas of the United States*), the rainfall depths from the NRCC are higher for storms greater than a 10-year, 24-hour storm, and provide a more conservative evaluation and design of existing and proposed stormwater management facilities, as well as a factor of safety for potential climate change.
- The Natural Resources Conservation Service's (NRCS) Web Soil Survey was consulted to determine the hydrologic soil groups (HSG) for the WWTP. The NRCS has classified approximately two-thirds of the soils as "Pootatuck fine sandy loam," with the remaining soils mostly as "Udorthents" and a small area as "Hinckley sandy loam." The Pootatuck and Udorthent soils belong to HSG "B", while the Hinckley soils belong to HSG "A." In addition, in August 2014, CDM Smith conducted a subsurface exploration program of the site. The borings and one monitoring well found that depth to groundwater ranged from 6 to 9 ft. Soils information pertaining to the study area is presented in Appendix B.
- The project site was divided into two subwatersheds, with surface runoff generally flowing in an easterly or westerly direction, as shown on Figures 1 and 2. In determining the subwatershed areas, open surfaces (e.g., aeration tanks) were subtracted from the contributory area.
- Curve Numbers (CNs) for the different land uses on the site were selected based on HSG "B" and "A" soils. Land uses included woods, grass cover, gravel, green roof, pervious concrete, and paved areas. Weighted CNs for each subdrainage area were calculated in HydroCAD.
- Times of concentration (Tc) were calculated in HydroCAD and were based on "Figure 15.4 – Velocities versus Slope Shallow Concentrated Flow" in the NRCS National Engineering Handbook (May 2010). A minimum Tc of 15 minutes was used for all drainage areas.

HydroCAD was used to generate peak rates of runoff and runoff volumes for existing and proposed conditions. Table 3-1 provides a summary of modeling results for existing and proposed conditions. As this table shows, peak rates of runoff and runoff volumes for proposed conditions are less than

existing conditions for all storm events. This reduction is due to the addition of open tanks, the conversion of the gravel area to grass, and no increase in impervious area. The HydroCAD modeling input and output can be found in Appendix C.

Table 3-1
Grafton Wastewater Treatment Plant Upgrade, Grafton, MA
Summary of HydroCAD Modeling at Blackstone River

Storm Event	Existing		Proposed	
	Peak Flow Rate (cfs)	Runoff Volume (ac-ft)	Peak Flow Rate (cfs)	Runoff Volume (ac-ft)
2-Year	2.5	0.24	1.7	0.18
10-Year	5.2	0.49	4.0	0.39
25-Year	7.5	0.71	6.0	0.57
100-Year	12.4	1.18	10.4	0.99

The site was also analyzed for compliance with the recharge (Rv) and water quality volume (WQv) requirements in the *Massachusetts Stormwater Handbook*. Since all the soils under the impervious surfaces are HSG “B” soils, the target depth factor for recharge is 0.35 inches. The required water quality volume is 0.5 inches times the total impervious area. Since this site is currently developed and there is no increase in impervious area, the project is a redevelopment project and is required to meet the infiltration and water quality requirements to the maximum extent practicable.

Because of the extensive subsurface piping and the limited open area around the buildings, infiltration is possible in only two areas: roof runoff from approximately half of the process and control building into a gravel infiltration trench near the building and stormwater runoff from the pervious concrete ADA-compliant ramp. The closest borings to these areas are borings CDM-8 and CDM-9. The soils in these borings are classified as silty sand with a depth to groundwater of approximately 9 ft. For silty sand, an infiltration rate of 0.52 inches/hour was assumed. The gravel trench was designed to infiltrate the required recharge volume from the roof area tributary to the roof drain. The pervious concrete was sized to infiltrate the water quality volume. The “Simple Dynamic Method,” as presented in the *Massachusetts Stormwater Handbook*, was used in HydroCAD to demonstrate that proposed gravel infiltration trench and pervious concrete have sufficient capacity to meet the required recharge and water quality volumes. The drawdown time of the water in these facilities was calculated and found to infiltrate within the required 72 hours.

Providing the full 80 percent total suspended solids (TSS) removal for the total water quality volume at the WWTP is not feasible, given the site constraints. At the parking lot, pretreatment of stormwater runoff is provided prior to discharge to the Blackstone River through the use of deep-sump hooded catch basins for all of the catch basins in the parking lot. The deep-sump hooded catch basins will provide 25 percent TSS removal. In addition, the existing outfall downstream of the parking lot drainage system is being replaced with a new outfall that will discharge to a small stilling basin, which will provide some additional TSS removal prior to final discharge into the buffer zone. The pervious concrete will provide 80 percent TSS removal for the impervious areas tributary to it. Because the

gravel infiltration trench cannot be sized to treat the entire WQv for the roof area, it will provide only partial TSS removal for the roof area tributary to it. However, that portion of the roof runoff that is infiltrated in the gravel trench will receive 80 percent TSS removal. The green roof does not provide any TSS removal credits; however it does reduce the required WQv for the site.

Table 3-2 summarizes the total impervious area, required recharge volume, required water quality volume, and treatment/infiltration volumes provided at the WWTP. Appendix D provides the recharge volume and water quality volume calculations. The TSS worksheets for the deep-sump hooded catch basins, pervious concrete, and gravel infiltration trench are provided in Appendix E.

**Table 3-2
Summary of Total Impervious Area, Rv and WQv
Grafton Wastewater Treatment Plant**

<i>Metric</i>	<i>Required</i>	<i>Provided</i>
Total Impervious Area (sf)	28,030	28,030
Recharge Volume (cf)	884	145
Water Quality Volume (cf)	1,151	145*

*Infiltration at gravel trench and pervious concrete ADA-compliant ramp only.

4.0 Compliance with Stormwater Standards

Under the *Massachusetts Stormwater Handbook*, the project is considered a redevelopment project because it is a redevelopment of an existing site without an increase in impervious area. Hence, stormwater management standards addressing peak flow attenuation, groundwater recharge, and TSS removal must be met only to the maximum extent practicable; the remaining standards must be fully met. The following summary below describes compliance with each of the stormwater standards. The Stormwater Checklist is provided at the end of this section.

4.1 Stormwater Standard No. 1

The proposed project fully meets the requirement of Stormwater Standard No. 1, as there are no new untreated discharges at the Grafton WWTP. Stormwater runoff from the parking lot will receive pretreatment through the use of deep-sump hooded catch basins. This closed drainage system will discharge to a new outfall that will replace the existing northeastern outfall. The new outfall will discharge to a stilling basin that will provide additional treatment.

4.2 Stormwater Standard No. 2

As shown on Table 3-1, peak flow rates and runoff volumes for proposed conditions are less than or equal to those for existing conditions. This reduction is due to the addition of open tanks, the conversion of the gravel area to grass, and no increase in impervious area.

4.3 Stormwater Standard No. 3

Recharge to groundwater is partially met by providing a gravel trench to infiltrate roof runoff from a portion of the Administration Building and pervious concrete for the ADA-compliant ramp. Since the soils are HSG “B” soils, the target depth factor for recharge is 0.35 inches. However, pervious concrete ADA-compliant ramp was designed to infiltrate the water quality volume, which is based on 0.5 inches

times the impervious area. The “Simple Dynamic Method” was used to demonstrate that proposed gravel trench and pervious concrete have sufficient capacity. Calculations also demonstrate that the infiltration facilities will drain within 72 hours.

4.4 Stormwater Standard No. 4

This standard is partially met. Deep-sump catch basins will be installed in the parking lot to provide pretreatment and provide 25 percent TSS removal. The stilling basin will provide additional treatment. The pervious pavement provides the full 80 percent TSS removal. The gravel infiltration trench will provide 80 percent TSS for the water it infiltrates. The TSS removal worksheets are provided in Appendix E.

4.5 Stormwater Standard No. 5

This standard is not applicable to this project. There are no LUHPPLs in the project area.

4.6 Stormwater Standard No. 6

This standard is not applicable to this project. There are no critical areas within the project area.

4.7 Stormwater Standard No. 7

This is a redevelopment project. As such, this project is meeting Standard 2 and meeting Standards 3 and 4 to the maximum extent practicable.

4.8 Stormwater Standard No. 8

The project is subject to a NPDES General Construction Permit, which will be obtained by the Contractor. A copy of the Stormwater Pollution Prevention Plan (SWPPP) will be submitted by the Contractor prior to construction.

4.9 Stormwater Standard No. 9

An Operation and Maintenance Plan and Long-Term Pollution Prevention Plan are included with this submittal in Appendix F.

4.10 Stormwater Standard No. 10

The proposed project fully meets the requirement of Stormwater Standard No. 10 as there are no illicit discharges.

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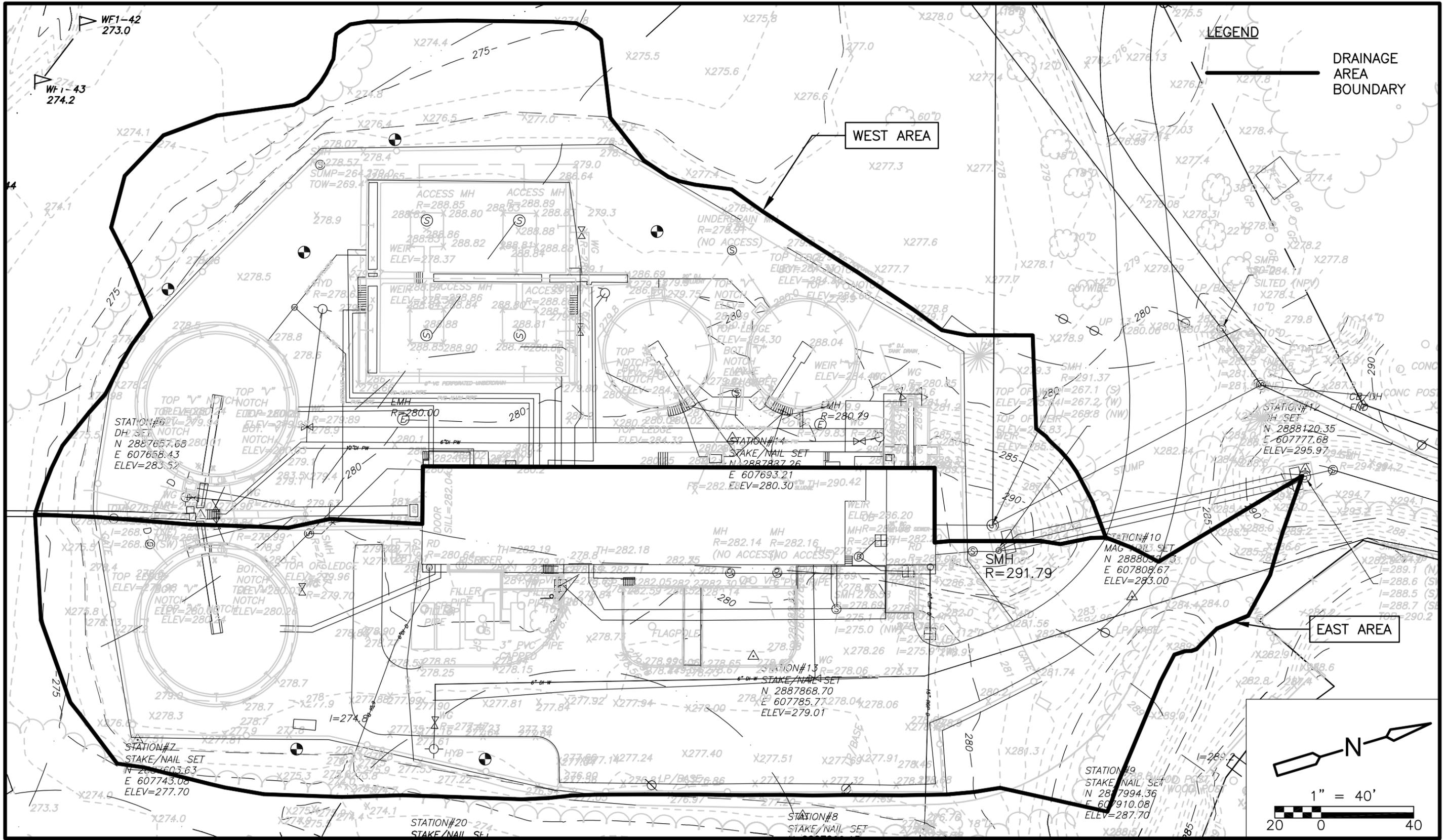


