Development of Regional Impact Application

Canal Unit 3

Sandwich, Massachusetts

September 2016

Submitted to:

Cape Cod Commission

3225 Main Street
Barnstable, Massachusetts 02630

Submitted by:

NRG Canal 3 Development LLC

9 Freezer Road
Sandwich, Massachusetts 02563

Prepared by:

Tetra Tech, Inc.

2 Lan Drive, Suite 210
Westford, Massachusetts 01886

TETRA TECH

nrg®

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

ACRONYMS/ABBREVIATIONS

Acronym/Abbreviation	Definition
%	percent
°F	degrees Fahrenheit
A	ampere
AGT	Algonquin Gas Transmission, LLC
AH	affordable housing
amsl	above mean sea level
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
AUL	Activity Use and Limitation
BACT	Best Available Control Technology
BDP	Best Development Practice
BFE	Base Flood Elevation
bgs	below ground surface
BMP	Best Management Practice
C&D	construction and demolition
Canal 3	NRG Canal 3 Development LLC
CCC	Cape Cod Commission
CEMS	continuous emissions monitoring system
CO	carbon monoxide
CO_2	carbon dioxide
CPA	Community Preservation Act
CR	coastal resources
CTG	combustion turbine generator
dB	decibel
dBA	A-weighted decibel
DCS	distributed control system
DLN	dry-low-NO_X
DPU	Department of Public Utilities

DRI	Development of Regional Impact
E	energy
EER	Energy Efficiency Ratio
ED	economic development
EFSB	Energy Facilities Siting Board
ESP	electrostatic precipitator
Eversource	NSTAR Electric Company d/b/a Eversource Energy
FAA	Federal Aviation Administration
FCA	Forward Capacity Auction
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GE	General Electric
GHG	greenhouse gas
gpd	gallons per day
gpm	gallons per minute
GSU	generator step-up
GWSA	Global Warming Solutions Act
H_2	hydrogen
H_2O	water
HAPs	hazardous air pollutants
HCP	Highway Capacity Manual
hp	horsepower
HPCC	heritage preservation and community character
HRSG	Heat Recovery Steam Generator
HVAC	heating, ventilation, and air conditioning
IESNA	Illuminating Engineering Society of North America
IND	Industrial Limited
ISO-NE	Independent System Operator – New England
kcmil	thousand circular mils
kV	kilovolt
kW	kilowatt

kWh	kilowatt-hours
L_{90}	residual noise
LAER	Lowest Achievable Emissions Rate
lb/net MW-hr	pounds per net megawatt hour
LCP	Local Comprehensive Plan
LEED	Leadership in Energy and Environmental Design
LFRM	Locational Forward Reserve Market
LID	Low Impact Development
LOS	level of service
LSCSF	Land Subject to Coastal Storm Flowage
LU	land use
MAAQS	Massachusetts Ambient Air Quality Standard
MACRIS	Massachusetts Cultural Resource Information System
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MEPA	Massachusetts Environmental Policy Act
MCP	Massachusetts Contingency Plan
MGD	million gallons per day
MHC	Massachusetts Historical Commission
mph	miles per hour
MPS	Minimum Performance Standard
MR	marine resources
MSGP	Multi-Sector General Permit
MW	megawatt
MWh	megawatt-hour
N_2	nitrogen
NAAQS	National Ambient Air Quality Standard
NAVD88	North American Datum of 1988
NEMA	Northeast Massachusetts
NFPA	National Fire Protection Association
NH_3	ammonia

NHESP	Natural Heritage and Endangered Species Program
NO_3-N	nitrate nitrogen
NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
O&M	operation and maintenance
O_2	oxygen
OPGW	optical ground wire
OS	open space and recreation
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PDC	power distribution center
PILOT	payment in lieu of taxes
PM	particulate matter
PNF	Project Notification Form
ppm	parts per million
Project	a new, highly efficient, fast-starting, approximately 350-megawatt peak electric generating unit
Project Site	an approximately 12-acre area within the Property
Property	the existing 52-acre Canal Generating Station site on Freezer Road in Sandwich, Massachusetts
PSD	Prevention of Significant Deterioration
psig	pounds per square inch gauge
ROP	Rest of Pool
ROW	right-of-way
RPP	Cape Cod Regional Policy Plan
RTN	Release Tracking Number
SCR	selective catalytic reduction
SEMA/RI	Southeast Massachusetts/Rhode Island
SENE	Southeastern New England
SNCR	selective non-catalytic reduction
SO_2	sulfur dioxide

SPCC	Spill Prevention, Control and Countermeasure
Station	existing Canal Generating Station
SWPPP	Stormwater Pollution Prevention Plan
the District	Old King's Highway Regional Historic District
TMNSR	Ten-Minute Non-Spinning Reserve
TR	Transportation
TRC	TRC Environmental Corporation
TSS	total suspended solids
ULSD	ultra-low sulfur distillate
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds
V-Zone	velocity zone
WET	wetlands
WM	waste management
WMA	Water Management Act
WPA	Wetlands Protection Act
WPH	Wildlife and Plant Habitat
WR	water resources

APPLICATION COVER SHEET

Application Cover Sheet

Cape Cod Commission
3225 Main Street, PO Box 226
Barnstable, MA 02630
Tel: (508) 362-3828 • Fax: (508) 362-3136

For Commission Use Only

Date Received:
Fee ($):
Check No:
File No:

A Type of Application (check all that apply)

- [X] Development of Regional Impact (DRI)
- [ ] Hardship Exemption
- [ ] Limited DRI Review
- [ ] Jurisdictional Determination
- [ ] DRI Exemption
- [ ] Request for Joint MEPA/DRI Review

B Project Information

Project Name: NRG Canal 3 Development Project

Total Site Acreage: 52.02 acres

Project/Property Location: 9 Freezer Road, Sandwich, Barnstable County, MA 02563

Zoning: Industrial

Brief Project Description:

Include total square footage of proposed and existing development, gross floor area, number of lots existing or to be created, specific uses, description of existing conditions, as applicable (attach additional sheets if necessary).

See Continuation

C Owner(s) of Record

List the following information for all involved parcels. Provide copies of each Deed and Purchase and Sale Agreement and/or evidence of leasehold interest, if applicable, for all involved parcels. Proof of ownership/legal rights for Applicant(s) to proceed with the proposed development must be documented prior to the Commission deeming any application complete (attach additional sheets if necessary).

Map/Parcel	Owner's Name	Lot & Plan	Land Court Certificate of Title #	Registry of Deeds Book/Page #
Map 91 Lot 3	NRG Canal LLC	Lot 7 Plan 14716-D	Ctf. No. 151549	
Map 92 Lot 2	NRG Canal LLC	Plan 33200A	Ctf. No. 151549	

There **ARE/ARE NOT** (circle one) court claims, pending or completed, involving this property (if yes, please attach relevant information).

D Certification

I hereby certify that all information provided on this application form and in the required attachments is true and accurate to the best of my knowledge. I agree to notify the Cape Cod Commission of any changes on the information provided in this application, in writing, as soon as is practicable. I understand failure to provide the required information and any fees may result in a procedural denial of my project.
NOTE: For wireless communication facilities, a licensed carrier should be either an applicant or a co-applicant.

APPLICANT

Applicant(s) Name: NRG Canal 3 Development LLC Tel: (617) 529-3874 Fax:

Address: 9 Freezer Road, Sandwich, Barnstable County, MA 02563

Signature: John Chillemi Date: September 25,2016

CO-APPLICANT

Co-Applicant(s) Name: Tel: Fax:

Address:

Signature: Date:

CONTACT

Contact: Shawn Konary Tel: (617) 529-3874 Fax:

Address: 9 Freezer Road, Sandwich, Barnstable County, MA 02563

Signature: Shawn Konary Date: September 23, 2016

PROPERTY OWNER

Property Owner: NRG Canal LLC* Tel: (617) 529-3874 Fax:

Address: 9 Freezer Road, Sandwich, Barnstable County, MA 02563

Signature: Date: September 23, 2016

BILLABLE ENTITY

Name: NRG Canal 3 Development LLC Tel: (617) 529-3874 Fax:

Address: 9 Freezer Road, Sandwich, Barnstable County, MA 02563

*Formally named Southern Energy Canal, LLC, Mirant Canal, LLC & GenOn Canal, LLC

Cape Cod Commission - Application Cover Sheet

(Continuation Page 1a)

Brief Project Description:

NRG Canal LLC owns approximately 52 acres of land (the "Property"), north of an active railroad right-of way owned by Massachusetts Department of Transportation and operated by Cape Cod Central Railroad, in the Town of Sandwich at which the existing Canal Generating Station (the "Station") and ancillary structures and infrastructure currently are located. The Property is bounded by Freezer Road and land owned by the United States Army Corps of Engineers to the east; by Canal Service Road and the Cape Cod Canal to the north; the Town of Bourne to the west; and Rickey's Road and railroad ROW to the south. The majority of the Property is currently developed to support the existing Canal Generating Station, which includes one oil and one oil and gas-fueled electric generation units with an output capacity of approximately 1,120 MW, a 498-foot high exhaust stack, several aboveground oil storage tanks, ammonia storage tanks, and appurtenant structures and infrastructure. The Property is located within the Massachusetts Coastal Zone and a majority of the Property is located within the FEMA-Mapped 100 year flood zone. The Property is zoned "Industrial Limited."

NRG Canal 3 Development LLC ("NRG Canal 3"), seeks to permit, construct, and operate a state-of-the-art, fast-starting, dual-fueled simple-cycle electric generating facility (the "Project") proposed on the Property. The Project will utilize a single General Electric (GE) 7HA.02 combustion turbine, or a comparable unit, with an approximate net nominal capacity of 350 MW[1] and will operate during peak times of energy demand, for up to 4,380 hours per year with a maximum of 720 hours on ultra-low sulfur distillate (ULSD) to provide the flexibility and reliability to meet the region's demonstrated power needs. The Project will include an approximately 220- foot tall stack.

Canal Unit 3 is proposed on approximately 12 acres on the Property (the "Project Site"), of which the Project will permanently occupy approximately 10.6 acres, with natural gas and ULSD interconnections running west-to- east along existing interconnection corridors. The Project Site is currently occupied by concrete-slab, aluminum-sided warehouses, two ammonia storage tanks, several temporary trailers, and hard-packed open area used for temporary parking. An electrical interconnection will connect the simple-cycle unit to the existing electrical grid via the Eversource-owned switchyard, located to the south from the Property, across Rickey's Road and the Cape Cod Central Railroad ROW, owned by Massachusetts Department of Transportation (MassDOT). Temporary use of land within the Property will occur during construction for parking and laydown. The proposed in-service date for the Project is June 2019.

[1] The gross electrical output of the combustion turbine will vary from approximately 330 MW at higher ambient temperatures to approximately 365 MW at very low temperatures.

REQUIRED FILING MATERIALS

The following must be attached to the Application Form at the time of its filing:

☒ Certified List of Abutters (required for all application types except Attachment 5, Jurisdictional Determination). A list of abutting property owners within 300 feet of the boundaries of the development site and their addresses. Include both local and off-Cape addresses when applicable.

See Attachment 1a.

- ☒ This list **must** be formatted in three columns consistent with the Standard Label Format designed to print on Avery Labels #5160.
- ☒ List must be certified by the Town Assessor's office. Note: Assessor's offices may take up to 10 days to certify an abutter's list.
- N/A ☐ If there are more than 50 abutters, applicants must provide **three sets** of the certified list on self-adhesive labels.

N/A ☐ Required Filing Fee. Please calculate according to the Schedule of Fees (see Enabling Regulations, Section 14). Please make check payable to **BARNSTABLE COUNTY TREASURER.**

☒ An 8 1/2"x 11" copy of the U.S.G.S. quadrangle map of the area, containing sufficient information for the Commission to locate the site of the proposed development.

See Section 4, Plan C-1.

☒ Development Plans. File as required for each application type you are making. See list of Attachment(s) below for specific instructions.

See Section 4, Plan D-2.

☒ Permits or Actions. List of local, state, or federal agencies or boards from which a permit or other actions have, will, or may need to be sought. Include agency/board name, type of permit, date filed, and file number. If one of the listed permits or actions requires the filing of an Environmental Notification Form under the Massachusetts Environmental Policy Act (MEPA), please contact the Commission's Chief Regulatory Officer to discuss the potential for joint Commission and MEPA review. For information on MEPA regulations contact the Executive Office of Energy and Environmental Affairs, MEPA Unit, at (617) 626-1020. Please attach all relevant MEPA documents and describe the status of the MEPA filing.

See Attachment 1b.

Applicants must also submit the necessary attachment(s) based on the type of application(s) being made:

Attachment 1:	DRI Application Filing Procedures & Requirements
Attachment 2:	DRI Exemption Application Filing Procedures & Requirements
Attachment 3:	Hardship Exemption Application Filing Procedures & Requirements
Attachment 4:	Limited DRI Review Application Filing Procedures & Requirements
Attachment 5:	Jurisdictional Determination Application Filing Procedures & Requirements
Attachment 6:	Joint MEPA/DRI Review Application

STEP FOUR: DRI CONSISTENCY REVIEW

Once an application is deemed *complete*, a substantive public hearing will be scheduled and Commission staff shall review the application for its consistency with the Act, Regional Policy Plan (RPP), Districts of Critical Planning Concern regulations, municipal development bylaws, and certified Local Comprehensive Plans and prepare a staff report. The RPP and associated technical bulletins applicable to the Commission review of the proposed development shall be those in effect at the date of the first substantive public hearing.

SECTION II. REQUIRED SUBMITTALS:

☒ **1. Application Cover Sheet and its Required Filing Materials.**

☒ **2. Massachusetts Historical Commission (MHC) Notification Form**. Applicant must complete and submit a Project Notification Form (PNF) to the MHC (PNF may be obtained from Commission staff or from MHC's web site). *(state.ma.us/mhc/mhcform/formidx.htm)*

a. ☒ If the proposed project involves demolition or alteration of a historic structure, current photographs of the historic structure and elevation drawings showing all proposed building facades should be included with the PNF. (This will allow MHC to provide comments on the PNF more quickly.) Copies of all submitted materials must be provided to the Commission.

b. ☒ Submit proof of receipt of PNF by the MHC.

☒ **3. Certification of Local Filing.** Provide certification of filing copies of **this** completed application with the Town Clerk, Building Inspector, DRI Liaison, Planning Board, and any other local board before which a permit is pending or action is required for this proposed project. It is the ongoing responsibility of the Applicant to continue to provide these municipal agencies and boards with all materials provided to the Commission throughout the DRI review process.

☒ **4. Required Plans.**

A. **Plan Size Requirements.** For each plan submitted, provide each of the following:

☒ Copy of plan(s) sheet size 24" x 36"

☒ Copy of plan(s) reduced to fit sheet size 11" x 17"

B. **General Requirements:**

☒ All plans should be drawn at a scale of 1" = 40', however other scales which provide sufficient detail are acceptable.

☒ If the plan requires more than one sheet, a cover sheet at the scale of 1"= 200' showing the entire property must be included.

☒ Include a locus map at 1:25,000 scale with the outline of the entire property clearly shown.

☒ Legal Data to Appear on **ALL** Submitted Plans, as appropriate:

1. ☒ Name and address of Applicant and authorization of owner if different from Applicant.
2. ☒ Name and address of owner(s) of record, if different from Applicant.
3. ☒ Name and address of person(s) or firm preparing the plan.
4. ☒ Current zoning classification of property, including exact zoning boundary if the development site is in more than one district.
5. ☒ Property boundary line plotted to scale. Distances, angles, and area should be shown.

6. ☒ North arrow, scale, and date.
7. ☒ Property lines and names of owners of adjoining parcels.
8. ☒ Location, width, and purpose of all existing and proposed easements, setbacks, reservations, and areas dedicated to public use within and adjoining the property.
9. ☒ Date of plan(s) and subsequent revisions.
10. ☒ Plans must be stamped with original stamp of registered architect, landscape architect, or professional engineer, as appropriate.

C. **Existing Conditions Plans.** Shall show the following:

1. ☒ **EXISTING** topography at contour intervals of no more than five feet.
2. ☒ Hydrologic features on-site or within 300 feet of the project boundary, including water bodies, wetlands, vernal pools, and floodplains.
3. ☒ Vegetative cover, including existing wooded areas, existing landscaped areas, and other significant features.
4. ☒ Indicate by survey point any trees that may qualify as Specimen Trees (Refer to definition of *Specimen Tree* in 2009 Regional Policy Plan.)
5. ☒ Where applicable, indicate in a table the square footage or acreage of the following: developed areas, open space or undisturbed areas, and wetlands.
6. ☒ Use, location, and dimensions of major buildings and/or structures, including but not limited to parking and loading areas, fences, walls, and docks.
7. ☒ Location and width of existing rights of way, roads, and paths, including site access. Information should include road geometry, sight distances, and emergency vehicle access.
8. ☒ Location of any existing sewage disposal facilities, water supply facilities and stormwater utilities.
9. ☒ Electric, gas, telephone lines, cable TV and appurtenances, and any other easements.
10. ☒ Identify historically significant sites, buildings, and/or features.

D. **Proposed Development Plans**. Shall show the following:

1. ☒ Grading and drainage plan showing **PROPOSED** topography at appropriate contour intervals. Erosion Control Measures (hay bales, fences, etc.) proposed for use should be noted. (Note that proposed grading and drainage must be shown on a **separate sheet** from the existing conditions.)
2. ☒ Location, proposed use and dimensions of all buildings and other structures, such as retaining walls, fences, docks, outdoor storage tanks, air-conditioning units, and waste disposal units. Include total square footage of impervious building area.
3. ☒ Location and arrangement of site access and egress, including parking, loading, outdoor storage areas and all paths for pedestrian travel within the site. Information should include profiles and cross-sections of roadways and sidewalks showing grades and widths. Include total square footage of impervious area from all paved surfaces.
4. ☒ Indicate in a table the square footage or acreage of the following: developed areas, open space or undisturbed areas, and wetlands.
5. ☒ Location, design and construction of all water, sewage disposal, stormwater disposal, oil, electric, gas and solar energy facilities.
6. ☒ General landscaping plan and planting schedule, including the treatment of buffer areas, the location, quantity, types, and size of all plant materials, and natural areas to be retained.
7. ☒ Elevation drawings (to scale) of all building façades that also specify all exterior building materials.
8. ☒ A roof plan showing the direction of all roof slopes, all roof materials, and the location of all rooftop equipment.

9. ☒ Floor plans of proposed buildings and other structures for all floors (as requested by Commission staff).
10. ☒ Samples of all proposed exterior materials are required for projects not using traditional wood or brick building materials. A materials board must include samples of all proposed exterior wall, trim, and roof materials, as well as their proposed colors.
11. ☒ Location, size, materials, and design of all outdoor lighting facilities and signs.