Figure No. 1
EXISTING DRAINAGE MAP
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS
APR 2015

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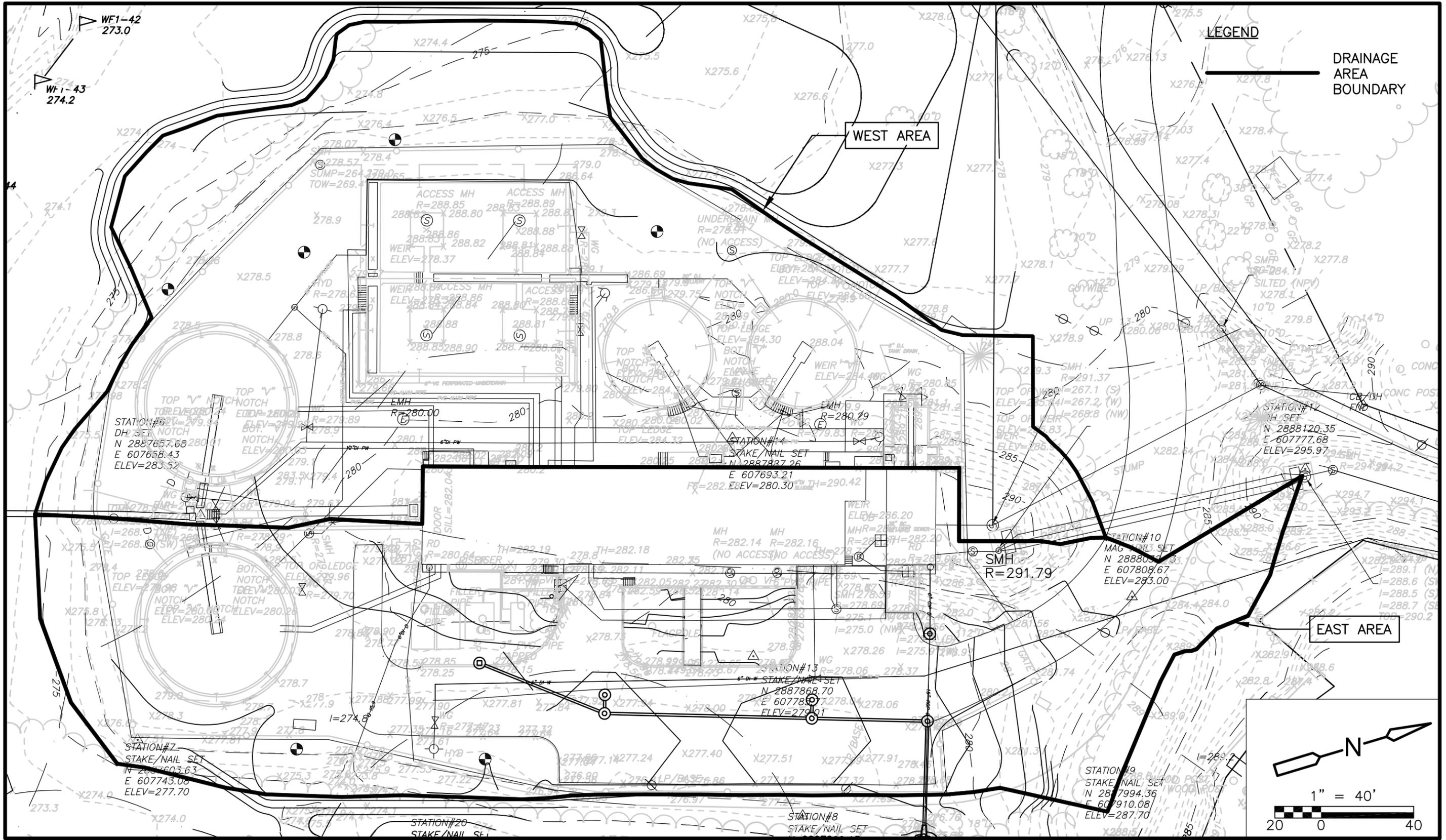


Figure No. 2
PROPOSED DRAINAGE MAP
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS
APR 2015

Stormwater Checklist



Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

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



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

Standard 3: Recharge

Maximum extent practicable.

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

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

Standard 4: Water Quality Maximum extent practicable.

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

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



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs) Not applicable.

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

Standard 6: Critical Areas Not applicable.

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



Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 9: Operation and Maintenance Plan

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

Standard 10: Prohibition of Illicit Discharges

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

Appendix A

Rainfall Data

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	71.686 degrees West
Latitude	42.207 degrees North
Elevation	Unknown/Unavailable
Date/Time	Thu, 07 Aug 2014 15:32:25 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.54	0.70	0.88	1.11	1yr	0.76	1.07	1.29	1.63	2.08	2.65	2.90	1yr	2.35	2.79	3.20	3.88	4.48	1yr
2yr	0.35	0.54	0.67	0.88	1.11	1.40	2yr	0.96	1.28	1.62	2.04	2.57	3.24	3.51	2yr	2.87	3.38	3.88	4.60	5.23	2yr
5yr	0.41	0.64	0.81	1.08	1.38	1.76	5yr	1.19	1.59	2.05	2.58	3.25	4.09	4.47	5yr	3.62	4.30	4.93	5.78	6.48	5yr
10yr	0.46	0.73	0.92	1.25	1.63	2.10	10yr	1.41	1.88	2.45	3.10	3.90	4.88	5.37	10yr	4.32	5.16	5.91	6.88	7.63	10yr
25yr	0.55	0.87	1.11	1.53	2.02	2.63	25yr	1.75	2.33	3.08	3.91	4.94	6.18	6.84	25yr	5.47	6.58	7.51	8.65	9.47	25yr
50yr	0.61	0.99	1.27	1.78	2.39	3.14	50yr	2.07	2.75	3.70	4.71	5.92	7.39	8.22	50yr	6.54	7.91	9.02	10.30	11.15	50yr
100yr	0.71	1.14	1.47	2.08	2.83	3.74	100yr	2.44	3.25	4.41	5.62	7.08	8.84	9.89	100yr	7.82	9.51	10.82	12.26	13.14	100yr
200yr	0.80	1.31	1.69	2.43	3.35	4.45	200yr	2.89	3.83	5.27	6.74	8.48	10.57	11.90	200yr	9.36	11.44	12.99	14.60	15.48	200yr
500yr	0.96	1.58	2.06	2.99	4.19	5.62	500yr	3.61	4.78	6.67	8.54	10.77	13.42	15.21	500yr	11.87	14.63	16.56	18.41	19.24	500yr

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.22	0.34	0.41	0.55	0.68	0.95	1yr	0.59	0.93	1.10	1.44	1.88	2.45	2.65	1yr	2.17	2.55	2.71	3.49	4.17	1yr
2yr	0.34	0.53	0.65	0.88	1.08	1.27	2yr	0.93	1.24	1.45	1.90	2.44	3.15	3.41	2yr	2.79	3.28	3.77	4.44	5.07	2yr
5yr	0.38	0.59	0.74	1.01	1.28	1.51	5yr	1.11	1.48	1.72	2.25	2.86	3.77	4.15	5yr	3.34	3.99	4.58	5.29	5.99	5yr
10yr	0.42	0.65	0.81	1.13	1.46	1.72	10yr	1.26	1.68	1.95	2.55	3.23	4.32	4.81	10yr	3.83	4.62	5.31	6.01	6.78	10yr
25yr	0.49	0.75	0.93	1.33	1.75	2.05	25yr	1.51	2.00	2.31	3.02	3.79	5.19	5.85	25yr	4.59	5.62	6.47	7.08	7.97	25yr
50yr	0.54	0.83	1.03	1.48	2.00	2.33	50yr	1.72	2.28	2.63	3.43	4.28	5.95	6.82	50yr	5.27	6.56	7.54	8.01	9.03	50yr
100yr	0.61	0.92	1.15	1.67	2.29	2.65	100yr	1.97	2.59	2.99	3.90	4.85	6.84	7.97	100yr	6.06	7.66	8.82	9.09	10.23	100yr
200yr	0.68	1.02	1.29	1.87	2.61	3.04	200yr	2.25	2.97	3.40	4.45	5.50	7.86	9.31	200yr	6.96	8.95	10.31	10.28	11.61	200yr
500yr	0.79	1.17	1.51	2.19	3.12	3.62	500yr	2.69	3.54	4.03	5.31	6.52	9.50	11.51	500yr	8.40	11.07	12.74	12.06	13.74	500yr

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.32	0.49	0.59	0.80	0.98	1.19	1yr	0.85	1.17	1.38	1.76	2.30	2.95	3.24	1yr	2.61	3.12	3.51	4.26	4.82	1yr
2yr	0.36	0.56	0.69	0.93	1.15	1.35	2yr	0.99	1.32	1.55	2.02	2.59	3.37	3.66	2yr	2.99	3.52	4.03	4.80	5.43	2yr
5yr	0.44	0.68	0.85	1.17	1.48	1.77	5yr	1.28	1.73	2.02	2.60	3.27	4.39	4.82	5yr	3.89	4.63	5.29	6.27	7.01	5yr
10yr	0.52	0.80	1.00	1.39	1.80	2.16	10yr	1.55	2.11	2.47	3.13	3.90	5.38	5.97	10yr	4.76	5.74	6.52	7.71	8.54	10yr
25yr	0.65	1.00	1.24	1.77	2.33	2.82	25yr	2.01	2.76	3.21	4.00	4.95	7.07	7.90	25yr	6.25	7.60	8.56	10.16	11.08	25yr
50yr	0.77	1.18	1.47	2.11	2.84	3.45	50yr	2.45	3.37	3.93	4.83	5.91	8.67	9.76	50yr	7.67	9.38	10.52	12.52	13.51	50yr
100yr	0.92	1.39	1.75	2.52	3.46	4.23	100yr	2.99	4.13	4.80	5.83	7.07	10.63	12.06	100yr	9.40	11.60	12.93	15.44	16.48	100yr
200yr	1.10	1.65	2.09	3.03	4.22	5.18	200yr	3.64	5.07	5.89	7.03	8.44	13.03	14.89	200yr	11.53	14.31	15.88	19.06	20.02	200yr
500yr	1.39	2.07	2.66	3.86	5.49	6.79	500yr	4.74	6.64	7.70	9.01	10.68	17.05	19.65	500yr	15.09	18.89	20.82	25.18	25.98	500yr



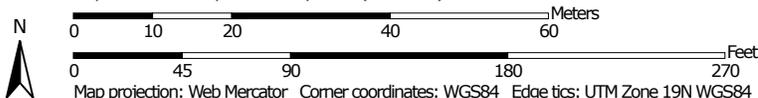
Appendix B

Geotechnical Information

Soil Map—Worcester County, Massachusetts, Southern Part
(Grafton WWTP Improvements)



Map Scale: 1:950 if printed on A portrait (8.5" x 11") sheet.



Soil Map—Worcester County, Massachusetts, Southern Part
(Grafton WWTP Improvements)

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part

Survey Area Data: Version 6, Dec 17, 2013

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

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

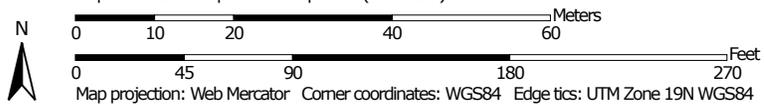
Map Unit Legend

Worcester County, Massachusetts, Southern Part (MA615)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2A	Pootatuck fine sandy loam, 0 to 3 percent slopes	1.7	63.4%
245B	Hinckley sandy loam, 3 to 8 percent slopes	0.3	9.8%
651	Udorthents, smoothed	0.7	26.8%
Totals for Area of Interest		2.7	100.0%

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part
(Grafton WWTP Improvements)



Map Scale: 1:950 if printed on A portrait (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part

Survey Area Data: Version 6, Dec 17, 2013

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Worcester County, Massachusetts, Southern Part (MA615)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2A	Pootatuck fine sandy loam, 0 to 3 percent slopes	B	1.7	63.4%
245B	Hinckley sandy loam, 3 to 8 percent slopes	A	0.3	9.8%
651	Udorthents, smoothed	B	0.7	26.8%
Totals for Area of Interest			2.7	100.0%

Description

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

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

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

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

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

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

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

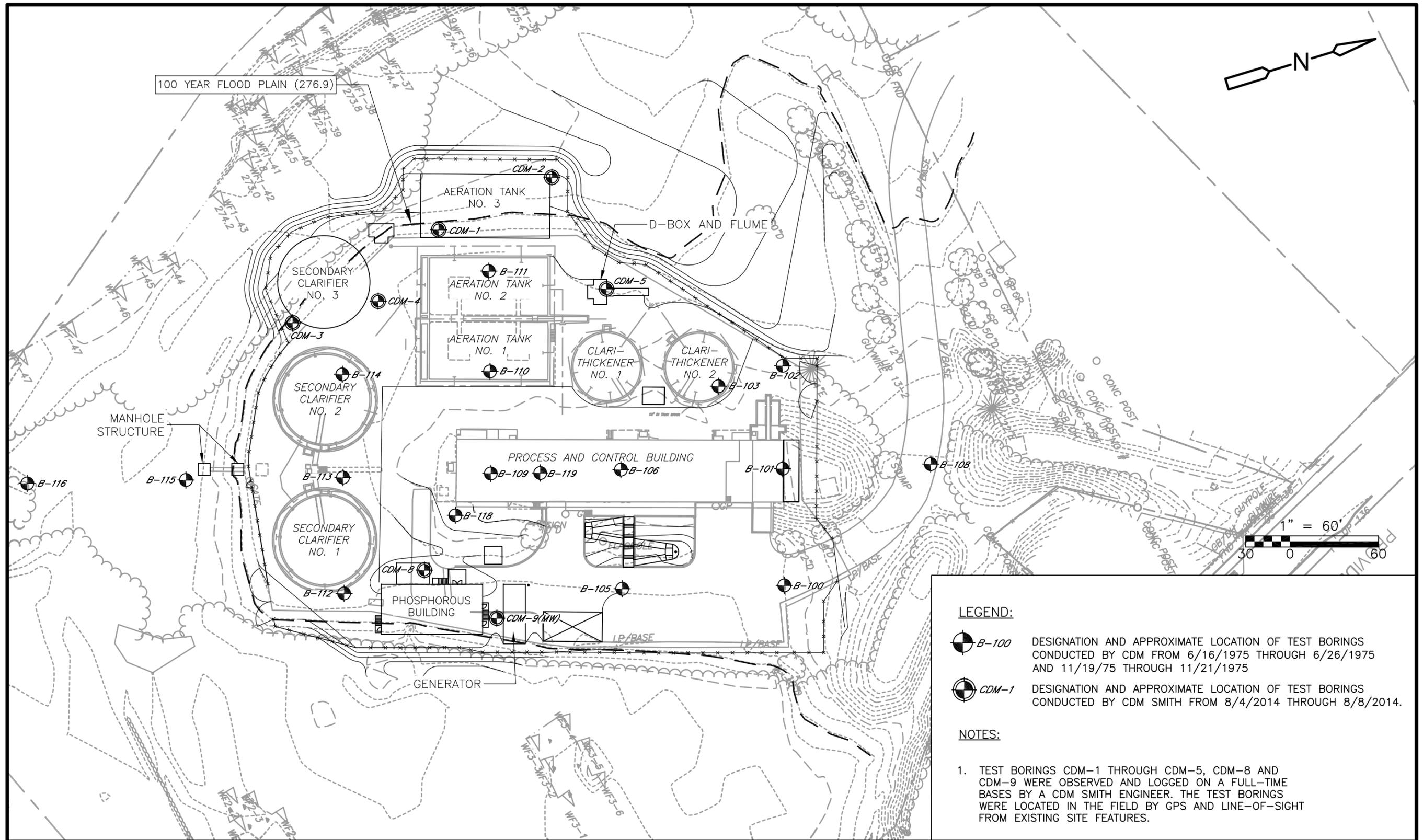
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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LEGEND:

-  B-100 DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS CONDUCTED BY CDM FROM 6/16/1975 THROUGH 6/26/1975 AND 11/19/75 THROUGH 11/21/1975
-  CDM-1 DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS CONDUCTED BY CDM SMITH FROM 8/4/2014 THROUGH 8/8/2014.

NOTES:

1. TEST BORINGS CDM-1 THROUGH CDM-5, CDM-8 AND CDM-9 WERE OBSERVED AND LOGGED ON A FULL-TIME BASES BY A CDM SMITH ENGINEER. THE TEST BORINGS WERE LOCATED IN THE FIELD BY GPS AND LINE-OF-SIGHT FROM EXISTING SITE FEATURES.



GRAFTON, MASSACHUSETTS
GRAFTON WASTEWATER TREATMENT PLANT IMPROVEMENTS

EXISTING AND PROPOSED STRUCTURES
 PREVIOUS AND RECENT BORING LOCATIONS
 FIGURE 1

Town of Grafton
Wastewater Treatment Plant Improvements
Grafton, Massachusetts

Table 1
Summary of Geotechnical Laboratory Test Results

Exploration Number	Sample Number	Sample Depth (ft)	Strata	USCS Classification ⁽¹⁾	Grain Size Analysis ⁽²⁾						Moisture Content (%) ⁽³⁾	
					Gravel (%)		Sand (%)			Fines (%)		
					Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
CDM-1	S-2	2-4	Fill	SM	0.0	40.0	7.1	13.5	22.9	16.5		6.6
CDM-1	S-8	14-16	Silt and Sand	SM	0.0	0.0	0.2	0.3	55.7	43.3	0.5	25.7
CDM-1	S-11	24-26	Silt and Sand	ML	0.0	0.0	0.0	0.1	47.5	52.4		25.4
CDM-2	S-7	12-14	Sand and Gravel	SM	0.0	30.4	11.4	13.5	25.0	19.7		18.0
CDM-2	S-10	19-21	Silt and Sand	ML	0.0	0.3	0.3	0.3	23.3	75.4	0.4	27.9
CDM-3	S-6	10-12	Sand	SP-SM	0.0	40.2	16.8	18.4	19.3	5.3		9.9
CDM-3	S-12	29-31	Silt and Sand	ML	0.0	0.0	0.0	0.0	15.7	77.0	7.3	20.7
CDM-3	S-14	39-41	Silt and Sand	SM	0.0	34.2	10.8	14.4	18.5	22.1		9.6
CDM-4	S-6	10-12	Sand	SM	0.0	6.7	3.6	3.3	61.3	25.1		19.9
CDM-4	S-8	14-16	Silt and Sand	SM	0.0	10.8	0.6	0.3	68.1	20.2		24.1
CDM-4	S-12	34-36	Silt and Sand	ML	0.0	0.0	0.0	0.1	45.3	54.2	0.4	23.7
CDM-4	S-14	44-46	Gravel	SW-SM	0.0	13.7	39.9	28.9	12.0	5.5		13.6
CDM-5	S-2	2-4	Fill	GW-GM	0.0	46.1	14.7	13.4	14.8	11.0		13.3
CDM-5	S-5	8-10	Sand and Gravel	SW-SM	0.0	26.2	12.8	29.9	19.5	11.6		8.6
CDM-5	S-8	14-16	Sand and Gravel	SP-SM	0.0	32.6	13.7	29.4	18.1	6.2		10.9
CDM-8	S-5	8-10	Sand	SM	0.0	9.0	3.2	7.4	52.4	28.0		19.4
CDM-8	S-10	19-21	Sand	SM	0.0	0.7	0.0	0.1	68.0	31.2		30.6
CDM-8	S-12	29-31	Sand	SM	0.0	0.0	0.0	0.1	55.7	44.2		25.1
CDM-9(MW)	S-4B	6-8	Sand	SM	0.0	5.6	4.3	20.0	34.6	33.5	2.0	25.9
CDM-9(MW)	S-8	14-16	Sand and Gravel	SW	0.0	47.6	22.9	20.7	4.8	4.0		11.3

Notes:

1. USCS classifications were performed in accordance with ASTM D-2488.
2. Grain size analysis tests performed in accordance with ASTM D-422.
3. Moisture content analysis performed in accordance with ASTM D-2216.