☒ **5. Supporting Studies, Reports, or Information.**

Note that the Commission's regulatory staff may initially waive some of the following requirements due to the location, size, or type of development. Guidance on these items, and the timing of their filing, may be obtained at the pre-application meeting.

A. ☒ Detailed Project Description. Clearly describe the scope of work, including the relationship of the proposal to the existing conditions on-site and the existing and proposed uses. Also:

☒ Clearly discuss the impacts of your project and how they will be mitigated.

☒ Explain how the project benefits the community and the region by meeting or exceeding the Regional Policy Plan's Minimum Performance Standards and Best Development Practices.

B. ☒ Written Design Narrative. The narrative should present the Applicants analysis of the context of the project's surroundings and the relationship of the project to this context (including a discussion of approaches taken and the success and appropriateness of the selected approach). Clearly explain the design concept, alternatives considered, and how the proposed project's siting and building design are consistent with Technical Bulletin 96-001, *Designing the Future to Honor the Past, Design Guidelines for Cape Cod*, as amended and with the Addendum to Technical Bulletin 96-001, *Contextual Design on Cape Cod: Design Guidelines for Large-Scale Development* (where applicable). Include information regarding materials, colors, and construction methods to be used.

C. ☒ A traffic impact analysis in accordance with Technical Bulletin 96-003, *Guidelines for Transportation Impact Assessment*, as amended.
D. ☒ A nitrogen loading analysis for existing and proposed conditions in accordance with Technical Bulletin 91-001, *Nitrogen Loading*, as amended.
E. ☒ Proposed monitoring well plan (sampling schedule), showing well locations, top of casing elevations, water table elevation, and other relevant information (if applicable).
F. ☒ Copies of any ground water discharge permits or wastewater treatment pilot project approvals from the Department of Environmental Protection, or any ground water investigations or studies.
G. ☒ Information on 21-E site assessments concerning environmental contamination on or affecting the project site (if available).
H. ☒ A plant and wildlife habitat assessment in accordance with Technical Bulletin 92-002, *DRI Guidelines for Natural Resources Inventory*, as amended.
I. ☒ Project, employment, and economic impact information in accordance with Technical Bulletin 04-002, *DRI Economic Development Technical Bulletin*, as amended.
J. ☒ Information on how the project will satisfy the Regional Policy Plan's affordable housing requirements, and, where applicable, Technical Bulletin 09-001, *DRI Guidelines for Mitigation Credit and Reduction of Minimum Performance Standard AH3.2*, as amended *and/or Technical Bulletin 10-001, DRI Guidelines for Calculation of Mitigation for DRIs in "Other" Category for Minimum Performance Standard AH3.1, as amended.*
K. ☒ Information on the sales price and/or rent including the methodology and assumptions used, breakdown on the number of bedrooms, size of bedrooms for affordable housing units and provisions for special needs housing.

L. ☒ Information on the types, amounts, methods of generation, use, storage, treatment, and disposal of solid wastes and/or hazardous materials and/or hazardous wastes.

M. ☒ Information on the provisions of open space in accordance with Technical Bulletin 94-001, *Guidelines for Calculation & Provision of Open Space in DRIs*, as amended.

N. ☒ For projects involving a structure that is listed on the National or State Register of Historic places, or that is a historic structure, submit photographs of the existing property, buildings, and the surrounding properties.

O. ☒ Information on construction sequencing for any rehabilitation or alteration work proposed on a structure that is listed on the National or State Register of Historic Places.

P. ☒ Information on exterior lighting in accordance with Technical Bulletin 95-001, *DRI Guidance for Exterior Lighting Design*, as amended.

Q. ☒ Information on the project's energy use in accordance with Technical Bulletin 09-002, *DRI Guidelines for Energy Compliance*, as amended.

R. ☒ For projects involving telecommunications facilities (monopoles, self supporting or guyed towers, etc.), information in accordance with Technical Bulletin 97-001, *Guidelines for DRI Review of Wireless Communication Towers,* as amended.

SECTION III. IMPORTANT NOTES:

If you have any questions or require assistance in completing this application form, please contact a member of the Commission's Regulatory staff at (508) 362-3828. A copy of the current Regional Policy Plan and Commission regulations are available at the Commission office or on the web at www.capecodcommission.org.

Copying Requirements

Note that additional copies of all submitted materials will be requested prior to scheduled meetings and hearings throughout the review process in accordance with the schedule below; however, the project Regulatory staff will contact the Applicant to discuss the required copies at each stage in the DRI review process:

- Once the DRI Application is deemed *complete* and the project Regulatory staff has scheduled a public hearing, the Applicant should provide eight (8) copies of the completed application (for inclusion in the Commission's files and distribution to Commission Subcommittee members).

- Fourteen (14) calendar days prior to any scheduled Subcommittee public hearing or meeting, eight (8) copies and one (1) electronic copy of any supplemental materials, revised reports or plans should be provided.

- Seven (7) business days prior to a final hearing before the full Commission, up to nineteen (19) copies of all materials should be submitted for distribution by Commission staff to Commission members.

If the Applicant fails to provide the necessary copies in a timely manner, any copies that must be produced by the Commission will be charged to the DRI Applicant in accordance with the *Schedule of Fees.*

In the event that a significant volume of copying needs to be undertaken by the Commission that necessitates the services of an outside vendor, the Applicant will be charged for this copying.

In an effort to reduce use of paper, the Commission can accept certain application materials electronically and/or on a CD. Also, in an effort to reduce non-recyclable materials, the Commission would prefer that all materials be submitted on recycled content paper and be printed double-sided. Additionally, please avoid the use of metal or plastic ring binders and plastic report covers.

1.0 INTRODUCTION

NRG Canal 3 Development LLC (Canal 3) proposes to construct a new, highly efficient, fast-starting, approximately 350-megawatt (MW)[1] peak electric generating unit (the Project) at the existing 52-acre Canal Generating Station site on Freezer Road in Sandwich, Massachusetts (the Property). Site Development Plans for the Project are provided in Section 4.0.

The Property has been used for power generation since the late 1960s, when the Canal Generating Station (the Station) became operational. The Property is generally bounded to the south by a railroad right-of-way (ROW), to the east by Freezer Road, and to the west by undeveloped land in the town of Bourne. The Cape Cod Canal lies to the north, with a public access walkway maintained by the United States Army Corps of Engineers (USACE) located along the Property boundary, adjacent to the canal. The proposed Project will be located on approximately 12 acres (Project Site) within the Property (see Site Development Plans in Section 4.0). The entire Property, including the proposed 12-acre Project Site, is zoned as "Industrial Limited" (IND) by the Town of Sandwich and is currently occupied by appurtenant structures supporting the existing Station. The main access road to the Property from Freezer Road passes along the southern boundary of the Property, just south of the proposed Project Site. The currently operating electric generating units and most of the associated facilities are located west of the proposed Project Site.

The Project will include one state-of-the-art simple-cycle combustion turbine with a net nominal electrical output of approximately 350 MW. Canal 3 plans to use a General Electric (GE) 7HA.02 combustion turbine generator (CTG), or a comparable unit. The Project is expected to operate during times of peak energy demand, for up to 4,380 hours per year and would run primarily on natural gas, with up to 720 hours per year on ultra-low sulfur distillate (ULSD), as the back-up fuel. The proposed Project will be equipped with state-of-the-art emissions control technologies, a near-zero liquid discharge design to reduce water demand, and noise attenuation, including an acoustically treated enclosure around the new turbine. The Project will meet all applicable local, state, and federal environmental regulations.

The Project will directly interconnect with the electrical grid via the existing NSTAR Electric Company d/b/a Eversource Energy (Eversource) 345-kilovolt (kV) switchyard and transmission lines located south of the Property, requiring an easement across an active railroad ROW owned by Massachusetts Department of Transportation (MassDOT) and operated by the Cape Cod Central Railroad. Canal 3 will construct an approximately 1,850-foot, three-phase 345-kV overhead circuit from a circuit breaker at the new generator step-up transformer to the Eversource switchyard.

Natural gas for the proposed Project will be delivered via an interconnection to the Algonquin Gas Transmission, LLC (AGT) pipeline. An existing interconnection already serves the Station; however, the proposed Project will require higher pressure natural gas. A new 3,590-foot natural gas pipeline will be constructed within the Property from the existing natural gas pipeline to the new gas compressor building, as shown in the Site Development Plans in Section 4.0

ULSD for the Project will be transported to the Project by barge, using the same delivery practices as used for the existing Station. A new unloading pipe will be installed adjacent to the existing unloading line. Storage of the ULSD will be within an existing 5.7-million-gallon storage tank and a 1.8-million-gallon day tank, both of which are equipped with full secondary containment. As shown in the Site Development Plans in Section 4.0, a new approximately 4,000-foot pipeline within the Property will connect the dock, ULSD storage tank, day tank, and CTG.

The existing 1,120-MW Station, which occupies the western portion of the Property, consists of two steam-electric generating units, each with a nominal generating capacity of 560 MW, served by a single 498-foot

[1] The gross electrical output of the CTG will vary from approximately 330 MW at higher ambient temperatures to approximately 365 MW at very low temperatures.

exhaust stack, several aboveground fuel oil storage tanks, ammonia (NH_3) storage tanks, and other appurtenant structures and infrastructure. The two existing 60,000-gallon NH_3 storage tanks, already located on the Project Site, will be enclosed in a new building and used to store NH_3 for the Project's selective catalytic reduction (SCR) system. Raw water will be supplied by the existing non-potable water supply wells (Well Nos. 2 and 3), which currently serve the existing Station.

The proposed Project is intended to provide additional needed capacity to the Southeast Massachusetts/Rhode Island (SEMA/RI)[2] load zone in the Independent System Operator-New England (ISO-NE) electric grid, to help meet energy demand during peak times.

In addition, the Project will enhance the region's overall electric system and support the future of renewable energy development in Massachusetts by providing a fast-starting back-up for intermittent renewable energy sources such as solar and wind. The proposed Project will also provide financial benefits including jobs during and after construction, and it will have a significant positive impact on the Town of Sandwich's property tax base.

Construction of the proposed Project is scheduled to begin in the summer of 2017 and continue for a period of 24 months. As the Project cleared in ISO-NE's most recent Forward Capacity Auction (FCA), held in February 2016, it is required to commence commercial operation no later than June 2019.

[2] On November 10, 2015, ISO-NE made a filing at the FERC with specific information related to FCA #10. Within that filing, they confirmed that only two capacity zones will be modeled in FCA #10: Southeastern New England (SENE) and Rest of Pool (ROP). SENE is a new capacity zone that includes two zones previously known as SEMA/RI and Northeast Massachusetts (NEMA).

2.0 MASSACHUSETTS HISTORICAL COMMISSION NOTIFICATION FORM

The Station is designated by the Town of Sandwich as a historic site. An archaeological investigation, including pedestrian survey of the Property and consultation with the Massachusetts Historical Commission (MHC), was undertaken in 1998 in support of a previously proposed project on the proposed Project Site. The investigation determined that, due to the extent of prior disturbance, it was unlikely any intact archaeological resources were present on the Property. Early twentieth century construction of the Cape Cod Canal, which involved deposition of dredged material on the Property, and erection of the existing Station, disturbed the area and likely caused the loss of any belowground resources that might have been present. Additionally, in the 1960s and 1970s, the Project Site was utilized as a staging area during the construction of Units 1 and 2. The MHC reviewed the 1998 archaeological investigation and determined that the proposed activity was "unlikely to affect significant historic or archaeological resources." The 1998 MHC correspondence is provided as Attachment 2A.

Although the proposed Project will be constructed adjacent to the existing Station structures, it will not alter any designated historic structures or features. A Project Notification Form (PNF) was submitted to the MHC on July 29, 2015. On October 2, 2015, the MHC confirmed that it had no comments in association with the Project. The PNF, Proof of Receipt, and the MHC's response are provided in Attachment 2B.

ATTACHMENT 2A: MHC 1998 CORRESPONDENCE

TRC

JUN 30 [illegible]

June 29, 1998

Mr. Gary Hammer
Director of Architecture Review
Massachusetts Historical Commission
220 Morrisey Boulevard
Boston, Massachusetts 02125

Subject: ***Canal Unit 3***
Canal Station
Sandwich, Massachusetts
Environmental Notification Form

Dear Mr. Johnson:

TRC Environmental Corporation is assisting Southern Energy in preparing an Environmental Notification Form for the construction of the combined Cycle Energy Project in Sandwich, MA.

Southern Energy Canal, L.L.C., is proposing to add an additional 525 megawatts (MW) of electric power generation capacity at the existing Canal Station in Sandwich, Massachusetts. The new equipment will be located on existing facility property, immediately adjacent and west of the existing Canal Station power block building.

We request your assistance in verifying that there are no historical sites or structures or archaeological sites associated with 9 Freezer Street (see attached site location map). We would appreciate a written response from you at your earliest convenience.

Thank you in advance for your assistance. Please contact me at (978) 656-3517 if you have any questions or need additional information regarding this project.

Sincerely yours,

Laura Lefebvre
Project Engineer

After review of MHC files and the materials you submitted, it has been determined that this project is unlikely to affect significant ~~historic~~ or archaeological resources.

MHC #RC. 21954 13 July 1998

Edward L. Bell — Date
Senior Archaeologist
Massachusetts Historical Commission

TRC Environmental Corporation
Boott Mills South, Foot of John Street • Lowell, Massachusetts 01852
Telephone 978-970-5600 • Fax 978-453-1995

Customer-Focused Solutions

ATTACHMENT 2B: PNF, PROOF OF RECEIPT, MHC CORRESPONDENCE

APPENDIX A

MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS. 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: (1) Canal Unit 3; (2) Canal Community Solar

Location / Address: 9 Freezer Road

City / Town: Sandwich

Project Proponent

Name: (1) NRG Canal 3 Development LLC; (2) NRG Renew Canal 1 LLC

Address: 9 Freezer Road

City/Town/Zip/Telephone: Sandwich, Barnstable County, MA, 02563, (508) 833-5363

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name	Type of License or funding (specify)

See attached Continuation Page 1a.

Project Description (narrative):

See attached Continuation Page 1b.

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition.

The Project will include demolition of several slab-based, aluminum-sided warehouse structures which currently occupy the Simple-Cycle Site (Photograph 3). Several trailers and two ammonia storage tanks will also be relocated within the Property (Photograph 4). No structural demolition is required at the Solar Site, however, clearing of wooded vegetation and scrub/shrub will occur. A vegetated buffer will be left around the solar array to minimize visual impact.

Does the project include rehabilitation of any existing buildings? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.

The Project does not include rehabilitation of any existing buildings.

Does the project include new construction? If so, describe (attach plans and elevations if necessary).

Construction of Canal Unit 3 will include a GE 7HA.02 generating unit, or equivalent, an approximatly 213-foot tall exhaust stack, several interconnections, and associated ancillary equipment. Canal Solar will include installation of two solar arrays comprised of 305-Watt LG photovolatic modules. All elements will be no taller than existing structures, and contained within the 88-acre Property. Plot Plans for Canal Unit 3 and Canal Solar are attached.

MHC Project Notification Form
(Continuation Page 1a)

List of Agency Permits Potentially Required

Agency Name	Type of License	Comments
Federal Aviation Administration (FAA)	Notice of Construction for Stack	Existing structures will be taller than proposed Project elements
U.S. Army Corps of Engineers (USACE)	Programmatic General Permit	Not anticipated, as wetlands can likely be avoided
U.S. Environmental Protection Agency (USEPA)	NPDES Stormwater Discharge Permits (construction and operation)	
Energy Facilities Siting Board (EFSB)	EFSB Approval	
Massachusetts Department of Environmental Protection (MADEP)/Bureau of Waste Prevention – Air Quality	PSD/NSR/Air Plan Approval/Title V Operating Permit Modification	
MADEP/Division of Water Quality	Industrial Discharge Permit	
MADEP/Division of Water Quality	Water Quality Certification	
MADEP/Division of Waterway	Chapter 91 License	Not anticipated, as no in-water work is proposed
MADEP/Sandwich Conservation Commission	Request for Determination of Applicability and/or Notice of Intent under Wetlands Protection Act	Associated with Land Subject to Coast Storm Flowage
Massachusetts State Fire Marshall	Hazardous Substance Tank Approval	
Massachusetts Department of Transportation (MassDOT)	Approval under M.G.L. Ch. 40, Section 54A	
Coastal Zone Management (CZM)	Federal Consistency Concurrence	
Cape Cod Commission	Development of Regional Impact Review	Joint review with MEPA
Town of Sandwich Old King's Highway Historic District Committee	Certificate of Appropriateness	Proposed work is consistent with goals and policies of the Town.

MCH Project Notification Form

(Continuation Page 1b)

Proposed Description (narrative):

NRG Canal 3 Development LLC seeks to permit, construct, and operate a dual-fueled simple cycle electric peaking unit (Canal Unit 3) and NRG Renew Canal 1 LLC seeks to permit, construct, and operate a photovoltaic solar array (Canal Solar). Both projects are proposed to be located within the existing Canal Generating Station property in Sandwich, Barnstable County, Massachusetts. The Property is bisected by an existing railroad right-of-way, with the 52-acre Northern Area proposed for Canal Unit 3 and the 36-acre Southern Area proposed for Canal Solar.

Although the two proposed projects will only occupy a fraction of the Canal Generating Station property, review of the entire 88-acre Property (see Figure 1) is requested, as project-related interconnections and relocation of existing facilities may occur in selected locations. The Property is bounded by Freezer Road to the East; by Canal Service Road to the North; the Town of Bourne to the west; and Tupper Road and Route 6A to the south. The existing Canal Generating Station occupies the entire northwestern portion of the Property. To the North, beyond Canal Service Road, is the Cape Cod Canal; East Boat Basin, a recreational and commercial marina, lies east of the Property, on the eastern side of Freezer Road. The entire Property is located within the Massachusetts Coastal Zone, with a majority of the Property located within the 100-year flood zone as delineated by Federal Emergency Management Agency (FEMA).

Much of the Northern Area is currently developed to support the existing Canal Generating Station, a 1,200-megawatt dual-fueled steam electric generating plant, located adjacent to the proposed Simple-Cycle Site (Photographs 1 – 4). Two large aboveground storage tanks are located on the northern portion of the Southern Area, adjacent to the proposed Solar Site (Photographs 5 – 8). A switchyard and associated high-voltage transmission lines, owned by Eversource (formerly known as NSTAR) and located on Rickey's Road south of the existing units, connect the generating units to the New England power grid.

APPENDIX A (continued)

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? If so, specify. The Canal Generating Station is designated by the Town of Sandwich as a Historic Site within the Old King's Highway Regional Historic District. Proposed structural development and alterations in this District are subject to review and approval by the Town's Old King's Highway Historic Commission. The proposed Project is consistent with the goals and policies of the Town; therefore, the Project is not anticipated to significantly affect any known historical or archaeological resources.

What is the total acreage of the project area?