Abbreviations:

SM	Silty sand
ML	Sandy silt
SP-SM	Poorly graded sand with silt and gravel
SW-SM	Well graded sand with silt
GW-GM	Well-graded gravel
SW	Well-graded sand

**Town of Grafton
Wastewater Treatment Plant Improvements
Grafton, Massachusetts**

**Table 2
Summary of Recent Subsurface Exploration Program**

Exploration Number	Approximate Ground Surface Elevation (ft) ⁽¹⁾	Exploration Depth (ft)	Strata Thickness (ft)					Depth to Groundwater (ft) ⁽²⁾	Approx. Groundwater Elevation (ft)
			Fill	Sand and Gravel	Sand and Silt	Gravel	Bedrock		
CDM-1	278.0	43	4	6	32	--	>1	7	271.0
CDM-2	275.0	34	4	10	14	--	>6	6	269.0
CDM-3	276.0	47.7	4	8	34.7	--	>1	7	269.0
CDM-4	278.0	46	4	6	36	--	--	6	272.0
CDM-5	279.0	29.3	8	9.5	10.8	--	>1	7	272.0
CDM-8	279.0	50.8	8	--	34.5	6.7	>1.7	9.3	269.7
CDM-9 (MW)	277.0	45	7	3.5	20	6.5	>1	9 ⁽³⁾	268.0

Notes:

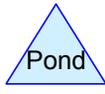
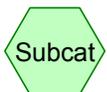
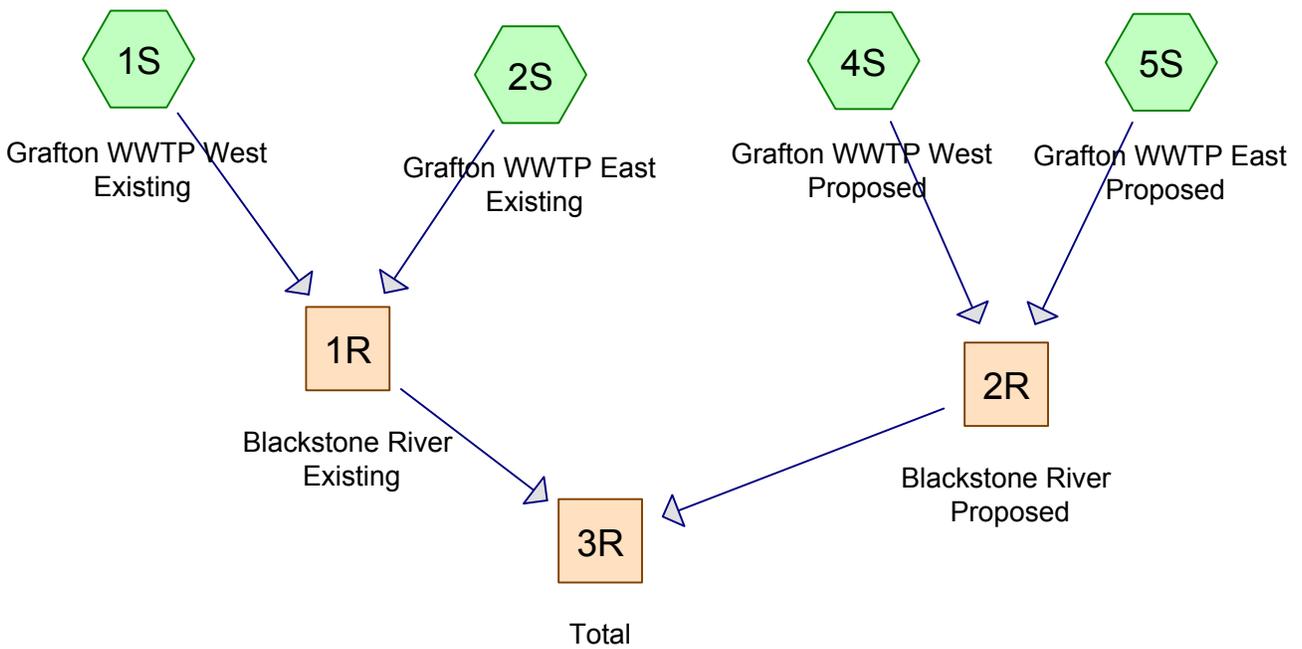
1. Elevations are referenced to NAVD29.
2. Groundwater level readings were taken upon completion of the test borings.
3. Groundwater monitoring well installed on 8/8/2014, groundwater level measured on 8/8/2014

Abbreviations:

- > Indicates strata not fully penetrated
- Indicates strata not encountered

Appendix C

HydroCAD Model



Grafton WWTP Ex & Prop

Prepared by CDM Smith

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Type III 24-hr 2-Year Storm Rainfall=3.24"

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Page 2

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Grafton WWTP West Existing

Runoff Area=44,687 sf 1.60% Impervious Runoff Depth=1.06"
Flow Length=143' Tc=15.0 min CN=74 Runoff=0.91 cfs 0.091 af

Subcatchment 2S: Grafton WWTP East Existing

Runoff Area=57,618 sf 47.43% Impervious Runoff Depth=1.37"
Flow Length=236' Tc=15.0 min CN=79 Runoff=1.58 cfs 0.151 af

Subcatchment 4S: Grafton WWTP West Proposed

Runoff Area=36,970 sf 2.51% Impervious Runoff Depth=0.58"
Flow Length=143' Tc=15.0 min CN=64 Runoff=0.33 cfs 0.041 af

Subcatchment 5S: Grafton WWTP East Proposed

Runoff Area=57,956 sf 46.37% Impervious Runoff Depth=1.18"
Flow Length=236' Tc=15.0 min CN=76 Runoff=1.34 cfs 0.131 af

Reach 1R: Blackstone River Existing

Inflow=2.49 cfs 0.242 af
Outflow=2.49 cfs 0.242 af

Reach 2R: Blackstone River Proposed

Inflow=1.66 cfs 0.172 af
Outflow=1.66 cfs 0.172 af

Reach 3R: Total

Inflow=4.14 cfs 0.413 af
Outflow=4.14 cfs 0.413 af

Total Runoff Area = 4.528 ac Runoff Volume = 0.413 af Average Runoff Depth = 1.10"
71.68% Pervious = 3.246 ac 28.32% Impervious = 1.282 ac

Grafton WWTP Ex & Prop

Prepared by CDM Smith

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Type III 24-hr 2-Year Storm Rainfall=3.24"

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Page 3

Summary for Subcatchment 1S: Grafton WWTP West Existing

Runoff = 0.91 cfs @ 12.22 hrs, Volume= 0.091 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.24"

Area (sf)	CN	Description
24,623	69	50-75% Grass cover, Fair, HSG B
3,186	55	Woods, Good, HSG B
* 717	98	Concrete Pads/Walk
16,161	85	Gravel roads, HSG B
44,687	74	Weighted Average
43,970		98.40% Pervious Area
717		1.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: Grafton WWTP East Existing

Runoff = 1.58 cfs @ 12.22 hrs, Volume= 0.151 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.24"

Area (sf)	CN	Description
17,829	69	50-75% Grass cover, Fair, HSG B
7,055	30	Woods, Good, HSG A
666	55	Woods, Good, HSG B
* 27,326	98	Paved parking, Buildings Concrete Pads, HSG B
4,742	85	Gravel roads, HSG B
57,618	79	Weighted Average
30,292		52.57% Pervious Area
27,326		47.43% Impervious Area

Grafton WWTP Ex & Prop

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Type III 24-hr 2-Year Storm Rainfall=3.24"

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Page 4

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 4S: Grafton WWTP West Proposed

Runoff = 0.33 cfs @ 12.25 hrs, Volume= 0.041 af, Depth= 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.24"

Area (sf)	CN	Description
33,215	61	>75% Grass cover, Good, HSG B
* 928	98	Concrete pads, buildings, HSG B
2,827	85	Gravel roads, HSG B
36,970	64	Weighted Average
36,042		97.49% Pervious Area
928		2.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 5S: Grafton WWTP East Proposed

Runoff = 1.34 cfs @ 12.22 hrs, Volume= 0.131 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.24"

Grafton WWTP Ex & Prop

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Type III 24-hr 2-Year Storm Rainfall=3.24"

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Page 5

Area (sf)	CN	Description
19,759	61	>75% Grass cover, Good, HSG B
7,055	30	Woods, Good, HSG A
* 26,876	98	Paved parking, buildings, concrete pads, HSG B
* 1,709	86	Green Roof
* 482	70	Porous Pavement
2,075	85	Gravel roads, HSG B
57,956	76	Weighted Average
31,080		53.63% Pervious Area
26,876		46.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Reach 1R: Blackstone River Existing

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 27.41% Impervious, Inflow Depth = 1.23" for 2-Year Storm event
 Inflow = 2.49 cfs @ 12.22 hrs, Volume= 0.242 af
 Outflow = 2.49 cfs @ 12.22 hrs, Volume= 0.242 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Blackstone River Proposed

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.179 ac, 29.29% Impervious, Inflow Depth = 0.95" for 2-Year Storm event
 Inflow = 1.66 cfs @ 12.22 hrs, Volume= 0.172 af
 Outflow = 1.66 cfs @ 12.22 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Total

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.528 ac, 28.32% Impervious, Inflow Depth = 1.10" for 2-Year Storm event
 Inflow = 4.14 cfs @ 12.22 hrs, Volume= 0.413 af
 Outflow = 4.14 cfs @ 12.22 hrs, Volume= 0.413 af, Atten= 0%, Lag= 0.0 min

Grafton WWTP Ex & Prop

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Type III 24-hr 2-Year Storm Rainfall=3.24"

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Page 6

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Grafton WWTP Ex & Prop

Prepared by CDM Smith

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Type III 24-hr 10-Year Storm Rainfall=4.88"

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Page 7

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Grafton WWTP West Existing

Runoff Area=44,687 sf 1.60% Impervious Runoff Depth=2.27"
Flow Length=143' Tc=15.0 min CN=74 Runoff=2.05 cfs 0.194 af

Subcatchment 2S: Grafton WWTP East Existing

Runoff Area=57,618 sf 47.43% Impervious Runoff Depth=2.70"
Flow Length=236' Tc=15.0 min CN=79 Runoff=3.17 cfs 0.297 af

Subcatchment 4S: Grafton WWTP West Proposed

Runoff Area=36,970 sf 2.51% Impervious Runoff Depth=1.50"
Flow Length=143' Tc=15.0 min CN=64 Runoff=1.05 cfs 0.106 af

Subcatchment 5S: Grafton WWTP East Proposed

Runoff Area=57,956 sf 46.37% Impervious Runoff Depth=2.44"
Flow Length=236' Tc=15.0 min CN=76 Runoff=2.87 cfs 0.270 af