Woodland	2.2 acres	Productive Resources:	
Wetland	5.5 acres	Agriculture	0 acres
Floodplain	57.3 acres	Forestry	0 acres
Open space	9.8 acres	Mining/Extraction	0 acres
Developed	49.7 acres	Total Project Acreage	88 acres

What is the acreage of the proposed new construction? 22 acres

What is the present land use of the project area? Much of the Property is developed to support the existing Canal Generating Station, a 1,200-megawatt steam electric generating plant which includes two dual-fueled electricity generating units, a 498-foot high exhaust stack, several oil tanks, ammonia storage tanks, and appurtenant facilities. A switchyard and associated high-voltage transmission lines, located on Rickey's Road, connect the station to the power grid. The Nothern Area, on which the existing generaiton station is located and Canal Unit 3 is proposed, is zoned "Industrial," and the Southern Area, on which Canal Solar is proposed, is zoned "Business Limited."

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location. See Figure 1.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submitting this form: _____ Date: _____

Name: Jackie Bruce

Address: 238 Littleton Road, Suite 201-B

City/Town/Zip: Westford, MA, 01886

Telephone: (978) 212-3284

REGULATORY AUTHORITY

950 CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St. 1988, c. 254.

Legend

Canal Property

N

0 500 1,000 2,000 Feet

USGS Topographic Map

NRG Renew Canal 1 LLC
NRG Canal 3 Development LLC
Sandwich, Massachusetts

Photograph 1. The Project Site
(view toward the southwest)

Photograph 2. The Project Site
(view toward the northwest)

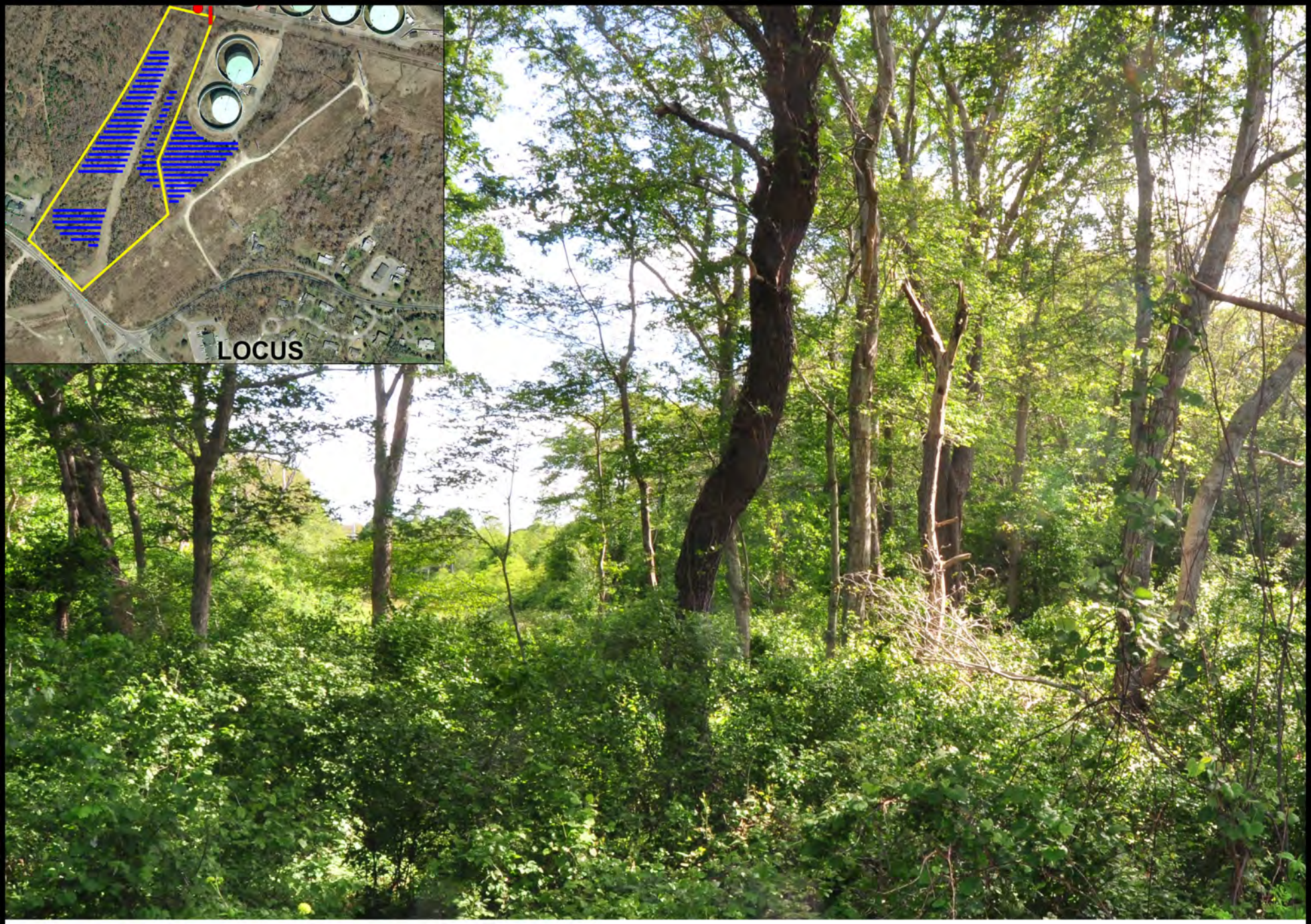
Photograph 3. Warehouses to be demolished
(view toward the northwest)

Photograph 4. Ammonia tanks & trailers to be relocated
(view toward the northwest)

Photograph 5. View of Solar Site
(view toward the northeast)

Photograph 6. View of Solar Site
(view toward the northwest)

Photograph 5. View of Solar Site
(view toward the northwest)



Photograph 5. View of Solar Site
(view toward the south)

31380-B024-16-11-220

N
PLANT NORTH
PLANT NORTH

PLANT NORTH

EXISTING SOUTH PRISM LINE
EASEMENT 5
EXIST. GATE
FENCING
EASEMENT 7
UNIT NO.2-C.W. INTAKE FLUME
TOP OF EXISTING RIPRAP
BRIDGE
HIGH WATER MARK
UNIT 1 C.W. INTAKE FLUME
UNIT 1 C.W. DISCHARGE FLUME
EXISTING SERVICE ROAD
R = 8114.49'
L=1393.33'
N282647.32
P.T. E870865.37
S 35°-08'-43" E 471.90'
P.I. N282581.76 E871298.00
NACLO STG TANK
RANGE TOWER w/ LIGHT
TRANS. LD TWR
DISCH. FLUME
TOP OF RETAINING WALL EL. 15.5'
S 84°-40'-00" W
NEW ROAD - EL 15.0' (SEE NOTE 1)
GRADE - EL 16.0' (SEE NOTE 2)
N282440.8
E869347.6
RELOC. SERV. RD.
PARKING
MAIN TRANS.
SERV TRANS
FUT. CONVEYOR
PUMP HSE
RES. SERV. TRANS
STA. SERV. TRANS.
TURBINE ROOM
N282481.47
E870100.00
AREA LOW POINT
AUX. BAY
UNIT "2" BOILER ROOM
UNIT "1" BOILER ROOM
ROOF TOWERS
STACK
WASTE POND
PRECIPITATOR
I.D. FAN HOUSE
℄ OF STACK N282201 E870395 (SEE NOTE 3)
SETTLING BASIN
EL.18'-0"
116' DIA. STEEL DIKE
80'-0" DIA.
S 76° 33' 04" E
S 76° 33' 04" W
595'
SWYD
106'
DUCT LINE
GATE
SWITCHYARD
390'
PROPERTY LINE
N28192?.86
E869879.67
N 29° 16' 25" W
S 15° 17' 46" W
162.87'
CENTRAL RR. R=5080.59' L=640.05'
R=5098.59'
R.R. P.C. N?23475.18
P.I. N281720.70 E871054.51
ACCESS ROAD
GATE
27' DOUBLE SLIDE GATE
N 47° 00' E
N 42° 28' W
N 2° 30' E
143.37'
139.55'
113.91'
241.28'
S 67° 19' 06" W
175.07'
S 12° 59' 51" E
237.71'
L = 211.28'
R = 541.40'
L = 141.62'
R = 3066.57'
248.75'
S 74° 12' 44" W
L=68.68'
R=970.00'
TUPPER ROAD
EXIST. R.R. SPUR
EXIST. SERV. RD.
EASEMENT 5
EASEMENT 2
EASEMENT 3
GATE HOUSE
WATER METER
DETAIL 2
DETAIL 1
P.I.2
N282175.70
P.C. E871225.53
N281066.21
E871184.37
NO. 1 TURNOUT
N281993.41
P.T. E871157.01
PT. OF SWITCH STA. 5+08.63
N281943.37
E871055.41
STA. 2+00
N281568.23
P.C. E871303.01
P.S. STA. 1+25
FREEZER ROAD (PRIVATE)
EASEMENT 4
EASEMENT 1
S 20° 35' 59" W
689.14'
R=5196.03'
L=1079.37'
S 15° 36' 10" W
CURVE 1
CURVE 2
CURVE 3
P.T.
P.C.

LEGEND
001 GAS TURBINE GE 7HA.02
002 GENERATOR
003 SCR/CO2 CATALYST
004 TEMPERING/PURGE FANS
005 STACK
006 EMERGENCY DIESEL GENERATOR
007 LUBE OIL SKID
008 CEMS
009 COMPRESSED AIR SYSTEM
010 COOLING FAN MODULE
011 EXISTING WELL NO.4
012 SERVICE WATER/FIRE PROTECTION PUMP HOUSE
013 DEMINERALIZED WATER SYSTEM
014 WATER TREATMENT PLANT
015 HYDROGEN STORAGE AREA
016 EXISTING TRAINING BLDG. / NEW CONTROL RM.
017 EXISTING AMMONIA STORAGE AREA
018 GAS COMPRESSOR
019 GAS PRE-HEATER AREA
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 GSU TRANSFORMER
023 PDC
024 TRANSMISSION LINES
025 SLUDGE ROLL-OFF BIN
026 OIL WATER SEPARATOR
027 DELETED
028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
029 SERVICE WATER/FIRE WATER TANK
030 DEMINERALIZED WATER TANK
031 CO2 STORAGE AREA
032 FUEL OIL PUMP HOUSE

NOTES:
1. ROAD MAY NEED TO BE ADJUSTED AFTER SURVEY LOCATION OF RAILWAY TRACKS.
2. ELEVATIONS MAY NEED SOME ADJUSTMENT AS MORE INFORMATION BECOMES AVAILABLE.
3. THE LOCATION OF THE STACK IS BASED ON THE MASSACHUSETTS STATE PLANE SYSTEM, (NAD27, DATUM) FOR THE HORIZONTAL COORDINATES. THE GRID PRESENTED WAS CREATED FROM IMAGE FILES RECEIVED FROM MAG. COORDINATE LOCATION REQUIRES RECHECK WHEN SURVEY DATA IS OBTAINED. MORE DETAILED DESIGN OF THE SITE ARRANGEMENT INCLUDING FACILITY PLACEMENT, GRADING AND DRAINAGE WILL REQUIRE TOPOGRAPHIC SURVEY WITH TIES TO THE PROPERTY AND EASEMENTS.

20' 0 20' 40' 60' 80'
SCALE: 1" = 60'

REVISION APPROVAL RECORD				REV			REV NO.	DATE	REVISIONS	BY	CHKR
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE		A	5/14/15	ISSUED FOR ENF PERMITTING	RLR	MD
ARCH.			MECHANICAL				B	5/18/15	REVISED GRADING	RLR	MD
BUILDING SERVICES			PIPING				C	6/9/15	ADDED FUEL OIL PUMPHOUSE; DELETED FUTURE ITEMS	TJK	RLR
CIVIL			PROCESS								
ELECTRICAL			QA / QC								
ENVIRON.			STRUCTURAL								
GEN. ARRANG.											
I & C											

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	C	6/9/15		PKS
APPROVED FOR CONSTRUCTION				
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REV.NO.				

PROJECT NO.: 31380
DRAWN: RLR DATE: 4/23/15
CHECKED: MD DATE: 5/14/15
SCALE: 1" = 60'-0"

URS
URS ENERGY & CONSTRUCTION, Inc.
510 CARNEGIE CTR.
PRINCETON, NJ 08540
(609) 720-2000

CANAL GENERATING PLANT
SIMPLE CYCLE PROJECT STACK WEST
PLOT PLAN

DWG. NO. 31380-B024-16-11-220-WEST REV C

USER: RUSSEK
PLOT SCALE: 1.0000 '/ INCH
PLOT STYLE TABLE: STAMES
FILE: SPILES

INCHES 1 2 3 4 5 6
CENTIMETERS 1 2 3 4 5 6

Simple Cycle Stack West.dgn

8 7 6 5 4 3 2 1

H G F E D C B A

u0826.dgn

LEGEND

- EXISTING CONTOUR LINE
- EDGE OF BORDERING VEGETATED WETLANDS
- 100' BUFFER ZONE
- EX. STONE WALL
- EX. FENCE
- EX. RETAINING WALL
- EX. GUARDRAIL
- ZONE AE EL=14 / ZONE X — FEMA FLOOD ZONE
- EDGE OF PROPOSED CLEARING
- LOCUS
- NHESP — NHESP PRIOIRTY HABITAT OF RARE SPECIES
- EXISTING UTILITY POLE
- NEW 22.8 kV EVERSOURCE UTILITY POLE
- NEW 22.8 kV CANAL SOLAR UTILITY POLE
- UNDERGROUND 22.8 kV THREE-PHASE CIRCUIT

480 VOLT MAIN PANELBOARD ON PAD (8' x 8' x 1' DEEP)

U/G — T — 480 VOLT — P

TRANSFORMER PAD AND 22.8 kV-480 V PADMOUNT TRANSFORMER (8' x 8' x 1' DEEP)

TRANSFORMER AND PANELBOARD DETAILS

N/F PENN CENTRAL TRANSPORTATION COMPANY

1390+00

1395+00

FEMA FLOOD ZONE

ZONE AE EL=14 / ZONE X

100' WETLAND BUFFER

100' WETLAND BUFFER

TANK

TANK

TANK

GRID NORTH 14.65°

TRANSFORMER AND PANELBOARD (TYPICAL — SEE DETAIL)

TRANSFORMER AND PANELBOARD

EXISTING GAS EASEMENT

ARRAY 1

3,784 SOLAR PANELS, 1,154.1 KW DC POWER
ESTIMATED DISTURBED AREA 5.25± ACRES

ARRAY 2

1,956 SOLAR PANELS, 596.6 KW DC
ESTIMATED DISTURBED AREA 2.0± ACRES

50' SHADING CLEARANCE

60' SHADING CLEARANCE

EXISTING ELECTRIC EASEMENT (NOT CLEARED)

STONEWALL CROSSING

NEW 22.8 kV THREE-PHASE EVERSOURCE OVERHEAD CIRCUITS

EXISTING EVERSOURCE UTILITY POLE #23-76

N/F
MAP 86, LOT 13
SOUTHERN ENERGY CANAL, LLC

NEW 22.8 kV THREE PHASE UNDERGROUND CIRCUITS

N/F
MAP 86, LOT 15
SOUTHERN ENERGY CANAL, LLC

EXISTING EVERSOURCE 22.8 kV THREE PHASE OVERHEAD DISTRIBUTION CIRCUIT (4-81A-349)

EXISTING EVERSOUCE UTILITY POLE #23-74

NEW 22.8 kV THREE-PHASE CANAL SOLAR CIRCUITS

EXISTING COMMONWEALTH ELECTRIC COMPANY ELECTRIC TRANSMISSION EASEMENT BOOK 3287 PAGE 295

ROUTE 6A

SANDWICH ROAD

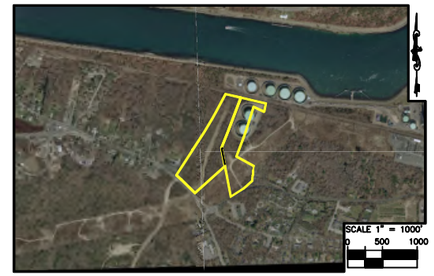
PUBLIC-160' STATE HIGHWAY LAYOUT (VARIABLE WIDTH)

TUPPER ROAD

WILSON ROAD

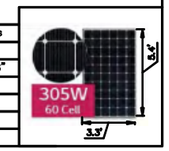
BOURNE

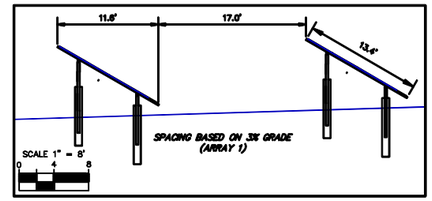
SANDWICH



ARRAY 1

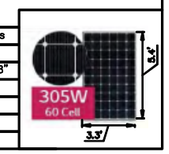
PV Modules	305 Watt LG Modules
Model	LG305N1C-B3 60
Dimensions	64.6" x 39.4" x 1.38"
Cell Count	60 Cell
Array Tilt	30°
Module Count	3,784
System Output	1,154.1 KW DC

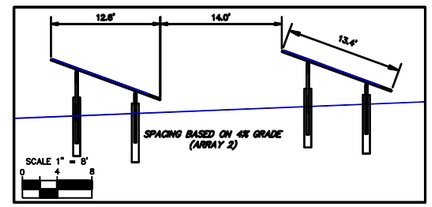




ARRAY 2

PV Modules	305 Watt LG Modules
Model	LG305N1C-B3 60
Dimensions	64.6" x 39.4" x 1.38"
Cell Count	60 Cell
Array Tilt	20°
Module Count	1,956 Panels
System Output	596.6 KW DC





GENERAL NOTES:

1) FINAL ARRAY LAYOUT MAY CHANGE BASED ON INVERTER LOCATIONS, ACCESS AND DRAINAGE DESIGN, SHADING ASSESSMENTS AND PERMITTING PROCESS
2) THE ARRAY 1 RACKING SYSTEM HAS BEEN DESIGNED FOR A 30° MODULE ANGLE FOR A BALANCE OF OPTIMUM SOLAR RADIATION AND ROW SPACING.
3) PANEL LAYOUTS ASSUME THE FOLLOWING EQUIPMENT SPECIFICATIONS:
   A) ARRAY 1 – 305 WATT 60 CELL MODULES USING A 30° RACKING TILT
   B) ARRAY 2 – 305 WATT 60 CELL MODULES AND USING A 20° RACKING TILT
   RACK SPACING AND PANEL TILT FOR ARRAY HAS BEEN OPTIMIZED TO SITE A 596KW±. ARRAY AND HAS NOT BEEN OPTIMIZED FOR ZERO SEASONAL RACK TO RACK SHADING
4) THE CURRENT LAYOUT WILL BE REVISED TO REFLECT UPDATED PANEL MODELS, IF DIFFERENT, DURING THE EQUIPMENT PROCUREMENT PROCESS

MonoX NeON

FILE: 2796.01 Solar Con REV2

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by : _____
Drawn by : _____
Checked by : _____
Survey chk. by : _____
Approved by : _____

SCALE
SCALE 1" = 80'
0 40 80 160

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL LLC
9 FREEZER ROAD
SANDWICH, MA 02563

CONCEPTUAL SOLAR LAYOUT PLAN
FOR
CANAL COMMUNITY SOLAR PROJECT
SANDWICH, MASSACHUSETTS 02563
JULY 27, 2015

Sheet 1 of 1
JOB NUMBER 2796.01

LEGEND

Northern Area

Simple-Cycle Site

Overview of Photograph Locations for Canal Unit 3

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

October 2, 2015

Jackie Bruce
238 Littleton Road, Suite 201-B
Westford, MA 01886

RE: Canal Unit 3, Canal Community Solar, 9 Freezer Road, Sandwich, MA; MHC# RC.21954

Dear Ms. Bruce:

Thank you for your inquiry to the Massachusetts Historical Commission (MHC) for the project referenced above. The staff of the MHC have reviewed the information submitted and have the following comments.