Reach 1R: Blackstone River Existing

Inflow=5.21 cfs 0.491 af
Outflow=5.21 cfs 0.491 af

Reach 2R: Blackstone River Proposed

Inflow=3.91 cfs 0.377 af
Outflow=3.91 cfs 0.377 af

Reach 3R: Total

Inflow=9.12 cfs 0.868 af
Outflow=9.12 cfs 0.868 af

Total Runoff Area = 4.528 ac Runoff Volume = 0.868 af Average Runoff Depth = 2.30"
71.68% Pervious = 3.246 ac 28.32% Impervious = 1.282 ac

Grafton WWTP Ex & Prop

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Type III 24-hr 10-Year Storm Rainfall=4.88"

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Page 8

Summary for Subcatchment 1S: Grafton WWTP West Existing

Runoff = 2.05 cfs @ 12.21 hrs, Volume= 0.194 af, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.88"

Area (sf)	CN	Description
24,623	69	50-75% Grass cover, Fair, HSG B
3,186	55	Woods, Good, HSG B
* 717	98	Concrete Pads/Walk
16,161	85	Gravel roads, HSG B
44,687	74	Weighted Average
43,970		98.40% Pervious Area
717		1.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: Grafton WWTP East Existing

Runoff = 3.17 cfs @ 12.21 hrs, Volume= 0.297 af, Depth= 2.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.88"

Area (sf)	CN	Description
17,829	69	50-75% Grass cover, Fair, HSG B
7,055	30	Woods, Good, HSG A
666	55	Woods, Good, HSG B
* 27,326	98	Paved parking, Buildings Concrete Pads, HSG B
4,742	85	Gravel roads, HSG B
57,618	79	Weighted Average
30,292		52.57% Pervious Area
27,326		47.43% Impervious Area

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Type III 24-hr 10-Year Storm Rainfall=4.88"

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Page 9

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 4S: Grafton WWTP West Proposed

Runoff = 1.05 cfs @ 12.22 hrs, Volume= 0.106 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.88"

Area (sf)	CN	Description
33,215	61	>75% Grass cover, Good, HSG B
* 928	98	Concrete pads, buildings, HSG B
2,827	85	Gravel roads, HSG B
36,970	64	Weighted Average
36,042		97.49% Pervious Area
928		2.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 5S: Grafton WWTP East Proposed

Runoff = 2.87 cfs @ 12.21 hrs, Volume= 0.270 af, Depth= 2.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.88"

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Type III 24-hr 10-Year Storm Rainfall=4.88"

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Page 10

Area (sf)	CN	Description
19,759	61	>75% Grass cover, Good, HSG B
7,055	30	Woods, Good, HSG A
* 26,876	98	Paved parking, buildings, concrete pads, HSG B
* 1,709	86	Green Roof
* 482	70	Porous Pavement
2,075	85	Gravel roads, HSG B
57,956	76	Weighted Average
31,080		53.63% Pervious Area
26,876		46.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Reach 1R: Blackstone River Existing

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 27.41% Impervious, Inflow Depth = 2.51" for 10-Year Storm event
 Inflow = 5.21 cfs @ 12.21 hrs, Volume= 0.491 af
 Outflow = 5.21 cfs @ 12.21 hrs, Volume= 0.491 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Blackstone River Proposed

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.179 ac, 29.29% Impervious, Inflow Depth = 2.07" for 10-Year Storm event
 Inflow = 3.91 cfs @ 12.21 hrs, Volume= 0.377 af
 Outflow = 3.91 cfs @ 12.21 hrs, Volume= 0.377 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Total

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.528 ac, 28.32% Impervious, Inflow Depth = 2.30" for 10-Year Storm event
 Inflow = 9.12 cfs @ 12.21 hrs, Volume= 0.868 af
 Outflow = 9.12 cfs @ 12.21 hrs, Volume= 0.868 af, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 10-Year Storm Rainfall=4.88"

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Page 11

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

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Type III 24-hr 25-Year Storm Rainfall=6.18"

Printed 3/24/2015

Page 12

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Grafton WWTP West Existing

Runoff Area=44,687 sf 1.60% Impervious Runoff Depth=3.34"
Flow Length=143' Tc=15.0 min CN=74 Runoff=3.03 cfs 0.285 af

Subcatchment 2S: Grafton WWTP East Existing

Runoff Area=57,618 sf 47.43% Impervious Runoff Depth=3.84"
Flow Length=236' Tc=15.0 min CN=79 Runoff=4.50 cfs 0.423 af

Subcatchment 4S: Grafton WWTP West Proposed

Runoff Area=36,970 sf 2.51% Impervious Runoff Depth=2.39"
Flow Length=143' Tc=15.0 min CN=64 Runoff=1.75 cfs 0.169 af

Subcatchment 5S: Grafton WWTP East Proposed

Runoff Area=57,956 sf 46.37% Impervious Runoff Depth=3.54"
Flow Length=236' Tc=15.0 min CN=76 Runoff=4.17 cfs 0.392 af

Reach 1R: Blackstone River Existing

Inflow=7.53 cfs 0.709 af
Outflow=7.53 cfs 0.709 af

Reach 2R: Blackstone River Proposed

Inflow=5.92 cfs 0.561 af
Outflow=5.92 cfs 0.561 af

Reach 3R: Total

Inflow=13.45 cfs 1.270 af
Outflow=13.45 cfs 1.270 af

Total Runoff Area = 4.528 ac Runoff Volume = 1.270 af Average Runoff Depth = 3.37"
71.68% Pervious = 3.246 ac 28.32% Impervious = 1.282 ac

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Type III 24-hr 25-Year Storm Rainfall=6.18"

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Page 13

Summary for Subcatchment 1S: Grafton WWTP West Existing

Runoff = 3.03 cfs @ 12.21 hrs, Volume= 0.285 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=6.18"

Area (sf)	CN	Description
24,623	69	50-75% Grass cover, Fair, HSG B
3,186	55	Woods, Good, HSG B
* 717	98	Concrete Pads/Walk
16,161	85	Gravel roads, HSG B
44,687	74	Weighted Average
43,970		98.40% Pervious Area
717		1.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: Grafton WWTP East Existing

Runoff = 4.50 cfs @ 12.20 hrs, Volume= 0.423 af, Depth= 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=6.18"

Area (sf)	CN	Description
17,829	69	50-75% Grass cover, Fair, HSG B
7,055	30	Woods, Good, HSG A
666	55	Woods, Good, HSG B
* 27,326	98	Paved parking, Buildings Concrete Pads, HSG B
4,742	85	Gravel roads, HSG B
57,618	79	Weighted Average
30,292		52.57% Pervious Area
27,326		47.43% Impervious Area

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Type III 24-hr 25-Year Storm Rainfall=6.18"

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Page 14

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 4S: Grafton WWTP West Proposed

Runoff = 1.75 cfs @ 12.22 hrs, Volume= 0.169 af, Depth= 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=6.18"

Area (sf)	CN	Description
33,215	61	>75% Grass cover, Good, HSG B
* 928	98	Concrete pads, buildings, HSG B
2,827	85	Gravel roads, HSG B
36,970	64	Weighted Average
36,042		97.49% Pervious Area
928		2.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 5S: Grafton WWTP East Proposed

Runoff = 4.17 cfs @ 12.21 hrs, Volume= 0.392 af, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=6.18"

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Type III 24-hr 25-Year Storm Rainfall=6.18"

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Page 15

Area (sf)	CN	Description
19,759	61	>75% Grass cover, Good, HSG B
7,055	30	Woods, Good, HSG A
* 26,876	98	Paved parking, buildings, concrete pads, HSG B
* 1,709	86	Green Roof
* 482	70	Porous Pavement
2,075	85	Gravel roads, HSG B
57,956	76	Weighted Average
31,080		53.63% Pervious Area
26,876		46.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Reach 1R: Blackstone River Existing

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 27.41% Impervious, Inflow Depth = 3.62" for 25-Year Storm event
 Inflow = 7.53 cfs @ 12.21 hrs, Volume= 0.709 af
 Outflow = 7.53 cfs @ 12.21 hrs, Volume= 0.709 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Blackstone River Proposed

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.179 ac, 29.29% Impervious, Inflow Depth = 3.09" for 25-Year Storm event
 Inflow = 5.92 cfs @ 12.21 hrs, Volume= 0.561 af
 Outflow = 5.92 cfs @ 12.21 hrs, Volume= 0.561 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Total

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.528 ac, 28.32% Impervious, Inflow Depth = 3.37" for 25-Year Storm event
 Inflow = 13.45 cfs @ 12.21 hrs, Volume= 1.270 af
 Outflow = 13.45 cfs @ 12.21 hrs, Volume= 1.270 af, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 25-Year Storm Rainfall=6.18"

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Page 16

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

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Type III 24-hr 100-Year Storm Rainfall=8.84"

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Page 17

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Grafton WWTP West Existing

Runoff Area=44,687 sf 1.60% Impervious Runoff Depth=5.68"
Flow Length=143' Tc=15.0 min CN=74 Runoff=5.15 cfs 0.486 af

Subcatchment 2S: Grafton WWTP East Existing

Runoff Area=57,618 sf 47.43% Impervious Runoff Depth=6.29"
Flow Length=236' Tc=15.0 min CN=79 Runoff=7.28 cfs 0.694 af

Subcatchment 4S: Grafton WWTP West Proposed

Runoff Area=36,970 sf 2.51% Impervious Runoff Depth=4.46"
Flow Length=143' Tc=15.0 min CN=64 Runoff=3.35 cfs 0.316 af

Subcatchment 5S: Grafton WWTP East Proposed

Runoff Area=57,956 sf 46.37% Impervious Runoff Depth=5.93"
Flow Length=236' Tc=15.0 min CN=76 Runoff=6.95 cfs 0.657 af

Reach 1R: Blackstone River Existing

Inflow=12.43 cfs 1.180 af
Outflow=12.43 cfs 1.180 af

Reach 2R: Blackstone River Proposed

Inflow=10.29 cfs 0.973 af
Outflow=10.29 cfs 0.973 af

Reach 3R: Total

Inflow=22.72 cfs 2.153 af
Outflow=22.72 cfs 2.153 af

Total Runoff Area = 4.528 ac Runoff Volume = 2.153 af Average Runoff Depth = 5.70"
71.68% Pervious = 3.246 ac 28.32% Impervious = 1.282 ac

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Type III 24-hr 100-Year Storm Rainfall=8.84"

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Page 18

Summary for Subcatchment 1S: Grafton WWTP West Existing

Runoff = 5.15 cfs @ 12.20 hrs, Volume= 0.486 af, Depth= 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=8.84"

Area (sf)	CN	Description
24,623	69	50-75% Grass cover, Fair, HSG B
3,186	55	Woods, Good, HSG B
* 717	98	Concrete Pads/Walk
16,161	85	Gravel roads, HSG B
44,687	74	Weighted Average
43,970		98.40% Pervious Area
717		1.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 2S: Grafton WWTP East Existing

Runoff = 7.28 cfs @ 12.20 hrs, Volume= 0.694 af, Depth= 6.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=8.84"

Area (sf)	CN	Description
17,829	69	50-75% Grass cover, Fair, HSG B
7,055	30	Woods, Good, HSG A
666	55	Woods, Good, HSG B
* 27,326	98	Paved parking, Buildings Concrete Pads, HSG B
4,742	85	Gravel roads, HSG B
57,618	79	Weighted Average
30,292		52.57% Pervious Area
27,326		47.43% Impervious Area

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Type III 24-hr 100-Year Storm Rainfall=8.84"

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Page 19

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 4S: Grafton WWTP West Proposed

Runoff = 3.35 cfs @ 12.21 hrs, Volume= 0.316 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=8.84"

Area (sf)	CN	Description
33,215	61	>75% Grass cover, Good, HSG B
* 928	98	Concrete pads, buildings, HSG B
2,827	85	Gravel roads, HSG B
36,970	64	Weighted Average
36,042		97.49% Pervious Area
928		2.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	60	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	83	0.0120	0.77		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.6	143	Total, Increased to minimum Tc = 15.0 min			

Summary for Subcatchment 5S: Grafton WWTP East Proposed

Runoff = 6.95 cfs @ 12.20 hrs, Volume= 0.657 af, Depth= 5.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=8.84"

Area (sf)	CN	Description
19,759	61	>75% Grass cover, Good, HSG B
7,055	30	Woods, Good, HSG A
* 26,876	98	Paved parking, buildings, concrete pads, HSG B
* 1,709	86	Green Roof
* 482	70	Porous Pavement
2,075	85	Gravel roads, HSG B
57,956	76	Weighted Average
31,080		53.63% Pervious Area
26,876		46.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	51	0.2350	2.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.3	26	0.0346	1.30		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	60	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	99	0.0400	4.06		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.5	236	Total, Increased to minimum Tc = 15.0 min			

Summary for Reach 1R: Blackstone River Existing

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 27.41% Impervious, Inflow Depth = 6.03" for 100-Year Storm event
 Inflow = 12.43 cfs @ 12.20 hrs, Volume= 1.180 af
 Outflow = 12.43 cfs @ 12.20 hrs, Volume= 1.180 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Blackstone River Proposed

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.179 ac, 29.29% Impervious, Inflow Depth = 5.36" for 100-Year Storm event
 Inflow = 10.29 cfs @ 12.21 hrs, Volume= 0.973 af
 Outflow = 10.29 cfs @ 12.21 hrs, Volume= 0.973 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Total

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.528 ac, 28.32% Impervious, Inflow Depth = 5.70" for 100-Year Storm event
 Inflow = 22.72 cfs @ 12.20 hrs, Volume= 2.153 af
 Outflow = 22.72 cfs @ 12.20 hrs, Volume= 2.153 af, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 100-Year Storm Rainfall=8.84"

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Page 21

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Appendix D
Recharge Volume and Water Quality Volume
Calculations

Grafton WWTP WQv and Rv Calculations

Water Quality Volume

Impervious Area: 28030 sf
 Green Roof: 1791 sf
 Pervious Concrete 482 sf
 Total 30,303 sf

WQV Target 0.5 in
 WQv **1263 cf**
 Green Roof Adj. **-112**
 WQv Required: **1151**
 WQv **0.029 af**

Provided: **145 cf**

Recharge Volume

Impervious Area: 28030 sf
 Green Roof: 1791 sf
 Pervious Concrete 482 sf
 Total 30,303 sf

Rv Target 0.35 in
 Rv **884 cf**
 Rv **0.020 af**

Provided: **145 cf**

Drawdown Time

At Gravel Trench

0.52 in/hr infiltration rate
 143 sf, bottom area
 125 cf, total volume

20 hours <72 hours, ok

At Pervious Concrete

0.52 in/hr infiltration rate
 482 sf, bottom area
 20 cf, total volume

1 hours <72 hours, ok

Green Roof

Disinfection Building 1791 sf
 WQV Target 0.5 in
 WQV Required 75 cf

Veg. Roof Area 1791 sf
 Thickness 3 in
 0.25 ft
 n (porosity) 0.25
 Provided: 112 cf

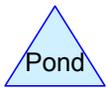
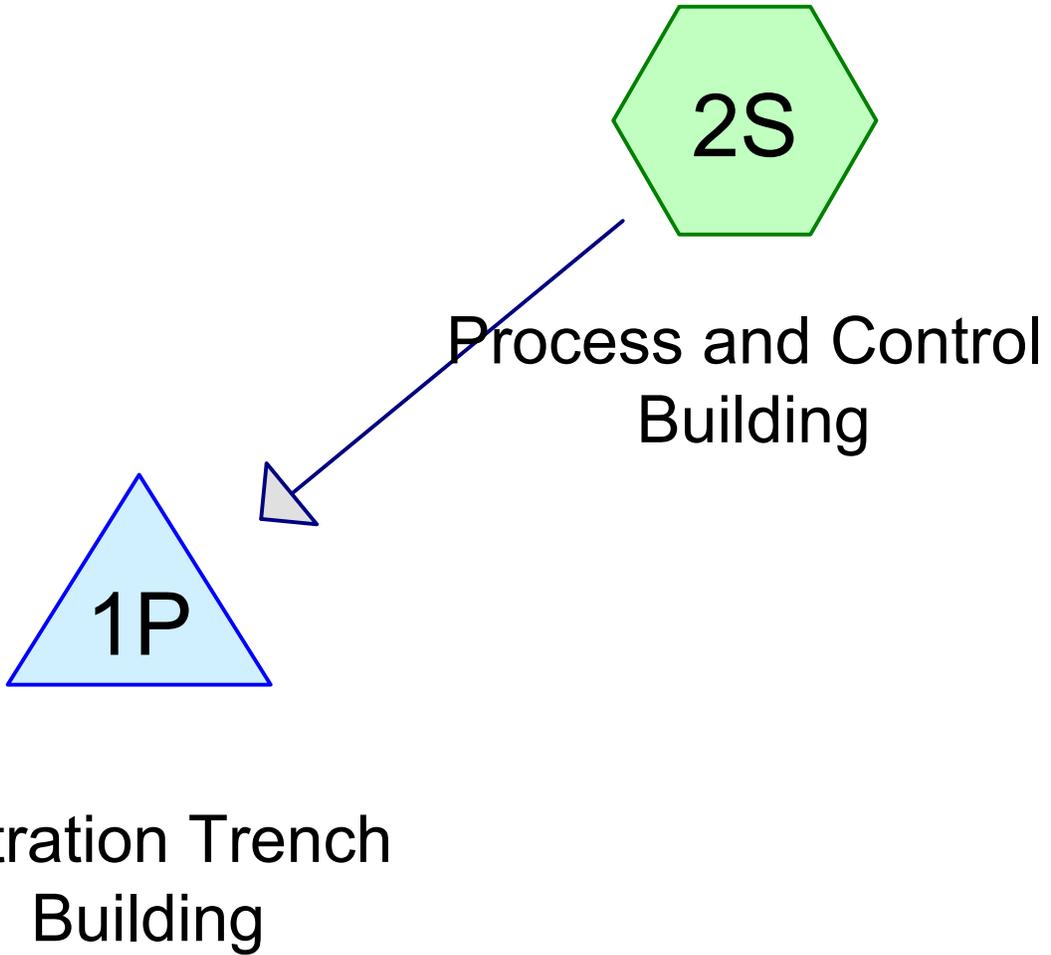
Gravel Trench

Process/Control Bldg. 4035 sf
 Rv Target 0.35 in
 Rv Required 118 cf

Recharge Area 143 sf
 Depth 2.5 ft
 n (porosity) 0.35
 Rv Provided 125 cf

Pervious Concrete

Pervious Concrete 482 sf
 WQv Target 0.5 in
 WQv Required 20 cf
 WQv Provided 20 cf



Grafton WWTP Gravel Infiltration

Type III 24-hr Infiltration Rainfall=0.82"

Prepared by CDM Smith

Printed 3/31/2015

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Page 2

Time span=11.00-13.00 hrs, dt=0.01 hrs, 201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: Process and Control Building

Runoff Area=4,035 sf 100.00% Impervious Runoff Depth>0.35"
Tc=5.0 min CN=98 Runoff=0.068 cfs 118 cf

Pond 1P: Infiltration Trench Building

Peak Elev=280.60' Storage=0.002 af Inflow=0.068 cfs 118 cf
Discarded=0.002 cfs 12 cf Primary=0.000 cfs 0 cf Outflow=0.002 cfs 12 cf

Total Runoff Area = 4,035 sf Runoff Volume = 118 cf Average Runoff Depth = 0.35"
0.00% Pervious = 0 sf 100.00% Impervious = 4,035 sf

Grafton WWTP Gravel Infiltration

Prepared by CDM Smith

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Type III 24-hr Infiltration Rainfall=0.82"

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Page 3

Summary for Subcatchment 2S: Process and Control Building

Runoff = 0.068 cfs @ 12.07 hrs, Volume= 118 cf, Depth> 0.35"

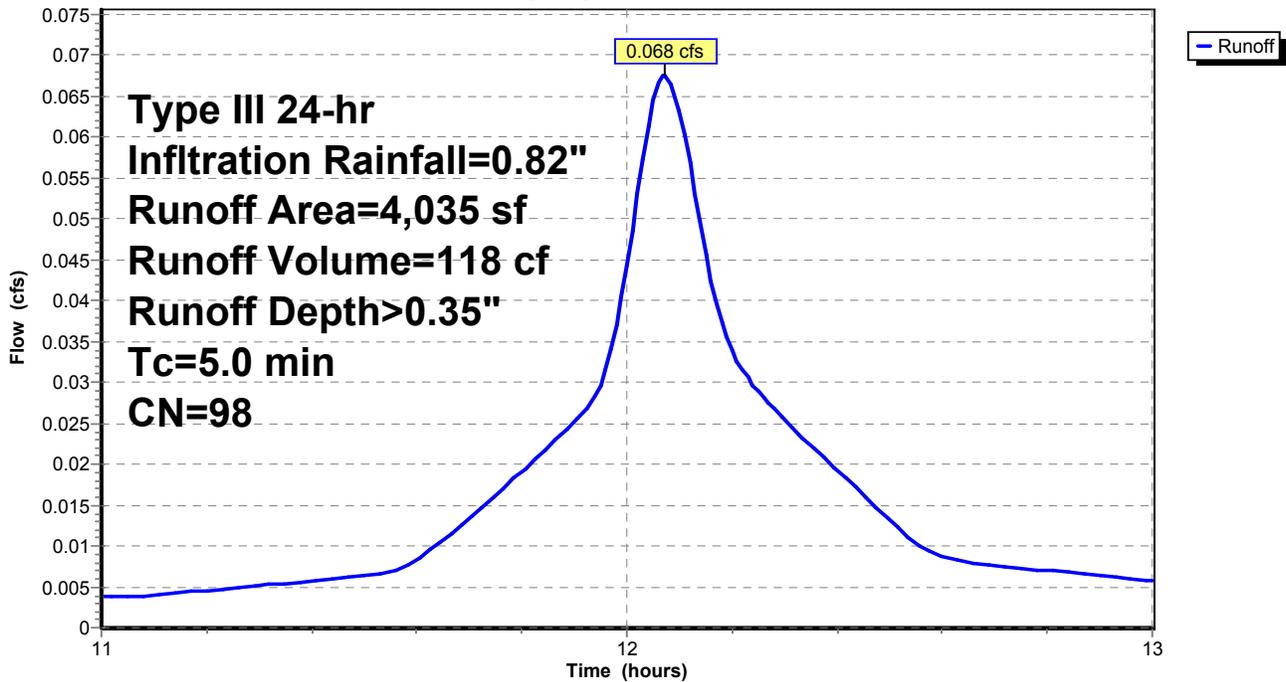
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
 Type III 24-hr Infiltration Rainfall=0.82"