The proposed project consists of the demolition of several warehouse structures, the construction of an exhaust stack, and the installation of two solar arrays at 9 Freezer Road in Sandwich. The information provided indicates that the project will require permits from the US Environmental Protection Agency (EPA), the Massachusetts Department of Transportation (MassDOT), and the Massachusetts Department of Environmental Protection (MassDEP).

Review of MHC files indicates that project information was received at this office on July 29, 2015. MHC did not issue comment or a determination of effect for the project within 30 days (36 CFR 800.3(c)(4); (950 CMR 71.07(2)(f)). Please obtain a Certificate of Appropriateness from the Sandwich Old Kings Highway Historic District Commission.

These comments are provided to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800) and M.G.L. Chapter 9, sections 26-27C, (950 CMR 71.00). If you have further questions or require additional information please contact Linda Santoro at this office.

Sincerely,

Brona Simon
State Historic Preservation Officer
Executive Director
Massachusetts Historical Commission

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.sec.state.ma.us/mhc

3.0 CERTIFICATION OF LOCAL FILING

LAW OFFICES OF MICHAEL D. FORD
ATTORNEYS AT LAW
72 MAIN STREET, P.O. BOX 485
WEST HARWICH, MA 02671
TEL. (508)430-1900 FAX (508)430-9979
mdfesq1@verizon.net

MICHAEL D. FORD
JEFFREY M. FORD

October 26, 2016

Jeffrey Ribeiro, Regulatory Planner
Cape Cod Commission
3225 Main Street
Barnstable, MA 02630

Re: Development of Regional Impact Application Canal Unit 3, Sandwich
Notice of Town Filing

Dear Mr. Ribeiro:

Please be advised that, pursuant to Chapter A Enabling Regulation of the Cape Cod Commission Regulations of General Applications Section 7 (b), copies of the DRI Application for NRG Canal 3, Sandwich, MA were filed on October 26, 2016 with the Sandwich Town Clerk, Building Inspector, Town Planner, Town Planning Board, Conservation Commission and the OLD Kings Highway Regional Historic District Commission.

Very truly yours,

Michael D. Ford, Esq.
MDF/jlg

Cc: Clients

4.0 REQUIRED PLANS

SITE DEVELOPMENT PLANS

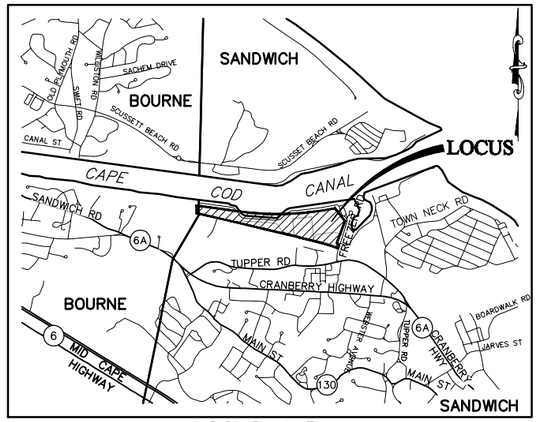
FOR THE

CANAL UNIT 3 PLANT EXPANSION

SANDWICH, MASSACHUSETTS

DATE: SEPTEMBER 16, 2016

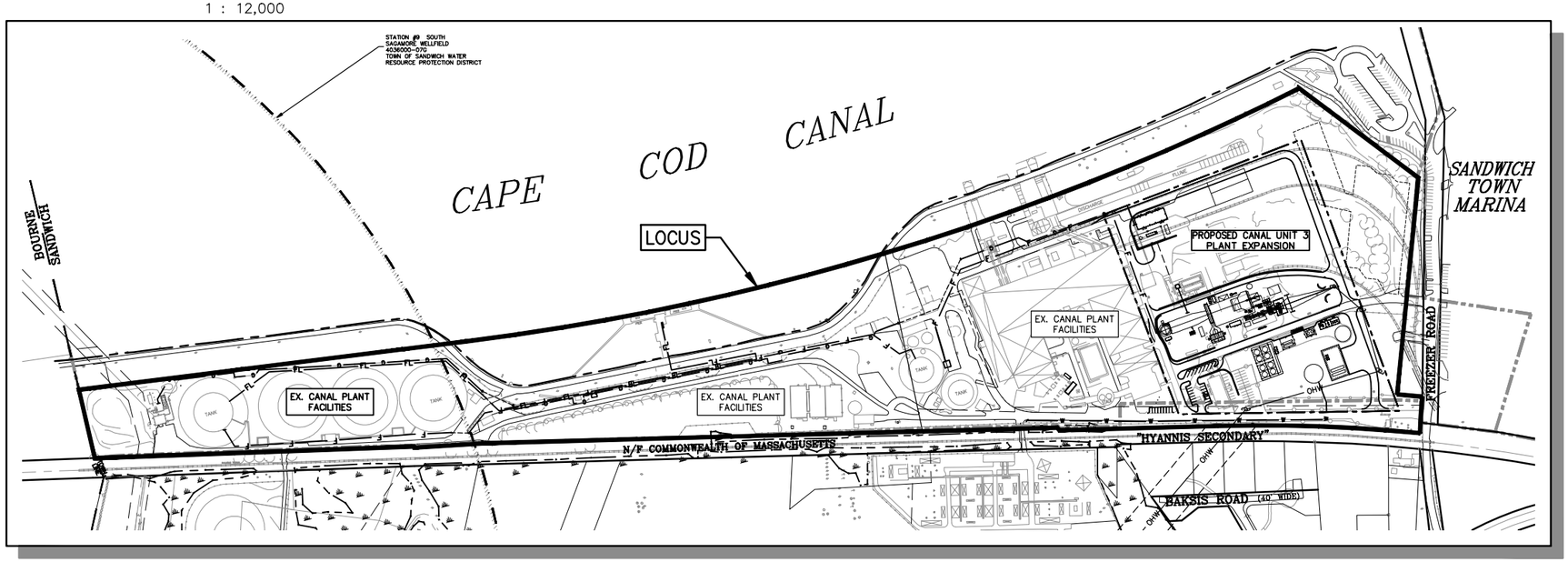
VICINITY MAP
1" = 1,000'
1 : 12,000



LOCUS MAP
1" = 2,000'

INDEX OF PLANS		
SHEET NO.	TITLE	SCALE
1	COVER SHEET	1" = 200'
2	OVERALL EXISTING CONDITIONS PLAN	1" = 150'
3–7	EXISTING CONDITIONS PLAN	1" = 40'
8	OVERALL SITE DEVELOPMENT PLAN	1" = 150'
9–13	SITE DEVELOPMENT PLAN	1" = 40'
14–15	DETAILS PLAN	AS NOTED

SEE SHEET 13 FOR LEGEND AND SHEET 15 FOR CONSTRUCTION NOTES



OVERALL LOCATION PLAN
SCALE: 1" = 200'

OWNER:
NRG CANAL, LLC
211 CARNEGIE CENTER
PRINCETON, NJ 08540

APPLICANT:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

ENGINEER:
Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563
(508) 888 – 9282

nrg
Power to be free™

FILE: 2796.03 SITE

Sheet	of
1	15

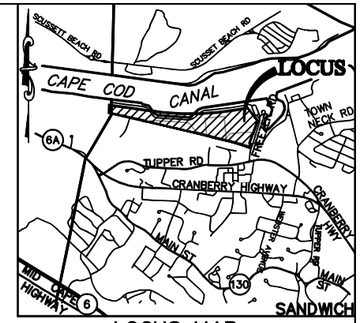
JOB NUMBER
2796.03

GENERAL NOTES:

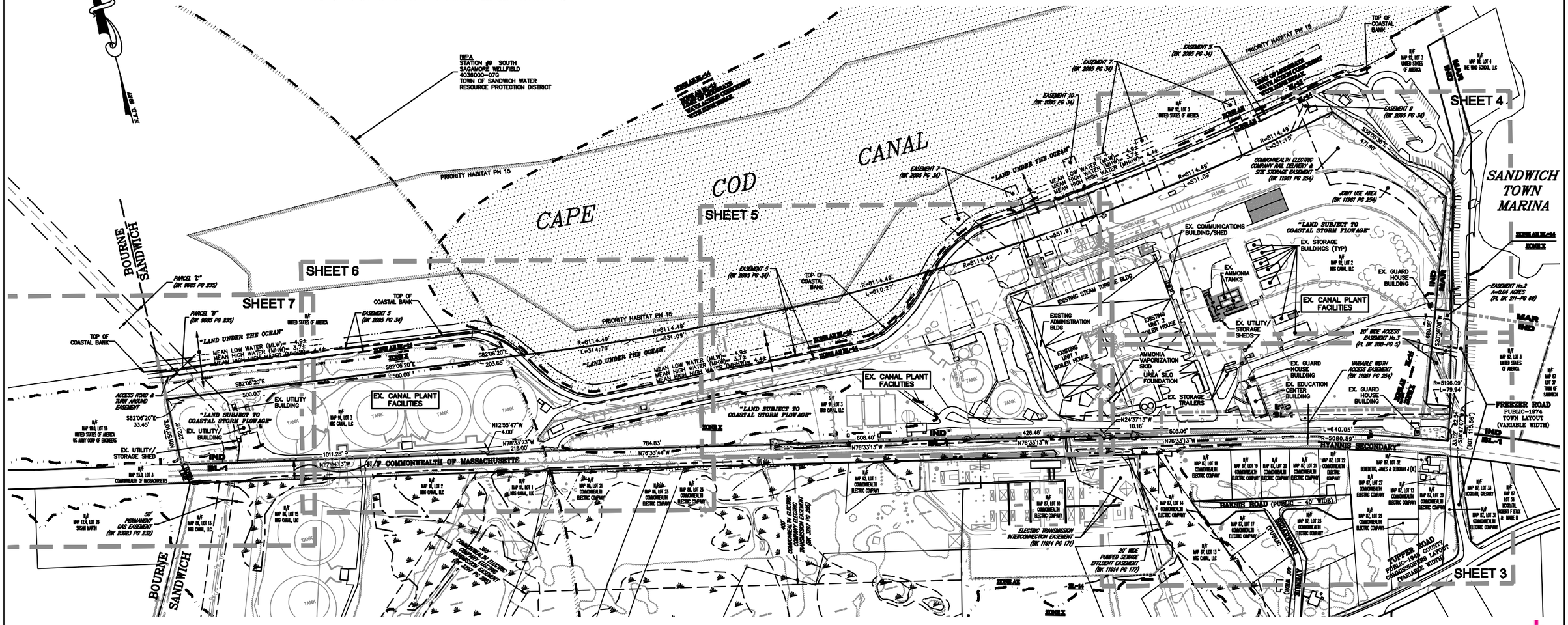
1. OWNERS OF RECORD:
   ATTN: TAX DEPARTMENT
   NRG CANAL, LLC
   211 CARNEGIE CENTER
   PRINCETON, NJ 08540
2. LOCUS IS COMPRISED OF:
   MAP 91 LOT 3 (±21.32 ACRES) AND MAP 92 LOT 2 (±30.72 ACRES).
3. PROPERTY LINES AND EXISTING CONDITIONS FROM PLANS ENTITLED LAND TITLE SURVEY PREPARED BY SURVEYING AND MAPPING CONSULTANTS, LABELED PRELIMINARY, DATED SEPTEMBER 15, 1998 AND SUPPLEMENTED WITH A PARTIAL EXISTING CONDITIONS FIELD SURVEY IN AUGUST 2016 BY ATLANTIC DESIGN ENGINEERS, INC.
4. THE WETLAND RESOURCE AREAS SHOWN HEREON ARE BASED UPON A FIELD DELINEATION AND FIELD LOCATION BY TRC ENVIRONMENTAL CORP, AND CONFIRMED BY ATLANTIC DESIGN ENGINEERS, INC. IN MAY, 2015 AND WERE APPROVED BY THE SANDWICH CONSERVATION COMMISSION VIA A DETERMINATION OF APPLICABILITY ISSUED FEBRUARY 23, 2016.
5. THE PROPERTY MOSTLY LIES WITHIN FLOOD ZONE AE14 AND PARTIALLY WITHIN ZONE X, OTHER AREAS, AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN (NAVD88), BASED UPON A REVIEW OF THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD INSURANCE RATE MAP (FIRM) MAP NUMBER 25001C0319J, DATED JULY 16, 2014.
6. THE PROPERTY PARTIALLY LIES WITHIN A INTERIM WELLHEAD PROTECTION AREA (IWPA) (STATION #9, SOUTH SAGAMORE WELLFIELD 4036000-07G) BASED UPON A REVIEW OF THE MASSACHUSETTS GEOGRAPHIC INFORMATION SYSTEM.
7. THE PROPERTY IS NOT LOCATED WITHIN A ZONE II BASED UPON A REVIEW OF THE MASSACHUSETTS GEOGRAPHIC INFORMATION SYSTEM.
8. HORIZONTAL COORDINATES BASED ON NAD 27 PER SURVEYING AND MAPPING CONSULTANTS AND EXISTING CONTOURS ARE BASED UPON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
9. THE PROPERTY PARTIALLY LIES WITHIN THE WATER RESOURCE PROTECTION DISTRICT, AND DOES NOT LIE WITHIN SURFACE WATER PROTECTION DISTRICT, BASED UPON A REVIEW OF THE TOWN OF SANDWICH ZONING MAP, DATED MAY 2013.
10. A PORTION OF THE PROPERTY LIES WITHIN PH15, AN ESTIMATED HABITAT OF RARE WILDLIFE AND A PRIORITY HABITAT OF RARE SPECIES BASED UPON A REVIEW OF THE NATURAL HERITAGE AND ENDANGERED SPECIES PROGRAM MAPS OBSERVED ON THE MASSACHUSETTS GEOGRAPHIC INFORMATION SYSTEM.
11. THE PROPERTY DOES NOT LIE WITHIN AN AREA OF CRITICAL ENVIRONMENTAL CONCERN (ACEC) BASED UPON A REVIEW OF THE MASSACHUSETTS GEOGRAPHIC INFORMATION SYSTEM.
12. MEAN LOW WATER AND MEAN HIGH WATER ELEVATIONS ARE BASED UPON "TIDAL FLOOD PROFILES, NEW ENGLAND COASTLINE" PREPARED BY THE HYDRAULICS AND WATER QUALITY SECTION, NEW ENGLAND DIVISION, U.S. ARMY CORPS OF ENGINEERS, DATED SEPTEMBER 1988.

EXISTING SITE INFORMATION
LOCUS AREA = ±2,267,227 sq.ft. / ±52.05 acres
DEVELOPED AREAS = ±1,989,455 sq.ft. / ±45.67 acres
OPEN SPACE/UNDISTURBED AREAS = ±129,246 sq.ft. / ±2.97 acres
WETLAND AREAS = ±7,487 sq.ft. / ±0.17 acres
LAND UNDER THE OCEAN = ±141,039 sq.ft. / ±3.24 acres

SEE SHEET 7 FOR LEGEND



LOCUS MAP
1" = 2,000'



nrg
Power to be free

FILE: 2796.03 BASE2_NAD27 and NAVD88

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by : _____
Drawn by : _____
Checked by : _____
Survey chk. by : _____
Approved by : _____

SCALE
SCALE 1" = 150'
0 75 150 300

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

OVERALL EXISTING CONDITIONS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 2 of 15
JOB NUMBER 2796.03

SEE SHEET 4

SEE SHEET 5

SEE SHEET 2 FOR NOTES AND SHEET 7 FOR LEGEND

EX. CANAL PLANT FACILITIES

AMMONIA VAPORIZATION SKID

UREA SILO FOUNDATION

STACK

EX. CB RIM=10.7

EX. MH RIM=10.38 INV. OUT(10"CMP)=7.16

EX. FIRE HOSE CONNECTION

EX. CONCRETE DRAINAGE INLET W/SLOTTED GRATE COVER RIM=11.13 INV. IN=8.21 (10" CMP) INV. OUT=7.94 (10" CMP)

EX. TRANSFORMER

EX. UTILITY/ STORAGE SHED

EX. ELECTRIC BOX (TYP)

EX. CONCRETE PAD

EX. EDGE OF PAVEMENT (TYP)

EX. MH RIM=10.09 INV. IN(12" CMP)=7.46 INV. OUT(12" CMP)=6.96

EX. STORAGE TRAILER

EX. MH RIM=10.47 INV. IN(12" CMP)=6.56 INV. IN(10" CMP)=6.56 INV. OUT(18" RCP)=6.46

EX. COMMUNICATION PEDESTAL

EX. CONCRETE DRAINAGE INLET W/SLOTTED GRATE COVER RIM=11.13 INV. IN/OUT=8.20 (10" CMP)

EX. CONCRETE LANDING AT GATES

EX. DRAIN RIM=10.58

EX. GUARD HOUSE BUILDING

GUY POLE

EX. BUILDING OVERHANG

EX. MH RIM=10.38 INV. IN(18" RCP)=6.16 INV. OUT(18" RCP)=6.06

EX. CONCRETE LANDING

EX. CONCRETE LANDING

EX. PARKING SPACES (TYP)

EX. CB RIM=11.17 INV. IN(12" CMP)=8.16 INV. OUT(2'x3' ELLIPTICAL CMP)=6.56

EX. CB RIM=10.39 INV. OUT(12" CMP)=8.26

EX. CB RIM=10.52 INV. IN(12" CMP)=5.06 (W) INV. IN(6" RCP)=4.86 (N) INV. IN(24" RCP)=4.76 (E) INV. OUT(24" RCP)=4.76 (S)

EX. MH RIM=10.37 INV. IN(24" RCP)=5.26 INV. OUT(24" RCP)=5.26

EX. EDGE OF PAVEMENT W/CAPE COD BERM (TYP)

EX. EDUCATION CENTER BUILDING

EX. CONCRETE LANDING

EX. CONCRETE PAD

EX. CONCRETE DRAINAGE INLET

EX MH RIM=10.93 INV OUT(12" CMP)=7.56

EX. DRAIN MANHOLE B RIM ELEV=9.3 INV. IN(EX. DMH A)=1.6 INV. IN(2'x3' CMP)=5.3 INV. OUT(24" CMP)=5.8 STANDING WATER ELEV=6.0

EX. MH RIM=10.35 INV. OUT(6" CMP)=8.46

EX. 4" PVC PIPES W/CONCRETE IN-FILL

EX. TRANSFORMER

EX. 15" CMP INV.=9.96

EX. 3" STEEL PIPE

EX. CB RIM=10.80 INV. IN(18" RCP)=5.66 INV. OUT(24" RCP)=5.66

EX. CONCRETE AIR CONDITIONER PADS (TYP)

EX. CONCRETE WALKWAY

EX. 12" CMP DRAIN PIPE INV.=9.70

EX. (2) 2" STEEL PIPES

EX. 12" CMP DRAIN PIPE NOT FOUND

EX. 24" CMP OUTLET=5.7

EX. 6' WIDE CONCRETE WEIR, CREST ELEV=9.3 (5) 6" PVC INV=6.1

IND BL-1

VARIABLE WIDTH ACCESS EASEMENT BOOK 11961 PAGE 254

"LAND SUBJECT TO COASTAL STORM FLOWAGE"

ZONE AE EL=14 ZONE X

20' WIDE ACCESS EASEMENT No.3 (PL BK 288-PG 5)

EX. MONITORING WELL RIM=10.79 WATER ELEVATION= 6.39 (10:10 AM – ±HIGH TIDE) 6.39 (4:26 PM – ±LOW TIDE) (MEASURED ON 9-15-16)

EX. SNOW FENCE (TYP)

EX. MOTORIZED ENTRANCE GATE (TYP)

EX. CALL BOXES

EX. CONCRETE PAD

EX. CONCRETE ISLAND

EX. SITE/ BUSINESS SIGN

EX. ELECTRIC HAND HOLE

EX. CONCRETE LANDING

EX. MOTORIZED CHAINLINK FENCE GATE AT ENTRANCE

EX. SEWER MANHOLE RIM=16.16

EX. GUARD HOUSE BUILDING

EX. COMMUNICATION PEDESTAL

FREEZER ROAD PUBLIC-1974 TOWN LAYOUT (VARIABLE WIDTH)

R=5196.09' L=79.94'

S18°47'07"W (82.54' (TOT. 115.56'))

33.02'

L=640.05' R=5080.59'

503.06' N76°33'13"W

OBSCURED AREA

"HYANNIS SECONDARY"

BENCHMARK: MAG NAIL SET IN PAVEMENT ELEV.=10.60

EX. DRAIN MANHOLE A RIM ELEV=10.96 INV. IN(24" RCP)=3.56 INV. OUT(24" CMP)=3.56

EX. 15" CMP NOT FOUND

ZONE AE EL=14 ZONE X

ZONE X

ZONE AE EL=14 BL-1

100' BUFFER ZONE

25" N Red Oak

27" Scarlet Oak

25"N Red Oak

ELECTRIC TRANSMISSION INTERCONNECTION EASEMENT (BK 11914 PG 171)

20' WIDE PUMPED SEWAGE EFFLUENT EASEMENT (BK 11914 PG 177)

20' WIDE PUMPED SEWAGE EFFLUENT EASEMENT (BK 11914 PG 177)

BAKSIS BOULEVARD (PUBLIC – 40' WIDE)

BRIARWOOD AVENUE (PUBLIC – 40' WIDE)

TUPPER ROAD PUBLIC-1948 COUNTY COMMISSIONERS LAYOUT (VARIABLE WIDTH)

N/F MAP 92, LOT 2 NRG CANAL, LLC

N/F MAP 92, LOT 3 UNITED STATES OF AMERICA

N/F MAP 87, LOT 14 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 18 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 19 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 20 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 21 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 22 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 32 BENEDETTO, JAMES & DEBORAH J (TE)

N/F MAP 87, LOT 13 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 27 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 30 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 31 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 29 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 33 MCGRATH, GREGORY

N/F MAP 87 LOT 34 MCGRATH, ROBERT F ETUX & MARIE R

N/F MAP 87, LOT 17 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 23 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 13 NRG CANAL, LLC

N/F MAP 87, LOT 17 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 23 COMMONWEALTH ELECTRIC COMPANY

K.V.D. 1887

Power to be free

FILE: 2796.03 BASE2_NAD27 and NAVD88

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by : _____
Drawn by : _____
Checked by : _____
Survey chk. by : _____
Approved by : _____

SCALE
SCALE 1" = 40'
0 10 20 40 80

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

EXISTING CONDITIONS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 3 of 15

JOB NUMBER 2796.03

SEE SHEET 2 FOR NOTES AND SHEET 7 FOR LEGEND

PRIORITY HABITAT PH 15

CANAL

COD

CAPE

"LAND UNDER THE OCEAN" = -4.9±

MEAN LOW WATER (MLW) = -4.9±

MEAN HIGH WATER (MHW) = 3.7±

MEAN HIGH HIGH WATER (MHHW) = 4.4±

EASEMENT 7 (BK 2095 PG 34)

EASEMENT 5 (BK 2095 PG 34)

EASEMENT 9 (BK 2095 PG 34)

ZONE AE EL=15

ZONE AE EL=14

ZONE AE EL=15

ZONE AE EL=14

TOP OF COASTAL BANK

BUFFER ZONE TO TOP OF COASTAL BANK

100' BUFFER ZONE TO TOP OF COASTAL BANK

BIKE PATH

ROAD

SERVICE

PATH

N/F MAP 92, LOT 3 UNITED STATES OF AMERICA

N/F MAP 92, LOT 4 THE WIND SCHOOL, LLC

"LAND SUBJECT TO COASTAL STORM FLOWAGE"

R=811.49'
L=331.09

R=811.49'
L=331.75

S38°08'36"E
471.90'

COMMONWEALTH ELECTRIC COMPANY RAIL DELIVERY & SITE STORAGE EASEMENT (BK 11961 PG 254)

JOINT USE AREA EASEMENT (BK 11961 PG 254)

FLUME

DISCHARGE

EX. CB
RIM=10.42
INV. IN(15" CMP)=5.76
INV. IN(10" CMP)=5.86
INV. OUT(24" CMP)=5.06

EX. CB
RIM=10.36
INV. OUT(12" CMP)=7.8

EX. CONCRETE WALL

EX. CONCRETE PAD

EX. CATCH BASIN (ROUND GRATE) RIM=10.03

EX. MH RIM=10.50

EX. CONCRETE CONTAINMENT VAULT/RETAINING WALLS

EX. "STOP" SIGN

EX. CATCH BASIN RIM=10.62

EX. EDGE OF PAVEMENT (TYP)

EX. MONITORING WELL
RIM=10.90
WATER ELEVATION=
5.10 (11:00 AM – ±HIGH TIDE)
5.03 (4:45 PM – ±LOW TIDE)
(MEASURED ON 9-15-16)

EX. STORAGE BUILDING

EX. STORAGE BUILDING

EX. STORAGE BUILDING

EX. STORAGE BUILDING

EX. STORAGE BUILDING

EX. EDGE OF DIRT/GRAVEL PATHWAYS (TYP)

N/F MAP 92, LOT 2 NRG CANAL, LLC

EXISTING STEAM TURBINE BLDG

EX. COMMUNICATIONS BUILDING/SHED

EX. CONCRETE DRAINAGE INLET W/SLOTTED GRATE COVER RIM=10.63
INV. IN=7.38 (10" CMP)
INV. OUT=7.34 (10" CMP)

EX. 4" STEEL VENT PIPE

EX. CONCRETE CONTAINMENT VAULT/RETAINING WALLS

EX. STEEL GANGWAY ON CONCRETE PAD

EX. EDGE OF GRAVEL (TYP)

EX. AMMONIA TANKS

EX. CONCRETE DRAINAGE INLET W/SLOTTED GRATE COVER RIM=11.62
INV. OUT=8.33 (10" CMP)

EX. CONCRETE MANHOLE RIM=15.09

EX. CONCRETE MANHOLE RIM=12.01

EX. MONITORING WELL
RIM=11.17
WATER ELEVATION=
5.67 (10:16 AM – ±HIGH TIDE)
5.56 (4:35 PM – ±LOW TIDE)
(MEASURED ON 9-15-16)

EX. WATER METER PIT

EX. CB RIM=9.14

EX. DOUBLE CB RIM=9.08

EX. "NO DUMPING" SIGN

EX. 4" STEEL VENT PIPES

EX. CONCRETE DRAINAGE INLET W/SLOTTED GRATE COVER RIM=10.19
INV. IN=7.87 (10" CMP)
INV. IN=8.62 (4" PVC)
INV. OUT=7.75 (10" CMP)

EX. 6" TRENCH DRAIN RIM=11.17
INV. OUT=9.48 (4" PVC)

EX. CONCRETE CONTAINMENT PAD

EX. "RAILROAD CROSSING" SIGNS

EX. CONTAINMENT AREA WITHIN RAILROAD TRACKS

EX. CONCRETE PADS

EX. 2" STEEL VENT PIPE

EX. 10" CMP DRAIN PIPE INV.=8.61

EX. 10" CMP DRAIN PIPE INV.=8.44

EX. 2" STEEL PIPE

EX. (3) 4" STEEL PIPES

EX. CONCRETE LANDING

EX. ELECTRIC BOX ON CONCRETE PAD

EX. UTILITY/ STORAGE SHED

EX. BOLLARDS (TYP)

EX. CONCRETE DRAINAGE INLET W/SLOTTED GRATE COVER RIM=11.29
INV. OUT=9.33 (10" CMP)

EX. CONCRETE PAD

EX. STORAGE BUILDING

EX. CONCRETE LIGHT POLE BASE

EX. CONCRETE DRAINAGE INLET

EX. GUARD HOUSE BUILDING

EX. CANAL PLANT FACILITIES

EXISTING UNIT 2 BOILER HOUSE

20" GAS

IND MAR

MAR IND

FREEZER ROAD
PUBLIC-1974 TOWN LAYOUT
(VARIABLE WIDTH)

SANDWICH TOWN MARINA

EASEMENT No.2 (PL BK 211-PG 69)

ZONE AE EL=14

ZONE X

689.08'
S20°36'08"W

N.A.D. 83

SEE SHEET 5

SEE SHEET 3

FILE: 2796.03 BASE2_NAD27 and NAV088

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

EXISTING CONDITIONS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 4 of 15

JOB NUMBER 2796.03

SEE SHEET 2 FOR NOTES AND SHEET 7 FOR LEGEND

N.A.D. 1927

SEE SHEET 4

SEE SHEET 6

SEE SHEET 3

CAPE COD CANAL

PRIORITY HABITAT PH 15

PRIORITY HABITAT PH 15

R=8114.49'
L=510.27'

R=8114.49'
L=531.09'

R=8114.49'
L=551.91'

PIER

"LAND UNDER THE OCEAN"

MEAN LOW WATER (MLW) = -4.9±

MEAN HIGH WATER (MHW) = 3.7±

MEAN HIGH HIGH WATER (MHHW) = 4.4±

N/F
UNITED STATES OF AMERICA

N/F
MAP 92, LOT 2
NRG CANAL, LLC

N/F
MAP 91, LOT 3
NRG CANAL, LLC

"LAND SUBJECT TO COASTAL STORM FLOWAGE"

"LAND SUBJECT TO COASTAL STORM FLOWAGE"

EASEMENT 5
(BK 2095 PG 34)

EASEMENT 7
(BK 2095 PG 34)

EASEMENT 10
(BK 2095 PG 34)

EASEMENT 5
(BK 2095 PG 34)

EASEMENT 5
(BK 2095 PG 34)

TOP OF COASTAL BANK

TOP OF COASTAL BANK

TOP OF COASTAL BANK

100' BUFFER ZONE TO TOP OF COASTAL BANK

100' BUFFER ZONE OF COASTAL BANK

ZONE AE EL=15
ZONE AE EL=14

ZONE AE EL=14
ZONE X

ZONE X
ZONE AE EL=14

FLOW TO CANAL

CMP (BROKEN) CULVERT

CMP (BROKEN) CULVERT

SERVICE

SERVICE

ROAD

ROAD

PIPES (TYP)

DRAINAGE DITCH (TYP)

OBSCURED AREA

OBSCURED AREA

EX. CATCH BASIN (ROUND GRATE) SET IN CONCRETE RIM=10.71

EX. 4" STEEL VENT PIPE

EX. 4" STEEL VENT PIPES

EX. MH
RIM=10.22

EX. MH
RIM=10.84
INV. IN(24" RCP)=2.56
INV. OUT(24" RCP)=2.56

EX. MH
RIM=10.42

EX. CB
RIM=10.51

EX. CB
RIM=10.09
INV. OUT(24" RCP)=6.16

EX. BEND
INV. IN(24" RCP)=6.66±
INV. OUT(24" RCP)=6.66±

EX. CATCH BASIN (BEE-HIVE GRATE)
RIM=10.44

EX. CATCH BASIN
RIM=9.99

EX. MH
RIM=10.47

EX. CB
RIM=9.99
INV. OUT(6" DIP)=5.86

EX. CB
RIM=10.23
INV. IN(24" RCP)=3.16 (S)
INV. OUT(24" RCP)=2.36
INV. IN(6" PVC)=6.66 (E)
INV. IN(6" DIP)=5.16 (W)

EXISTING STEAM TURBINE BLDG

EXISTING ADMINISTRATION BLDG

EX. CANAL PLANT FACILITIES

EX. CANAL PLANT FACILITIES

EXISTING UNIT 1 BOILER HOUSE

EX. MH
RIM=11.89
INV. IN(18" RCP)=4.86
INV. OUT(24" RCP)=4.86

EX. CB
RIM=11.17
INV. OUT(10" PVC)=10.16

EX. CB
RIM=10.23
INV. IN(12" CMP)=8.66
INV. OUT(12" CMP)=8.66

EX. MH
RIM= 10.21
INV. IN(10" VCP)=5.76 (E)
INV. IN(18" RCP)=4.16 (S)
INV. OUT(18" RCP)=3.76

EX. CB
RIM=10.51
INV. IN(12" CMP)=8.16
INV. OUT(12" CMP)=8.06

EX. CB
RIM=11.14
INV. IN(10" PVC)=9.46
INV. OUT(12" CMP)=9.56

EX. CB
RIM=9.79
INV. IN(12" CMP)=7.46 (NW)
INV. IN(15" RCP)=5.66 (E)
INV. IN(12" CMP)=7.26 (S)
INV. OUT(18" RCP)=5.46

APPROX. CULVERT LOCATION

10"SS CONC. ENCASED

10" DUCT

TANK

TANK

N02°59'55"E
576.81'

IND
BL-1

IND
BL-1

608.40'

426.46'

N76°33'13"W

N76°33'13"W

1410+00

1415+00

ASSUMED DIRECTION OF FLOW

100' BUFFER ZONE

100' BUFFER ZONE

100' BUFFER ZONE

A16 A17 A18 A19 A20 A-1 A-2 A-3 A-4 A-5 A-6 A-7 A-8 A-9 A-10 A-11 A-12 A-13 A-14 A-15

B-6 B-7 B-8

D-6 D-7 D-8

E-7 E-8

nrg
Power to be free

FILE: 2796.03 BASE2_NAD27 and NAVD88

Atlantic® DESIGN ENGINEERS, INC. P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282	Designed by : Drawn by : Checked by : Survey chk. by : Approved by :	SCALE SCALE 1" = 40' 0 10 20 40 80	DATE	NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

EXISTING CONDITIONS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 5 of 15
JOB NUMBER 2796.03

SEE SHEET 2 FOR NOTES AND SHEET 7 FOR LEGEND

N.A.D. 1983

CAPE COD CANAL

PRIORITY HABITAT PH 15

IWPA
STATION #9 SOUTH SAGAMORE WELLFIELD
4036000-07G
TOWN OF SANDWICH WATER RESOURCE PROTECTION DISTRICT

N/F
UNITED STATES OF AMERICA

"LAND UNDER THE OCEAN"

MEAN LOW WATER (MLW) = -4.9±
MEAN HIGH WATER (MHW) = 3.7±
MEAN HIGH HIGH WATER (MHHW) = 4.4±

ROAD
SERVICE
EOP
PIER

ZONE AE EL=14
ZONE X

ZONE AE EL=15
ZONE AE EL=14

R=8114.49'
L=314.76'

S82°06'20"E
203.65'

S82°06'20"E
500.00'

EASEMENT 5
(BK 2095 PG 34)

100' BUFFER ZONE TO TOP OF COASTAL BANK

TOP OF COASTAL BANK

"LAND SUBJECT TO COASTAL STORM FLOWAGE"

EX. CANAL PLANT FACILITIES

TANK

N/F
MAP 91, LOT 3
NRG CANAL, LLC

SEE SHEET 7

IND
BL-1

N77°04'13"W
1011.28'

PIPES (TYP)

1.8' DIA. CMP CULVERT

FLOW FROM H-7 TO I-9

RAILROAD TRACKS

OBSCURED AREA

N/F
COMMONWEALTH OF MASSACHUSETTS
HYANNIS SECONDARY

1395+00
1398+26.83
1400+00

N12°55'47"W
4.00'

N78°33'23"W
218.00'

360' COMMONWEALTH ELECTRIC COMPANY ELECTRIC TRANSMISSION EASEMENT (BK 3297 PG 295)

N/F
MAP 91, LOT 2
NRG CANAL, LLC

N/F
MAP 91, LOT 1
NRG CANAL, LLC

DRAINAGE DITCH (TYP)

400' COMMONWEALTH ELECTRIC COMPANY ELECTRIC TRANSMISSION EASEMENT (BK 3297 PG 295)

N/F
MAP 86, LOT 21
COMMONWEALTH ELECTRIC COMPANY

N/F
MAP 86, LOT 26
COMMONWEALTH ELECTRIC COMPANY

N/F
MAP 86, LOT 23
COMMONWEALTH ELECTRIC COMPANY

FLOW TO CANAL

12" RCP CULVERT

784.83'
N76°33'44"W

1405+00

SEE SHEET 5

nrg
Power to be free

FILE: 2796.03 BASE2_NAD27 and NAVD88

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 - 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