Area (sf)	CN	Description
4,035	98	Roofs, HSG A
4,035		100.00% Impervious Area

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

Subcatchment 2S: Process and Control Building

Hydrograph



Grafton WWTP Gravel Infiltration

Type III 24-hr Infiltration Rainfall=0.82"

Prepared by CDM Smith

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Page 4

Summary for Pond 1P: Infiltration Trench Building

[82] Warning: Early inflow requires earlier time span

Inflow Area = 4,035 sf, 100.00% Impervious, Inflow Depth > 0.35" for Infiltration event
 Inflow = 0.068 cfs @ 12.07 hrs, Volume= 118 cf
 Outflow = 0.002 cfs @ 13.00 hrs, Volume= 12 cf, Atten= 97%, Lag= 55.7 min
 Discarded = 0.002 cfs @ 13.00 hrs, Volume= 12 cf
 Primary = 0.000 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 280.60' @ 13.00 hrs Surf.Area= 0.003 ac Storage= 0.002 af

Plug-Flow detention time= 40.7 min calculated for 12 cf (10% of inflow)
 Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	278.50'	0.003 af	14.30'W x 10.00'L x 2.50'H Infiltration Trench 0.008 af Overall x 35.0% Voids

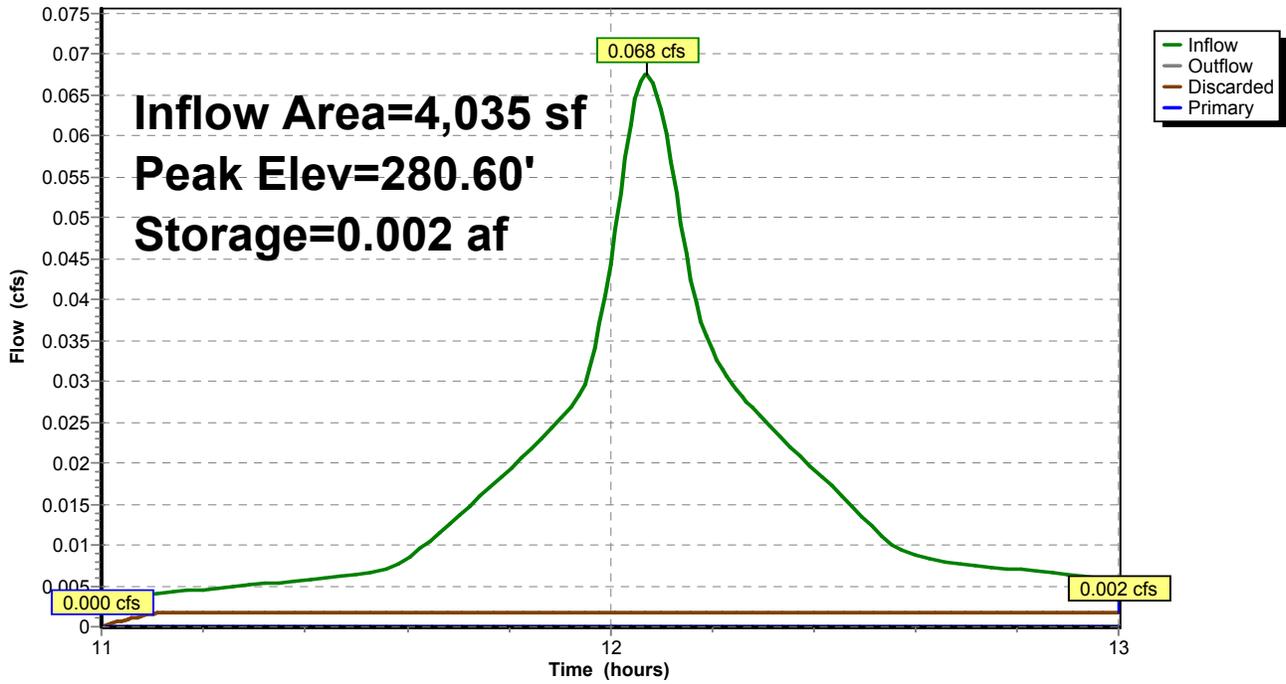
Device	Routing	Invert	Outlet Devices
#1	Discarded	278.50'	0.520 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 0.00'
#2	Primary	280.90'	10.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

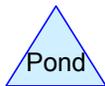
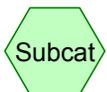
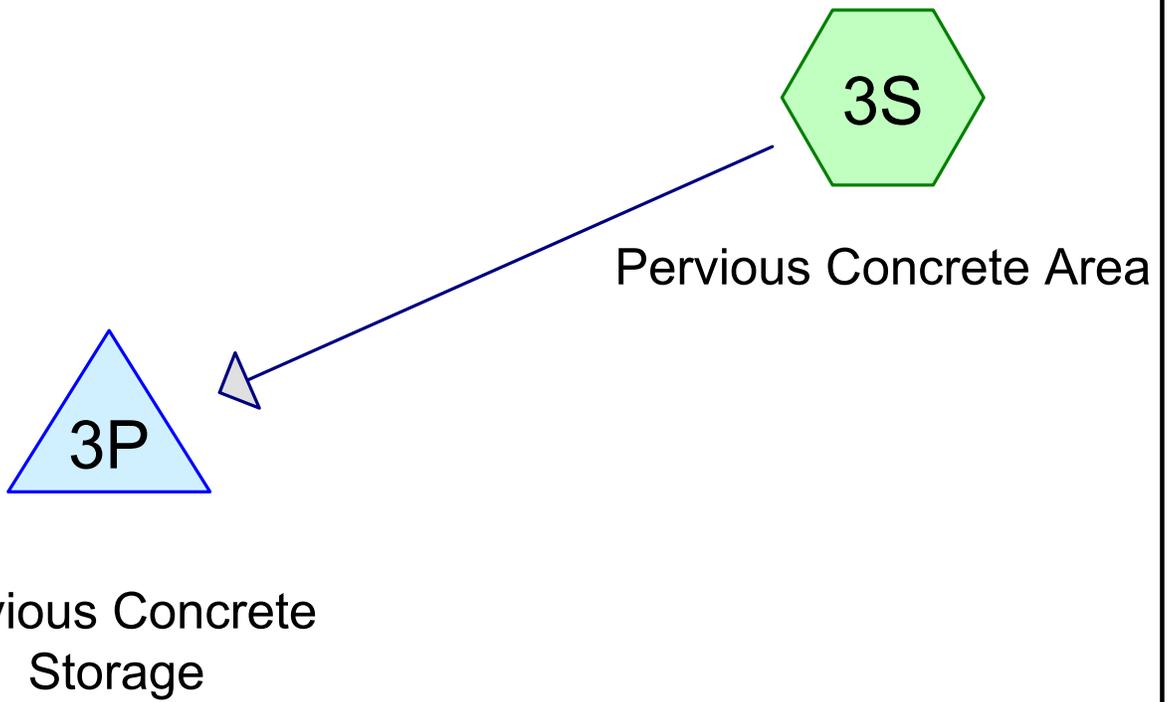
Discarded OutFlow Max=0.002 cfs @ 13.00 hrs HW=280.60' (Free Discharge)
 ↑**1=Exfiltration** (Controls 0.002 cfs)

Primary OutFlow Max=0.000 cfs @ 11.00 hrs HW=278.50' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.000 cfs)

Pond 1P: Infiltration Trench Building

Hydrograph





Grafton WWTP PC Infiltration

Prepared by CDM Smith

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Type III 24-hr Infiltration Rainfall=1.11"

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Page 2

Time span=11.00-13.00 hrs, dt=0.01 hrs, 201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Pervious Concrete Area

Runoff Area=482 sf 100.00% Impervious Runoff Depth>0.50"
Tc=5.0 min CN=98 Runoff=0.011 cfs 20 cf

Pond 3P: Pervious Concrete Storage

Peak Elev=280.70' Storage=0.000 af Inflow=0.011 cfs 20 cf
Discarded=0.006 cfs 20 cf Primary=0.000 cfs 0 cf Outflow=0.006 cfs 20 cf

Total Runoff Area = 482 sf Runoff Volume = 20 cf Average Runoff Depth = 0.50"
0.00% Pervious = 0 sf 100.00% Impervious = 482 sf

Grafton WWTP PC Infiltration

Prepared by CDM Smith

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Type III 24-hr Infiltration Rainfall=1.11"

Printed 4/1/2015

Page 3

Summary for Subcatchment 3S: Pervious Concrete Area

Runoff = 0.011 cfs @ 12.07 hrs, Volume= 20 cf, Depth> 0.50"

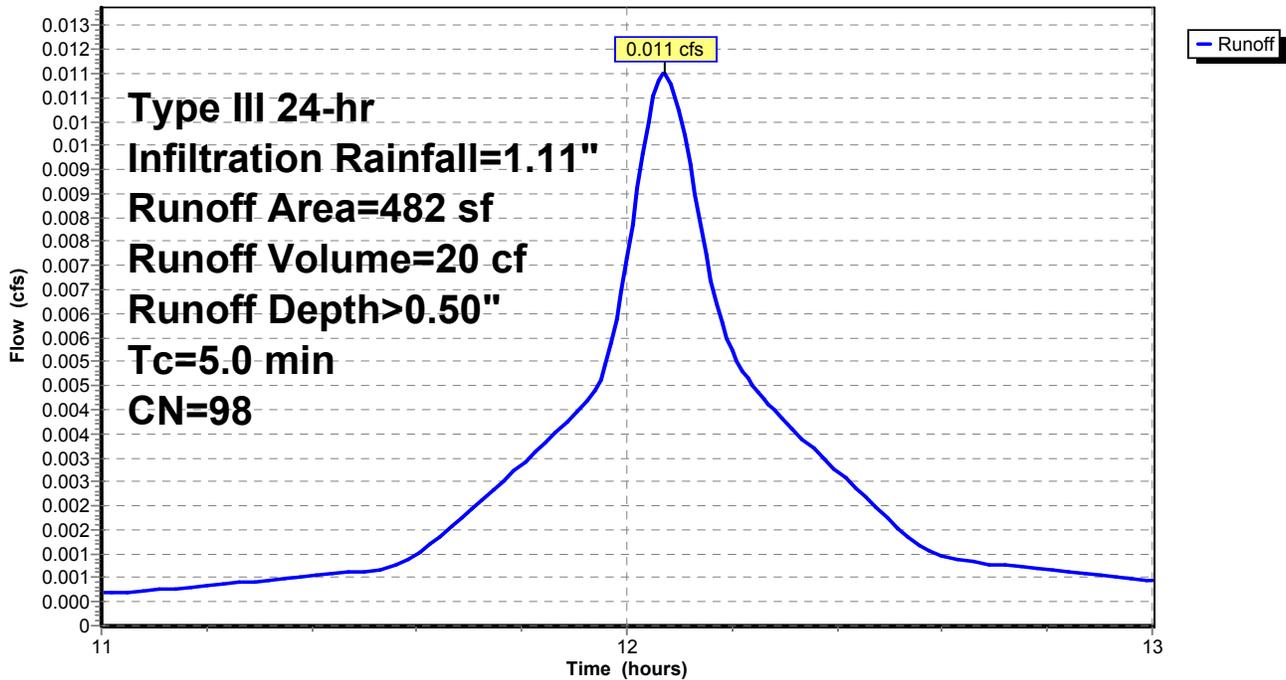
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
 Type III 24-hr Infiltration Rainfall=1.11"