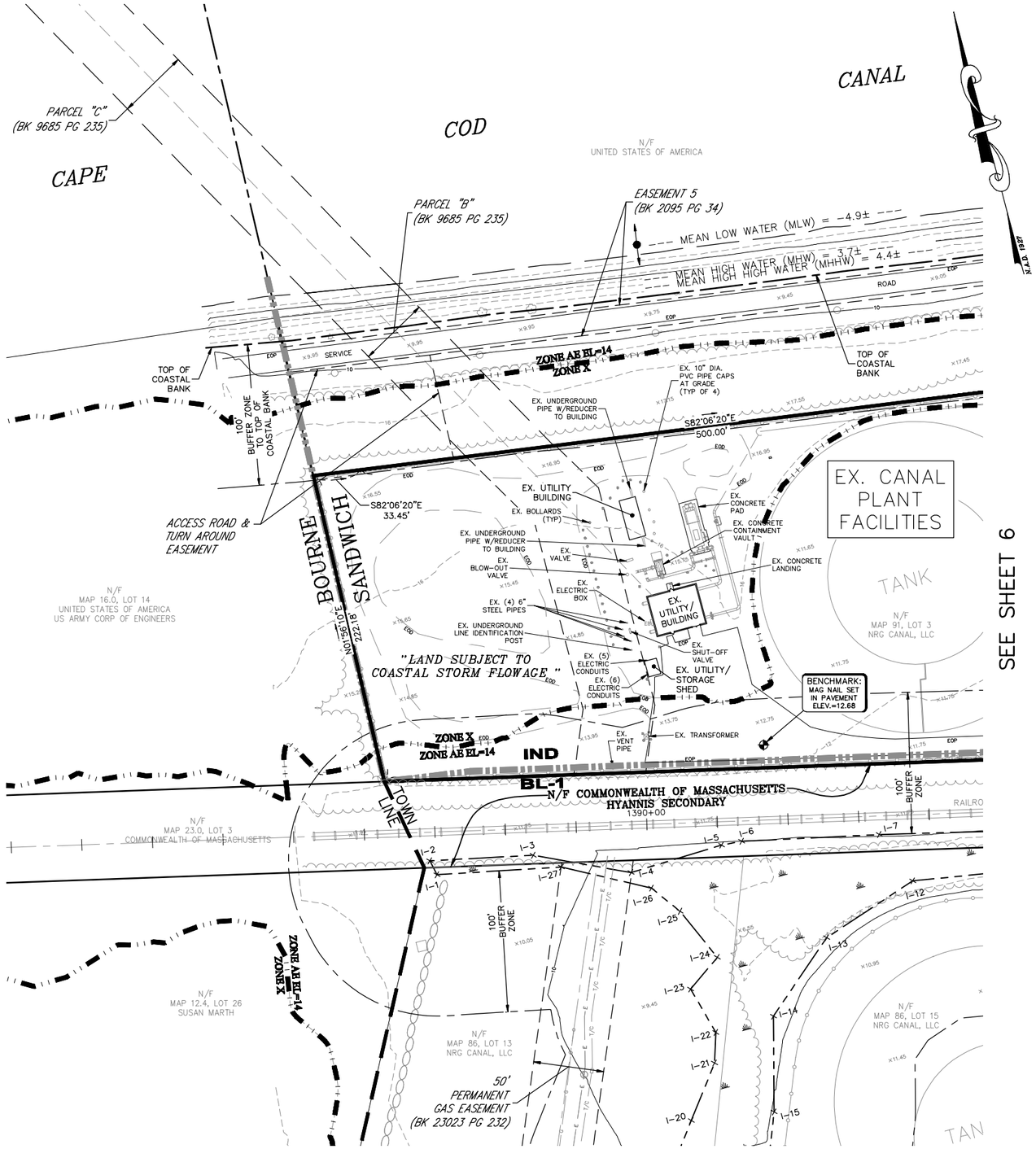
DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

EXISTING CONDITIONS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 6 of 15
JOB NUMBER 2796.03



SEE SHEET 2
FOR NOTES

LEGEND

- EX. RAILROAD TRACKS
- EX. EDGE OF PAVEMENT
- EX. EDGE OF PAVEMENT W/CAPE COD BERM
- EX. EDGE OF GRAVEL
- EX. EDGE OF DIRT
- EX. CONTOUR LINE
- EDGE OF BORDERING VEGETATED WETLANDS W/WETLAND FLAG BASED UPON A FIELD DELINEATION
- 100' BUFFER ZONE
- EDGE OF WATER PER MASSGIS
- TOP OF COASTAL BANK
- 100' TOP OF COASTAL BANK BUFFER
- IWPA AND TOWN OF SANDWICH WATER RESOURCE PROTECTION DISTRICT
- NHESP PRIORITY HABITAT OF RARE SPECIES
- FEMA FLOOD ZONE
- ZONING LINE
- EX. EASEMENT
- EX. CHAIN LINK FENCE
- EX. POST AND RAIL FENCE
- EX. GUARD RAILS
- EX. STONE WALL
- EX. TREE LINE
- EX. TREE
- EX. SPECIMEN TREE
- EX. HEDGE LINE
- EX. GUY WIRE ANCHOR
- EX. UTILITY POLE
- EX. CATCH BASINS (CB)
- EX. MANHOLES
- EX. BENCHMARK
- EX. TRANSMISSION TOWER
- EX. LIGHT
- EX. POST/BOLLARD
- EX. SIGNS
- EX. BOUND
- EX. SPOT ELEVATION
- EX. HYDRANTS
- EX. WATER GATE
- EX. GAS GATE
- EX. MONITORING WELL
- EX. ELECTRIC HAND HOLE
- EX. ELECTRIC BOX
- EX. ELECTRIC MANHOLE
- EX. UNDERGROUND ELECTRIC LINES
- EX. OVERHEAD ELECTRIC LINE
- EX. WATER LINE
- EX. DRAINAGE LINE
- EX. COMMUNICATION LINES
- EX. GAS LINE

nrg
Power to be free

FILE: 2796.03 BASE2_NAD27 and NAVD88

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

EXISTING CONDITIONS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 7 of 15
JOB NUMBER 2796.03

Scusset Beach State Reservation

Old King's Highway Regional Historic District

Cape Cod Canal Access

Canal Fish and Freezing Company

Canal Electric Company Plant

Cape Cod Canal Access

Freeman Farm

Town Neck

Sagamore Inn

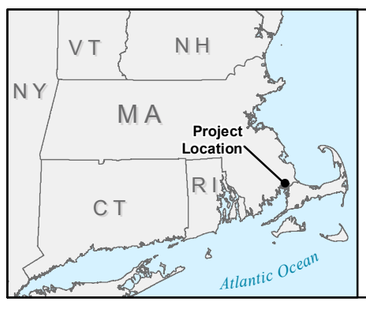
Bourne-Sandwich Town Line Marker

Freeman, Watson House

Saddle and Pillion Burial Ground

Roberti Dairy Farm

Water District Land



Legend

- Canal Property
- Facility Site
- Protected and Recreational Open Space

Historic

- Historic Point
- Old King's Highway Regional Historic District
- Old King's Highway Regional Historic District
- Route 6A - West Area
- Town Neck

N

0 100 200 400 Feet

Source: MassGIS 2014, ESRI Imagery 2013.

Existing Conditions
Historic Resources

NRG Canal 3 Development LLC
Sandwich, Massachusetts

R:\Projects_2014\Canal_3\maps\Figure13_1_Canal3_Cultural_Constraints_rev_e.mxd

E

PROPOSED PLANT COMPONENTS LEGEND

001 GAS TURBINE GE 7HA.02 (w/ACOUSTICAL ENCLOSURE)
002 GENERATOR
003 SCR/CO2 CATALYST (w/ACOUSTICAL SHROUD)
004 TEMPERING/PURGE FANS
005 STACK
006 EMERGENCY DIESEL GENERATOR
007 LUBE OIL SKID
008 CEMS
009 COMPRESSED AIR SYSTEM
010 COOLING FAN MODULE
011 EXISTING WELL
012 SERVICE WATER/FIRE PROTECTION PUMP ENCLOSURE
013 DEMINERALIZED WATER SYSTEM
014 DELETED
015 HYDROGEN STORAGE AREA
016 EXISTING TRAINING BLDG.
017 EXISTING AMMONIA STORAGE AREA
018 GAS COMPRESSOR
019 GAS PRE-HEATER AREA
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 GENERATOR STEP-UP TRANSFORMER (GSU)
023 POWER DISTRIBUTION CENTER (PDC)
024 TRANSMISSION LINES
025 DELETED
026 OIL WATER SEPARATOR
027 DELETED
028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
029 SERVICE WATER/FIRE WATER TANK
030 DEMINERALIZED WATER TANK
031 CO2 STORAGE AREA
032 FUEL OIL PUMP ENCLOSURE
033 INFILTRATION BASIN 1
034 INFILTRATION BASIN 2
035 UNDERGROUND 4,000 GALLON CT WATER-WASH TANK
036 ACOUSTICAL WALL
037 AMMONIA VAPORIZATION SKID
038 DCS ENCLOSURE
039 INFILTRATION BASIN 3
040 NEW ULSD FUEL UNLOADING LINE
041 NEW WATER LINE
042 NEW AMMONIA LINE

PROPOSED SITE INFORMATION

LOCUS AREA = ±2,267,227 sq.ft. / ±52.05 acres
DEVELOPED AREAS = ±1,989,455 sq.ft. / ±45.67 acres
OPEN SPACE/UNDISTURBED AREAS = ±129,246 sq.ft. / ±2.97 acres
WETLAND AREAS = ±7,487 sq.ft. / ±0.17 acres
LAND UNDER THE OCEAN = ±141,039 sq.ft. / ±3.24 acres

IMPERVIOUS AREAS WITHIN PROPOSED FACILITY SITE AREA =
* ±143,222 sq.ft. / ±3.29 acres (TOTAL EXISTING)
* ±141,346 sq.ft. / ±3.24 acres (TOTAL PROPOSED)
  *±54,664 sq.ft. / ±1.25 acres (BUILDINGS/STRUCTURES)
  *±86,682 sq.ft. / ±1.99 acres (ROADWAYS)

* PROVIDED BY CLIENT

SEE SHEET 13 FOR LEGEND AND SHEET 15 FOR CONSTRUCTION NOTES

ZONING REQUIREMENTS
TOWN OF SANDWICH
ZONING BYLAWS; NOVEMBER 2015

(IND) INDUSTRIAL DISTRICT

	REQUIRED	PROVIDED
SECTION 2600: INTENSITY OF USE SCHEDULE		
MINIMUM LOT SIZE:	40,000 S.F.	±2,267,227 S.F./±52.05 ACRES
MINIMUM LOT FRONTAGE:	150'	115.56' (EXISTING)
MINIMUM FRONT YARD SETBACK (c):	30' (f)	156.3' (PROPOSED)
MINIMUM SIDE/REAR YARD SETBACK (c,d,e,):	30' (m)	136.0' (SIDE-PROPOSED)/210' (REAR-EXISTING)
MAXIMUM LOT COVERAGE:	NONE	N/A
MAXIMUM BUILDING HEIGHT (g):	45'	< ±500' (EXISTING STACK)
MAXIMUM SHAPE FACTOR:	22	42.3 (EXISTING)

(BL-1) BUSINESS DISTRICT

	REQUIRED	PROVIDED
SECTION 2600: INTENSITY OF USE SCHEDULE		
MINIMUM LOT SIZE:	20,000 S.F.	±2,267,227 S.F./±52.05 ACRES
MINIMUM LOT FRONTAGE:	125'	115.56' (EXISTING)
MINIMUM FRONT YARD SETBACK (c):	30' (p)	156.3' (PROPOSED)
MINIMUM SIDE/REAR YARD SETBACK (c,d,e,):	0'	136.0' (SIDE-PROPOSED)/210' (REAR-EXISTING)
MAXIMUM LOT COVERAGE:	NONE	N/A
MAXIMUM BUILDING HEIGHT (g):	35'	< ±500' (EXISTING STACK)
MAXIMUM SHAPE FACTOR:	22	42.3 (EXISTING)

(c) ON SPECIAL PERMIT FROM THE BOARD OF APPEALS, MAY BE REDUCED TO THE LESSER OF THIRTY PERCENT (30%) OF LOT DEPTH OR THE AVERAGE OF THE SETBACKS OF THE BUILDINGS ON THE LOT NEXT THERETO ON EITHER SIDE, A VACANT LOT OR A LOT OCCUPIED BY A BUILDING SET BACK MORE THAN THE MINIMUM REQUIREMENT BEING COUNTED AS THOUGH OCCUPIED BY A BUILDING SET BACK BY THE MINIMUM.

(d) ONE-STORY ACCESSORY BUILDINGS MAY BE LOCATED WITHIN A REQUIRED YARD, BUT NOT LESS THAN TEN (10) FEET FROM LOT LINES OTHER THAN STREET LINES; EXCEPT AN ACCESSORY BUILDING OF ONE HUNDRED (100) SQUARE FEET OR LESS MAY BE LOCATED NO CLOSER THAN SIX (6) FEET TO THE LINE.

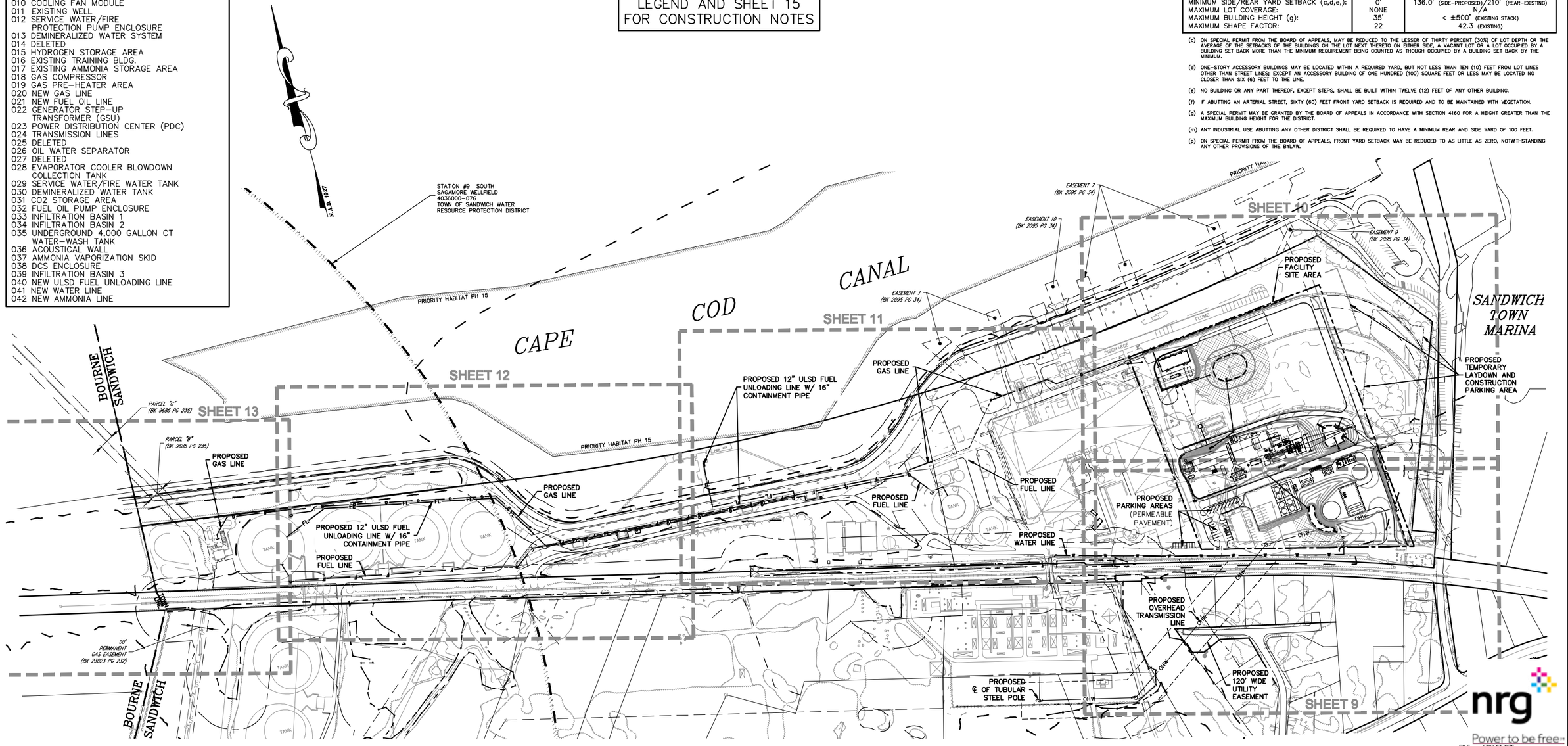
(e) NO BUILDING OR ANY PART THEREOF, EXCEPT STEPS, SHALL BE BUILT WITHIN TWELVE (12) FEET OF ANY OTHER BUILDING.

(f) IF ABUTTING AN ARTERIAL STREET, SIXTY (60) FEET FRONT YARD SETBACK IS REQUIRED AND TO BE MAINTAINED WITH VEGETATION.

(g) A SPECIAL PERMIT MAY BE GRANTED BY THE BOARD OF APPEALS IN ACCORDANCE WITH SECTION 4160 FOR A HEIGHT GREATER THAN THE MAXIMUM BUILDING HEIGHT FOR THE DISTRICT.

(m) ANY INDUSTRIAL USE ABUTTING ANY OTHER DISTRICT SHALL BE REQUIRED TO HAVE A MINIMUM REAR AND SIDE YARD OF 100 FEET.

(p) ON SPECIAL PERMIT FROM THE BOARD OF APPEALS, FRONT YARD SETBACK MAY BE REDUCED TO AS LITTLE AS ZERO, NOTWITHSTANDING ANY OTHER PROVISIONS OF THE BYLAW.



FILE: 2796.03 SITE

Power to be free™

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 - 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 150'
0 75 150 300

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

OVERALL SITE DEVELOPMENT PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 8 of 15
JOB NUMBER 2796.03

SEE SHEET 10

SEE SHEET 11

EX. CANAL PLANT FACILITIES

SEE SHEET 13 FOR LEGEND AND SHEET 15 FOR CONSTRUCTION NOTES

PROPOSED EDGE OF PAVEMENT (TYP)

PROP GRASSED CHANNEL (TYP)

PR-MH-4 RIM=10.68

L=7' 12"DIA. RC 9.18%

PROP DRY WELL (TYP) PR-DW-1 RIM=10.83

PROP OVERFLOW PARKING AREA (PERMEABLE PAVEMENT - 16 SPACES)

PROPOSED 9' X 18' PARKING SPACES (TYP)

PROPOSED 8' X 18' HANDICAP SPACES (TYP)

PROP PARKING AREA (PERMEABLE PAVEMENT - 15 SPACES)

L=172' 12"DIA. RC 8.70%

PR-OCS-3 RIM=10.00

PROP SOUTH BASIN

PROP FILTER STRIP (TYP)

PROPOSED RIP-RAP (TYP)

PROP GRASSED CHANNEL (TYP)

PROPOSED EDGE OF PAVEMENT (TYP)

PROPOSED FACILITY SITE AREA

PROPOSED EROSION CONTROL BARRIER (TYP)

PROPOSED ℄ OF TUBULAR STEEL POLE

TIE INTO EXISTING PAVEMENT

IND BL-1

ZONE AE EL=14 ZONE X

FREEZER ROAD PUBLIC-1974 TOWN LAYOUT (VARIABLE WIDTH)

R=5196.09' L=79.94'

S18°47'07"W (TOT. 115.56')

82.54'

33.02'

503.06' N76°33'13"W

L=640.05' R=5080.59'

"HYANNIS SECONDARY"

BENCHMARK: MAG NAIL SET IN PAVEMENT ELEV.=10.60

PROPOSED OVERHEAD TRANSMISSION LINE

PROPOSED 120' WIDE UTILITY EASEMENT

BAKSIS (PUBLIC - 40' WIDE) BOULEVARD

BRIARWOOD (PUBLIC - 40' WIDE) AVENUE

TUPPER ROAD PUBLIC-1948 COUNTY COMMISSIONERS LAYOUT (VARIABLE WIDTH)

N/F MAP 92, LOT 2 NRG CANAL, LLC

N/F MAP 92, LOT 3 UNITED STATES OF AMERICA

N/F MAP 87, LOT 14 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 18 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 19 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 20 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 21 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 22 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 23 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 27 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 32 BENEDETTO, JAMES & DEBORAH J (TE)

N/F MAP 87, LOT 13 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 30 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 31 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 33 MCGRATH, GREGORY

N/F MAP 87 LOT 34 MCGRATH, ROBERT F ETUX & MARIE R

N/F MAP 87, LOT 17 COMMONWEALTH ELECTRIC COMPANY

N/F MAP 87, LOT 13 NRG CANAL, LLC

ZONE AE EL=14

ZONE X

100' BUFFER ZONE

OBSCURED AREA

STACK

EX. STORAGE TRAILER

EX. BUILDING OVERHANG

EX. FENCE

EX. EDGE OF PAVEMENT (TYP)

GUY POLE

25"N Red Oak

27" N Red Oak

PROPOSED PLANT COMPONENTS LEGEND

001 GAS TURBINE GE 7HA.02 (w/ACOUSTICAL ENCLOSURE)
002 GENERATOR
003 SCR/CO2 CATALYST (w/ACOUSTICAL SHROUD)
004 TEMPERING/PURGE FANS
005 STACK
006 EMERGENCY DIESEL GENERATOR
007 LUBE OIL SKID
008 CEMS
009 COMPRESSED AIR SYSTEM
010 COOLING FAN MODULE
011 EXISTING WELL
012 SERVICE WATER/FIRE PROTECTION PUMP ENCLOSURE
013 DEMINERALIZED WATER SYSTEM
014 DELETED
015 HYDROGEN STORAGE AREA
016 EXISTING TRAINING BLDG.
017 EXISTING AMMONIA STORAGE AREA
018 GAS COMPRESSOR
019 GAS PRE-HEATER AREA
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 GENERATOR STEP-UP TRANSFORMER (GSU)
023 POWER DISTRIBUTION CENTER (PDC)
024 TRANSMISSION LINES
025 DELETED
026 OIL WATER SEPARATOR
027 DELETED
028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
029 SERVICE WATER/FIRE WATER TANK
030 DEMINERALIZED WATER TANK
031 CO2 STORAGE AREA
032 FUEL OIL PUMP ENCLOSURE
033 INFILTRATION BASIN 1
034 INFILTRATION BASIN 2
035 UNDERGROUND 4,000 GALLON CT WATER-WASH TANK
036 ACOUSTICAL WALL
037 AMMONIA VAPORIZATION SKID
038 DCS ENCLOSURE
039 INFILTRATION BASIN 3
040 NEW ULSD FUEL UNLOADING LINE
041 NEW WATER LINE
042 NEW AMMONIA LINE

Power to be free

FILE: 2796.03 SITE

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 - 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

SITE DEVELOPMENT PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 9 of 15

JOB NUMBER 2796.03

PROPOSED PLANT COMPONENTS LEGEND

001 GAS TURBINE GE 7HA.02 (w/ACOUSTICAL ENCLOSURE)	022 GENERATOR STEP-UP TRANSFORMER (GSU)
002 GENERATOR	023 POWER DISTRIBUTION CENTER (PDC)
003 SCR/CO2 CATALYST (w/ACOUSTICAL SHROUD)	024 TRANSMISSION LINES
004 TEMPERING/PURGE FANS	025 DELETED
005 STACK	026 OIL WATER SEPARATOR
006 EMERGENCY DIESEL GENERATOR	027 DELETED
007 LUBE OIL SKID	028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
008 CEMS	029 SERVICE WATER/FIRE WATER TANK
009 COMPRESSED AIR SYSTEM	030 DEMINERALIZED WATER TANK
010 COOLING FAN MODULE	031 CO2 STORAGE AREA
011 EXISTING WELL	032 FUEL OIL PUMP ENCLOSURE
012 SERVICE WATER/FIRE PROTECTION PUMP ENCLOSURE	033 INFILTRATION BASIN 1
	034 INFILTRATION BASIN 2
013 DEMINERALIZED WATER SYSTEM	035 UNDERGROUND 4,000 GALLON CT WATER-WASH TANK
014 DELETED	036 ACOUSTICAL WALL
015 HYDROGEN STORAGE AREA	037 AMMONIA VAPORIZATION SKID
016 EXISTING TRAINING BLDG.	038 DCS ENCLOSURE
017 EXISTING AMMONIA STORAGE AREA	039 INFILTRATION BASIN 3
018 GAS COMPRESSOR	040 NEW ULSD FUEL UNLOADING LINE
019 GAS PRE-HEATER AREA	041 NEW WATER LINE
020 NEW GAS LINE	042 NEW AMMONIA LINE
021 NEW FUEL OIL LINE	

SEE SHEET 13 FOR LEGEND AND SHEET 15 FOR CONSTRUCTION NOTES

PRIORITY HABITAT PH 15

CAPE COD CANAL

MEAN LOW WATER (MLW) = -4.9±

MEAN HIGH WATER (MHW) = 3.7±

MEAN HIGH HIGH WATER (MHHW) = 4.1±

ZONE AE EL=15

ZONE AE EL=14

TOP OF COASTAL BANK

BUFFER ZONE TO TOP OF COASTAL BANK

100' BUFFER ZONE TO TOP OF COASTAL BANK

N/F MAP 92, LOT 3 UNITED STATES OF AMERICA

R=811.49' L=531.09

R=811.49' L=531.15'

S38°08'36"E 471.90'

478' M.L.W.

PROPOSED FACILITY SITE AREA

FLUME

DISCHARGE

PROPRIETARY STRUCTURE (TYP) PR-PS-1 RIM=10.46

PROPOSED GAS LINE 20

SAWCUT AND REMOVE EXISTING PAVEMENT

PROP VEGETATED FILTER STRIP (TYP)

L=48' 12"DIA. RC 2.0%

PR-MH RIM=10.4

TIE INTO EXISTING PAVEMENT

EX. CONCRETE PAD

OUTLET CONTROL STRUCTURE (TYP) PR-OCS-1 RIM=9.50

PROP NORTH BASIN

PROPOSED EROSION CONTROL BARRIER (TYP)

PROPOSED RIP-RAP (TYP)

EX. STORAGE BUILDING

EX. EDGE OF DIRT/GRAVEL PATHWAYS (TYP)

PROP TEMPORARY LAYDOWN AND CONSTRUCTION PARKING AREA

N/F MAP 92, LOT 2 NRG CANAL, LLC

L=110' 12"DIA. RC 3.25%

PR-MH-3 RIM=10.31

SAWCUT AND REMOVE EXISTING PAVEMENT

PROPOSED FUEL OIL LINE 21

L=166' 12"DIA. RC 1.0%

PROPOSED AMMONIA LINE 42

EX. EDGE OF GRAVEL (TYP)

EX. AMMONIA TANKS

PR-MH-1 RIM=15.40

PR-CB-2 RIM=11.30

L=28' 12"DIA. RC 1.0%

PROP SEDIMENT FOREBAY

EX. WATER METER PIT

PR-OCS-2 RIM=10.00

L=40' 12" DIA. RC 1.00%

PROPOSED EROSION CONTROL BARRIER (TYP)

L=31' 12" DIA. RC 0.16%

PR-CB-1 RIM=14.83

PR-MH-2 RIM=11.69

TIE INTO EXISTING PAVEMENT

PROPOSED RETAINING WALL (TYP)

TIE INTO EXISTING PAVEMENT

L=85' 12"DIA. RC 18.17%

PR-HDW-1 RIM=12.00

ZONE AE EL=14

ZONE X

S20°36'08"W 689.08'

FREEZER ROAD

PUBLIC-1974 TOWN LAYOUT (VARIABLE WIDTH)

IND MAR

MAR IND

SANDWICH TOWN MARINA

N/F MAP 92, LOT 3 UNITED STATES OF AMERICA

EX. CANAL PLANT FACILITIES

SEE SHEET 11

SEE SHEET 9

nrg Power to be free

FILE: 2796.03 SITE

Atlantic® DESIGN ENGINEERS, INC. P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282	Designed by : _____ Drawn by : _____ Checked by : _____ Survey chk. by : _____ Approved by : _____	SCALE SCALE 1" = 40' 0 10 20 40 80	DATE	NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

SITE DEVELOPMENT PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 10 of 15
JOB NUMBER 2796.03

PROPOSED PLANT COMPONENTS LEGEND

001 GAS TURBINE GE 7HA.02 (w/ACOUSTICAL ENCLOSURE)
002 GENERATOR
003 SCR/CO2 CATALYST (w/ACOUSTICAL SHROUD)
004 TEMPERING/PURGE FANS
005 STACK
006 EMERGENCY DIESEL GENERATOR
007 LUBE OIL SKID
008 CEMS
009 COMPRESSED AIR SYSTEM
010 COOLING FAN MODULE
011 EXISTING WELL
012 SERVICE WATER/FIRE PROTECTION PUMP ENCLOSURE
013 DEMINERALIZED WATER SYSTEM
014 DELETED
015 HYDROGEN STORAGE AREA
016 EXISTING TRAINING BLDG.
017 EXISTING AMMONIA STORAGE AREA
018 GAS COMPRESSOR
019 GAS PRE-HEATER AREA
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 GENERATOR STEP-UP TRANSFORMER (GSU)
023 POWER DISTRIBUTION CENTER (PDC)
024 TRANSMISSION LINES
025 DELETED
026 OIL WATER SEPARATOR
027 DELETED
028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
029 SERVICE WATER/FIRE WATER TANK
030 DEMINERALIZED WATER TANK
031 CO2 STORAGE AREA
032 FUEL OIL PUMP ENCLOSURE
033 INFILTRATION BASIN 1
034 INFILTRATION BASIN 2
035 UNDERGROUND 4,000 GALLON CT WATER-WASH TANK
036 ACOUSTICAL WALL
037 AMMONIA VAPORIZATION SKID
038 DCS ENCLOSURE
039 INFILTRATION BASIN 3
040 NEW ULSD FUEL UNLOADING LINE
041 NEW WATER LINE
042 NEW AMMONIA LINE

SEE SHEET 13 FOR LEGEND AND SHEET 15 FOR CONSTRUCTION NOTES

SEE SHEET 10

SEE SHEET 12

SEE SHEET 9

CAPE COD CANAL

PRIORITY HABITAT PH 15

R=8114.49'
L=510.27'

R=8114.49'
L=531.09'

R=8114.49'
L=551.91'

N/F
UNITED STATES OF AMERICA

N/F
MAP 92, LOT 2
NRG CANAL, LLC

N/F
MAP 91, LOT 3
NRG CANAL, LLC

PIER

MEAN LOW WATER (MLW) = -4.9±

MEAN HIGH WATER (MHW) = 3.7±

MEAN HIGH HIGH WATER (MHHW) = 4.4±

ZONE AE EL=15
ZONE AE EL=14
ZONE X

FLOW TO CANAL

CMP (BROKEN) CULVERT

ROAD

SERVICE

100' BUFFER ZONE TO TOP OF COASTAL BANK

TOP OF COASTAL BANK

OBSCURED AREA

DRAINAGE DITCH (TYP)

PROPOSED 12" ULSD FUEL UNLOADING LINE W/ 16" CONTAINMENT PIPE
40

PROPOSED FUEL OIL LINE
21

PROPOSED ABOVE GROUND GAS LINE
20

PROPOSED UNDERGROUND GAS LINE
20

PROPOSED FUEL OIL PUMP ENCLOSURE
32

PROPOSED WATER LINE
41

APPROX. CULVERT LOCATION

10"SS CONC. ENCASED

10" DUCT

ASSUMED DIRECTION OF FLOW

TANK

EX. CANAL PLANT FACILITIES

IND BL-1

608.40' N76°33'13"W

426.46' N76°33'13"W

N07°55'55"E 576.85'

A16 A17 A18 A19 A20 A-1 A-2 A-3 A-4 A-5 A-6 A-7 A-8 A-9 A-10 A-11 A-12 A-13 A-14 A-15 B-7 D-6 D-7 D-8 E-1

FILE: 2796.03 SITE

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

SITE DEVELOPMENT PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 11 of 15

JOB NUMBER 2796.03

nrg Power to be free

SEE SHEET 13 FOR LEGEND AND SHEET 15 FOR CONSTRUCTION NOTES

CAPE

COD CANAL

PRIORITY HABITAT PH 15

N.L.T. 187

IWPA
STATION #9 SOUTH
SAGAMORE WELLFIELD
4036000-07G
TOWN OF SANDWICH WATER
RESOURCE PROTECTION DISTRICT

PROPOSED PLANT COMPONENTS LEGEND

001 GAS TURBINE GE 7HA.02 (w/ACOUSTICAL ENCLOSURE)
002 GENERATOR
003 SCR/CO2 CATALYST (w/ACOUSTICAL SHROUD)
004 TEMPERING/PURGE FANS
005 STACK
006 EMERGENCY DIESEL GENERATOR
007 LUBE OIL SKID
008 CEMS
009 COMPRESSED AIR SYSTEM
010 COOLING FAN MODULE
011 EXISTING WELL
012 SERVICE WATER/FIRE PROTECTION PUMP ENCLOSURE
013 DEMINERALIZED WATER SYSTEM
014 DELETED
015 HYDROGEN STORAGE AREA
016 EXISTING TRAINING BLDG.
017 EXISTING AMMONIA STORAGE AREA
018 GAS COMPRESSOR
019 GAS PRE-HEATER AREA
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 GENERATOR STEP-UP TRANSFORMER (GSU)
023 POWER DISTRIBUTION CENTER (PDC)
024 TRANSMISSION LINES
025 DELETED
026 OIL WATER SEPARATOR
027 DELETED
028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
029 SERVICE WATER/FIRE WATER TANK
030 DEMINERALIZED WATER TANK
031 CO2 STORAGE AREA
032 FUEL OIL PUMP ENCLOSURE
033 INFILTRATION BASIN 1
034 INFILTRATION BASIN 2
035 UNDERGROUND 4,000 GALLON CT WATER-WASH TANK
036 ACOUSTICAL WALL
037 AMMONIA VAPORIZATION SKID
038 DCS ENCLOSURE
039 INFILTRATION BASIN 3
040 NEW ULSD FUEL UNLOADING LINE
041 NEW WATER LINE
042 NEW AMMONIA LINE

N/F
UNITED STATES OF AMERICA

MEAN LOW WATER (MLW) = -4.9±
MEAN HIGH WATER (MHW) = 3.7±
MEAN HIGH HIGH WATER (MHHW) = 4.4±

ROAD
SERVICE
EOP
100' BUFFER ZONE TO TOP OF COASTAL BANK
TOP OF COASTAL BANK

ZONE AE EL=14
ZONE X

PROPOSED ABOVE GROUND GAS LINE (20)

S82°06'20"E 500.00'
S82°06'20"E 203.65'

R=8114.49'
L=314.76'

ZONE AE EL=15
ZONE AE EL=14

PROPOSED 12" ULSD FUEL UNLOADING LINE W/ 16" CONTAINMENT PIPE (40)

FLOW TO CANAL
12" RCP CULVERT

EX. CANAL PLANT FACILITIES

N/F
MAP 91, LOT 3
NRG CANAL, LLC

TANK

PROPOSED FUEL OIL LINE (21)

PROPOSED UNDERGROUND FUEL OIL LINE (21)

PROPOSED ULSD DRAIN PUMP HOUSE/PIT

PROPOSED ABOVE GROUND GAS LINE (20)

N12°55'47"W 4.00'
N78°33'23"W 218.00'
N76°33'44"W 784.83'

IND
BL-1
1011.28'
N77°04'13"W

18" DIA. CMP CULVERT

FLOW FROM H-7 TO I-9

RAILROAD TRACKS

OBSCURED AREA

N/F
MAP 91, LOT 2
NRG CANAL, LLC

N/F
MAP 91, LOT 1
NRG CANAL, LLC

360' COMMONWEALTH ELECTRIC COMPANY ELECTRIC TRANSMISSION EASEMENT (BK 3297 PG 295)

N/F
MAP 86, LOT 21
COMMONWEALTH ELECTRIC COMPANY

400' COMMONWEALTH ELECTRIC COMPANY ELECTRIC TRANSMISSION EASEMENT (BK 3297 PG 295)

DRAINAGE DITCH (TYP)

N/F
MAP 86, LOT 23
COMMONWEALTH ELECTRIC COMPANY

N/F
MAP 86, LOT 26
COMMONWEALTH ELECTRIC COMPANY

SEE SHEET 13

SEE SHEET 11

nrg
Power to be free

FILE: 2796.03 SITE

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 - 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