Area (sf)	CN	Description
482	98	Paved parking, HSG A
482		100.00% Impervious Area

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

Subcatchment 3S: Pervious Concrete Area

Hydrograph



Summary for Pond 3P: Pervious Concrete Storage

[82] Warning: Early inflow requires earlier time span

Inflow Area = 482 sf, 100.00% Impervious, Inflow Depth > 0.50" for Infiltration event
 Inflow = 0.011 cfs @ 12.07 hrs, Volume= 20 cf
 Outflow = 0.006 cfs @ 12.20 hrs, Volume= 20 cf, Atten= 50%, Lag= 7.6 min
 Discarded = 0.006 cfs @ 12.20 hrs, Volume= 20 cf
 Primary = 0.000 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 280.70' @ 12.20 hrs Surf.Area= 0.011 ac Storage= 0.000 af

Plug-Flow detention time= 3.9 min calculated for 20 cf (99% of inflow)
 Center-of-Mass det. time= 3.6 min (728.0 - 724.4)

Volume	Invert	Avail.Storage	Storage Description
#1	280.67'	0.001 af	10.00'W x 48.20'L x 0.50'H Pervious Concrete 0.006 af Overall x 20.0% Voids

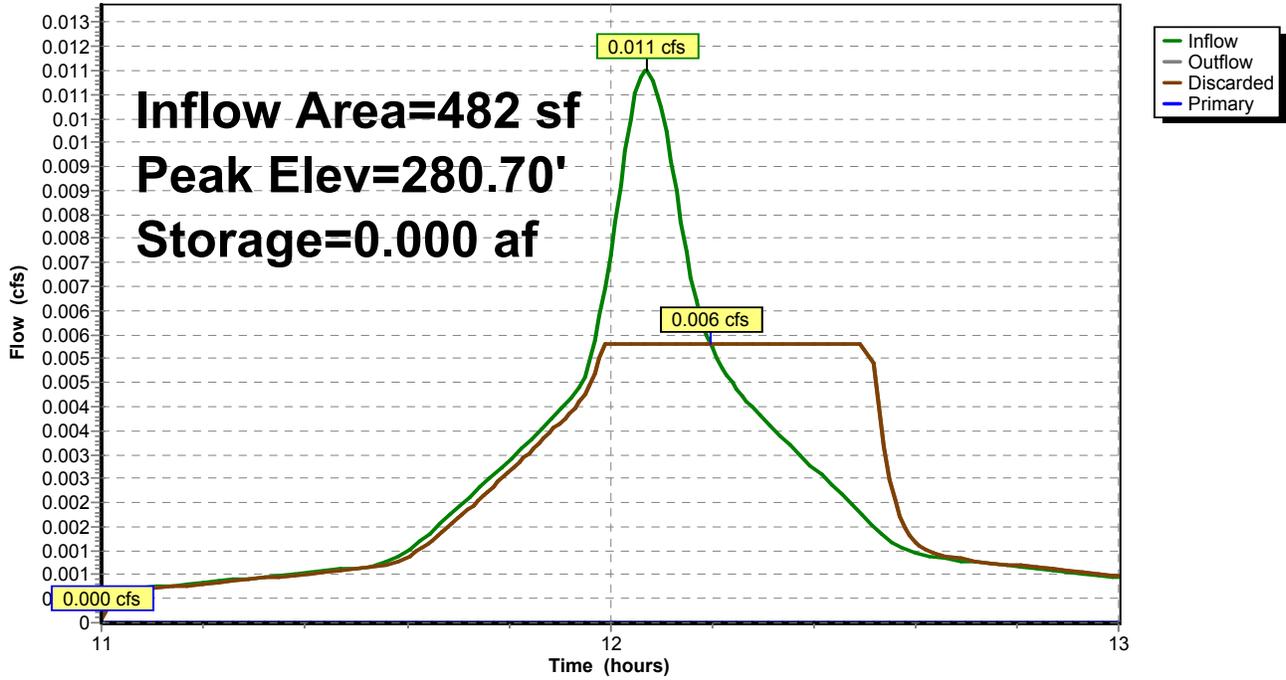
Device	Routing	Invert	Outlet Devices
#1	Discarded	280.67'	0.520 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 0.00'
#2	Primary	281.00'	10.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.006 cfs @ 12.20 hrs HW=280.70' (Free Discharge)
 ↑**1=Exfiltration** (Controls 0.006 cfs)

Primary OutFlow Max=0.000 cfs @ 11.00 hrs HW=280.67' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.000 cfs)

Pond 3P: Pervious Concrete Storage

Hydrograph



Appendix E

TSS Removal Spreadsheets

Location:

TSS Removal Calculation Worksheet

B BMP ¹	C TSS Removal Rate ¹	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75
	0.00	0.75	0.00	0.75

Total TSS Removal =

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project:
 Prepared By:
 Date:

*Equals remaining load from previous BMP (E) which enters the BMP

Location:

TSS Removal Calculation Worksheet

B BMP ¹	C TSS Removal Rate ¹	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Porous Pavement	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Total TSS Removal =

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project:
 Prepared By:
 Date:

*Equals remaining load from previous BMP (E) which enters the BMP

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

	B	C	D	E	F
	BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
TSS Removal Calculation Worksheet	Infiltration Trench	0.80	1.00	0.80	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20

Total TSS Removal =

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project:
 Prepared By:
 Date:

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
 1. From MassDEP Stormwater Handbook Vol. 1

Appendix F
**Operation and Maintenance Plan/
Long-Term Pollution Prevention Plan**

Post-Construction Operation and Maintenance Plan

Project: Grafton Wastewater Treatment Plant Improvements

Location: Grafton, MA

Owner/Responsible Party: Town of Grafton

This document describes the operation and maintenance activities for the proposed stormwater management facilities at the Grafton Wastewater Treatment Plant

Deep-Sump Hooded Catch Basins

Initially, the deep sump hooded catch basins should be inspected every six months to determine the depth of the sediment and debris in the catch basin. Based on these inspections, a schedule for cleaning the catch basins will be established to ensure that the catch basin sumps will be no more than 50 percent full at any time. Oil and sediments should be removed and disposed of in accordance with local, state and federal guidelines and regulations. In the case of an oil or bulk pollutant release, the system must be cleaned immediately following the spill and the proper authorities notified.

Stilling Basin

After construction, the preformed scour hole at the flared end should be inspected for any signs of wash-out and immediately repaired. The preformed scour hole should be checked periodically and after every major storm for damage. Any signs of erosion in the preformed scour hole should be repaired. Annually, any accumulated sediment, debris, and emergent woody growth should be removed from the preformed scour hole.

Gravel Infiltration Trench

During construction and upon completion of construction, the Contractor will be required to inspect and remove any debris from the gravel infiltration trench to ensure that the new system is in proper working order when the City takes control of it.

Initially, the gravel infiltration trench should be inspected after the first several rainfall events, after all major storms, and on regularly scheduled dates every six months for the accumulation of debris. Any debris found in the gravel infiltration trench should be promptly removed. The frequency should be evaluated and adjusted, if warranted by inspection results.

The trench should be inspected within 3 days after a major storm to look for ponded water. If there is ponded water at the surface of the trench, the trench surface is likely clogged. To address surface clogging, remove and replace the first layer of stone aggregate and the filter fabric. If water is ponded inside the trench, it may indicate that the bottom of the trench has failed. To rehabilitate a failed trench, strip all accumulated sediment from the bottom of the trench, and then scarify and till the bottom of the trench to induce infiltration. Replace all the stone aggregate and filter fabric in the trench.

Green Roof

During the initial establishment period, the plants require irrigation and occasional fertilization or until the vegetation is fully established. Once the plants are established, irrigation should no longer be required. Weeding and mulching should be done during the establishment period, and then occasionally thereafter. Any woody plants that become established should be removed. If fertilizer is required, slow-release zero-phosphorus fertilizer should be used once per year. The drainage system on the roof should be periodically inspected to ensure its proper function. The roof membrane should also be periodically inspected for possible leaks.

Pervious Concrete

Routine maintenance includes cleaning the surface using a power washer to dislodge trapped particles and then vacuum sweeping the area. Vacuuming should occur during spring cleanup after the last snow event and during fall cleanup to remove dead leaves. It is recommended that landscaped areas near these surfaces be maintained to prevent the deposition of soil or organic material on these surfaces to prevent clogging. During the winter months it is not recommended to store plowed snow and apply sand during icy periods on the pervious concrete. The surface should be inspected annually for deterioration and to assess the exfiltration capacity of the pervious concrete. Periodically, the surface will need to be repaired and need spot replacement of the pervious concrete.

Stormwater Management Facility Inspection Form

Location: Grafton Wastewater Treatment Plant
Grafton, MA

Inspected By: _____

Inspection Date: _____

BMP Measure	Status/Inspection	Action Taken
Deep-Sump Hooded Catch Basin		
Stilling Basin		
Gravel Infiltration Trench		
Green Roof		
Pervious Concrete		

Long-Term Pollution Prevention Plan

The following practices will be employed at the Grafton Wastewater Treatment Plant to provide source control and pollution prevention:

1. The gravel infiltration trench will be periodically inspected to remove trash and debris.
2. The pervious concrete area will be inspected periodically, and power-washed and vacuumed biannually.
3. The paved parking area and access drive will be periodically swept to remove trash and debris.
4. All hazardous materials at the site shall be stored under cover.
5. Any spills that occur at the site shall be contained and cleaned up in a timely manner to prevent the spilled product from entering the gravel infiltration trench and pervious concrete.

All personnel who provide regular maintenance at the Grafton WWTP shall be trained annually on the pollution prevention measures described above.