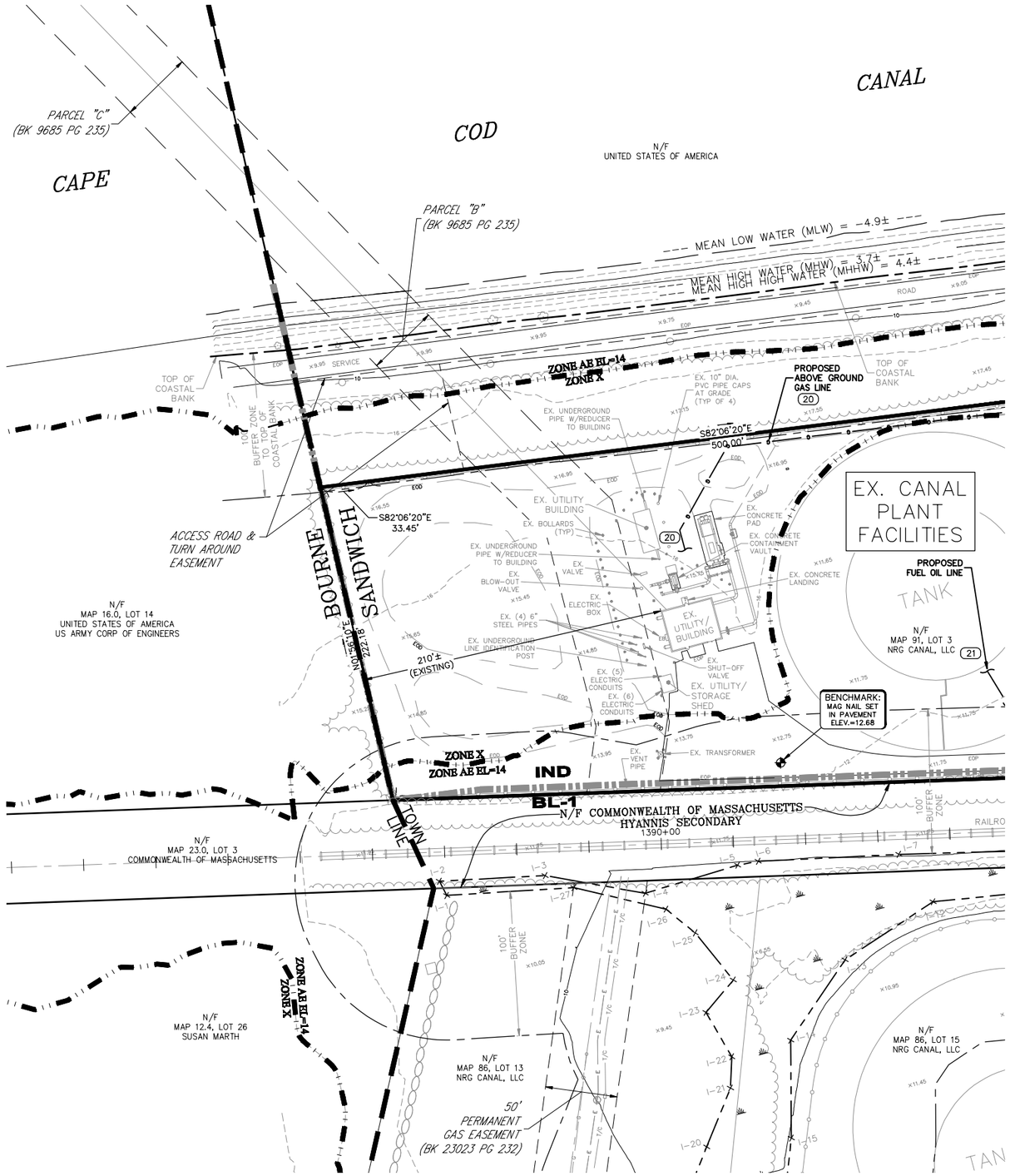
DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

SITE DEVELOPMENT PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 12 of 15
JOB NUMBER 2796.03



LEGEND

- EX. RAILROAD TRACKS
- EX. EDGE OF PAVEMENT
- EX. EDGE OF PAVEMENT W/CAPE COD BERM
- EX. EDGE OF GRAVEL
- EX. EDGE OF DIRT
- EX. CONTOUR LINE
- EDGE OF BORDERING VEGETATED WETLANDS W/WETLAND FLAG BASED UPON A FIELD DELINEATION
- 100' BUFFER ZONE
- EDGE OF WATER PER MASSGIS
- TOP OF COASTAL BANK
- 100' TOP OF COASTAL BANK BUFFER
- IWPA AND TOWN OF SANDWICH WATER RESOURCE PROTECTION DISTRICT
- NHESP PRIORITY HABITAT OF RARE SPECIES
- FEMA FLOOD ZONE
- ZONING LINE
- EX. EASEMENT
- EX. CHAIN LINK FENCE
- EX. POST AND RAIL FENCE
- EX. GUARD RAILS
- EX. STONE WALL
- EX. TREE LINE
- EX. TREE
- EX. SPECIMEN TREE
- EX. HEDGE LINE
- EX. GUY WIRE ANCHOR
- EX. UTILITY POLE
- EX. CATCH BASINS (CB)
- EX. MANHOLES
- EX. BENCHMARK
- EX. TRANSMISSION TOWER
- EX. LIGHT
- EX. POST/BOLLARD
- EX. SIGNS
- EX. BOUND
- EX. SPOT ELEVATION
- EX. HYDRANT
- EX. WATER GATE
- EX. GAS GATE
- EX. MONITORING WELL
- EX. ELECTRIC HAND HOLE
- EX. ELECTRIC BOX
- EX. ELECTRIC MANHOLE
- EX. UNDERGROUND ELECTRIC LINES
- EX. OVERHEAD ELECTRIC LINE
- EX. WATER LINE
- EX. DRAINAGE LINE
- EX. COMMUNICATION LINES
- EX. GAS LINE
- PROPOSED FACILITY SITE AREA
- PROP. GAS LINE
- PROP. FUEL LINE
- PROP. FUEL UNLOADING LINE
- PROP. WATER LINE
- PROP. DRAINAGE LINE
- PROP. OVERHEAD TRANSMISSION LINE
- PROP. 120' WIDE UTILITY EASEMENT
- PROPOSED TUBULAR STEEL POLE
- PROP. EDGE OF PAVEMENT
- PROP. CONTOUR LINE
- PROP. GRASSED CHANNEL
- PROP. DRAINAGE FLARED END SECTION
- PROP. DRAINAGE MANHOLE (MH)
- PROP. HEADWALL (HW)
- PROP. CATCH BASIN (CB)
- PROP. RIP-RAP
- PROP. EROSION CONTROL BARRIER

N.A.D. 1927

PROPOSED PLANT COMPONENTS LEGEND

001 GAS TURBINE GE 7HA.02 (w/ACOUSTICAL ENCLOSURE)
002 GENERATOR
003 SCR/CO2 CATALYST (w/ACOUSTICAL SHROUD)
004 TEMPERING/PURGE FANS
005 STACK
006 EMERGENCY DIESEL GENERATOR
007 LUBE OIL SKID
008 CEMS
009 COMPRESSED AIR SYSTEM
010 COOLING FAN MODULE
011 EXISTING WELL
012 SERVICE WATER/FIRE PROTECTION PUMP ENCLOSURE
013 DEMINERALIZED WATER SYSTEM
014 DELETED
015 HYDROGEN STORAGE AREA
016 EXISTING TRAINING BLDG.
017 EXISTING AMMONIA STORAGE AREA
018 GAS COMPRESSOR
019 GAS PRE-HEATER AREA
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 GENERATOR STEP-UP TRANSFORMER (GSU)
023 POWER DISTRIBUTION CENTER (PDC)
024 TRANSMISSION LINES
025 DELETED
026 OIL WATER SEPARATOR
027 DELETED
028 EVAPORATOR COOLER BLOWDOWN COLLECTION TANK
029 SERVICE WATER/FIRE WATER TANK
030 DEMINERALIZED WATER TANK
031 CO2 STORAGE AREA
032 FUEL OIL PUMP ENCLOSURE
033 INFILTRATION BASIN 1
034 INFILTRATION BASIN 2
035 UNDERGROUND 4,000 GALLON CT WATER-WASH TANK
036 ACOUSTICAL WALL
037 AMMONIA VAPORIZATION SKID
038 DCS ENCLOSURE
039 INFILTRATION BASIN 3
040 NEW ULSD FUEL UNLOADING LINE
041 NEW WATER LINE
042 NEW AMMONIA LINE

SEE SHEET 15 FOR CONSTRUCTION NOTES

nrg
Power to be free

FILE: 2796.03 SITE

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by :
Drawn by :
Checked by :
Survey chk. by :
Approved by :

SCALE
SCALE 1" = 40'
0 10 20 40 80

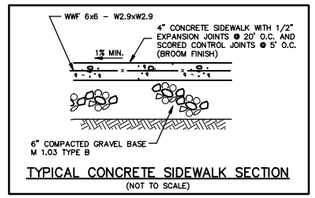
DATE

NO.	BY	DATE	REVISION

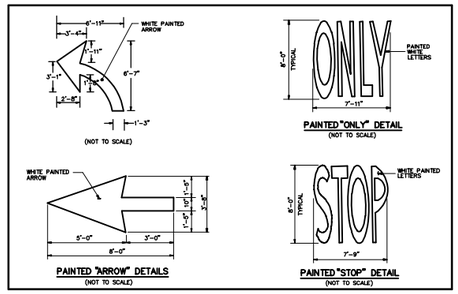
PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

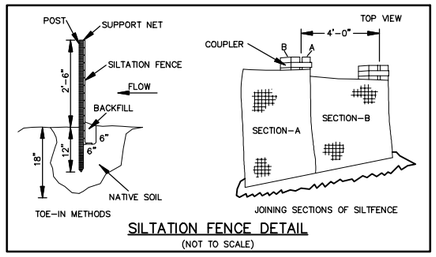
SITE DEVELOPMENT PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 13 of 15
JOB NUMBER 2796.03

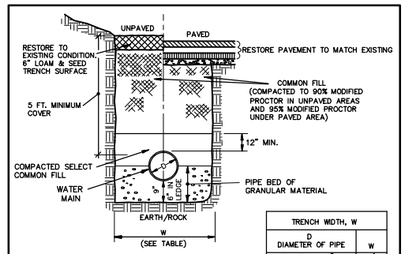


TYPICAL CONCRETE SIDEWALK SECTION
(NOT TO SCALE)



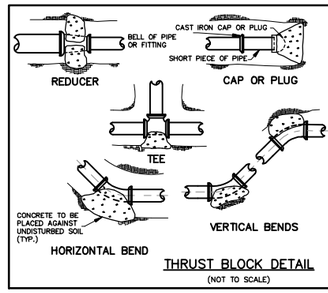


SILTATION FENCE DETAIL
(NOT TO SCALE)



TRENCH WIDTH, W	
DIAMETER OF PIPE	W
LESS THAN 12"	2'
12"	3'
15" TO 24"	4'

TYPICAL WATER TRENCH SECTION
NOT TO SCALE



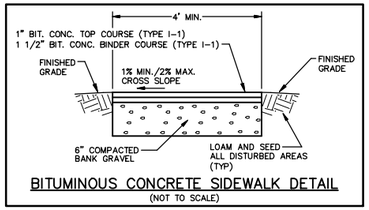
THRUST BLOCK DETAIL
(NOT TO SCALE)

THRUST BLOCK AREA TABLES

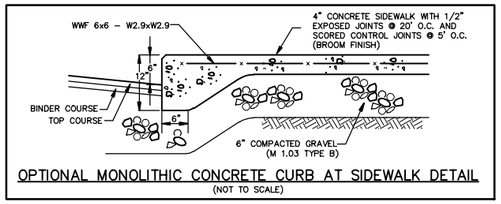
BENDS	6" PIPE	8" PIPE	10" PIPE
1/32 (11.25°)	2 S.F.	2 S.F.	2 S.F.
1/16 (22.5°)	2 S.F.	2 S.F.	4 S.F.
1/8 (45°)	2 S.F.	3 S.F.	7 S.F.
1/4 (90°)	3 S.F.	5 S.F.	10 S.F.
PLUG OF CAP	3 S.F.	4 S.F.	8 S.F.

TEES		
12" X 12"	8 S.F.	10" X 10"
12" X 10"	6 S.F.	10" X 8"
8" X 8"	4 S.F.	10" X 6"
23° X 6"	3 S.F.	

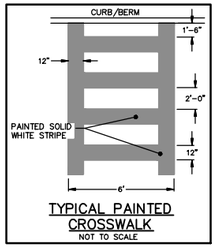
REDUCERS	
12 X 10	3 S.F.
12 X 8	4 S.F.
12 X 6	6 S.F.
10 X 8	2 S.F.
10 X 6	4 S.F.
8 X 6	2 S.F.



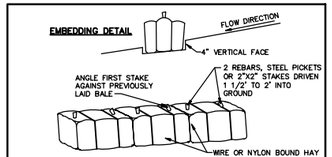
BITUMINOUS CONCRETE SIDEWALK DETAIL
(NOT TO SCALE)



OPTIONAL MONOLITHIC CONCRETE CURB AT SIDEWALK DETAIL
(NOT TO SCALE)

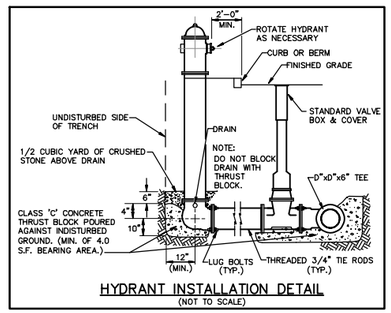


TYPICAL PAINTED CROSSWALK
NOT TO SCALE

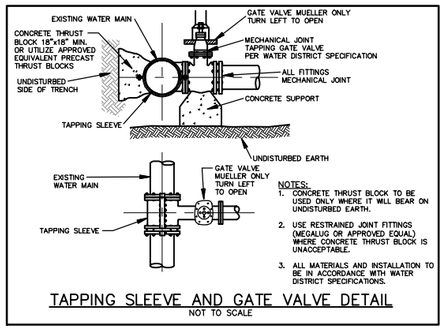


NOTES:
1. BALES SHALL BE PLACED IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MIN. OF 4".
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY STAKES OR REBARS DRIVEN THROUGH THE BALES. THE FIRST STAKE IN EACH BALE SHALL BE ANGLED TOWARD THE PREVIOUSLY LAID BALE TO FORCE BALE ENDS TOGETHER.
4. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE AS PROMPTLY AS NEEDED.
5. BALES SHALL BE REMOVED UPON STABILIZATION OF DISTURBED AREAS.

HAY BALE DETAIL
NOT TO SCALE

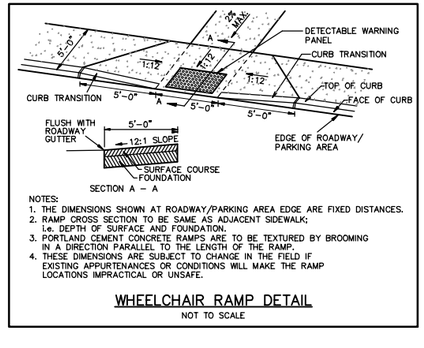


HYDRANT INSTALLATION DETAIL
(NOT TO SCALE)



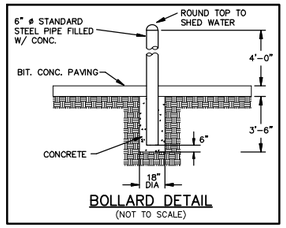
NOTES:
1. CONCRETE THRUST BLOCK TO BE USED ONLY WHERE IT WILL BEAR ON UNDISTURBED EARTH.
2. USE RESTRAINED JOINT FITTINGS (MEGALUG OR APPROVED EQUAL) WHERE CONCRETE THRUST BLOCK IS UNACEPTABLE.
3. ALL MATERIALS AND INSTALLATION TO BE IN ACCORDANCE WITH WATER DISTRICT SPECIFICATIONS.

TAPPING SLEEVE AND GATE VALVE DETAIL
NOT TO SCALE

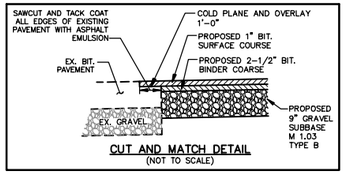


NOTES:
1. THE DIMENSIONS SHOWN AT ROADWAY/PARKING AREA EDGE ARE FIXED DISTANCES.
2. RAMP CROSS SECTION TO BE SAME AS ADJACENT SIDEWALK; i.e. DEPTH OF SURFACE AND FOUNDATION.
3. PORTLAND CEMENT CONCRETE RAMPS ARE TO BE TEXTURED BY BROOMING IN A DIRECTION PARALLEL TO THE LENGTH OF THE RAMP.
4. THESE DIMENSIONS ARE SUBJECT TO CHANGE IN THE FIELD IF EXISTING APPURTENANCES OR CONDITIONS WILL MAKE THE RAMP LOCATIONS IMPRACTICAL OR UNSAFE.

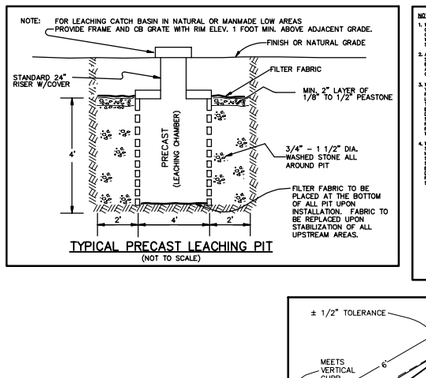
WHEELCHAIR RAMP DETAIL
NOT TO SCALE



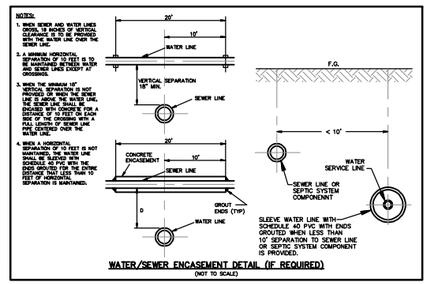
BOLLARD DETAIL
(NOT TO SCALE)



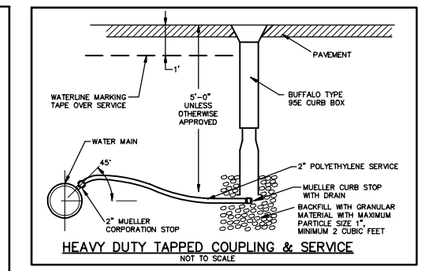
CUT AND MATCH DETAIL
(NOT TO SCALE)



TYPICAL PRECAST LEACHING PIT
(NOT TO SCALE)



WATER/SEWER ENCASEMENT DETAIL (IF REQUIRED)
(NOT TO SCALE)



HEAVY DUTY TAPPED COUPLING & SERVICE
NOT TO SCALE

HCP SIGN DETAIL
(NOT TO SCALE)

PAINTED HANDICAPPED SYMBOL DETAIL
NOT TO SCALE

HANDICAP PARKING LAYOUT
(NOT TO SCALE)

NOTE: SIGNS SHALL BE PLACED 2' OFF THE BACK EDGE OF SIDEWALK WHERE POSSIBLE, OTHERWISE MINIMIZE AMOUNT OF SIDEWALK ENCROACHMENT

TRAFFIC SIGN DETAIL
NOT TO SCALE

CAST-IN-PLACE DETECTABLE WARNING PANEL
NOT TO SCALE

CAPE COD BERM DETAIL
(NOT TO SCALE)

PAVEMENT CROSS SECTION
NOT TO SCALE

TYPICAL ROAD CROSS SECTION
(NOT TO SCALE)

PRECAST CONCRETE CURB DETAIL
(NOT TO SCALE)

TRANSITION CURB DETAIL
(NOT TO SCALE)

STONE TRACKING PAD/CONSTRUCTION ENTRANCE
(NOT TO SCALE)

– FOR INFORMATION ONLY –
CONTACT UTILITY COMPANY AND REFER TO PLANS BY OTHERS FOR SPECIFIC DETAIL FOR THIS SITE.

TYPICAL UTILITY TRENCH DETAIL
(NOT TO SCALE)

NOTE:
BUILDER/DEVELOPER RESPONSIBLE FOR DIGGING AND BACKFILLING TRENCH TO THE GAS COMPANY STANDARDS. CALL THE GAS COMPANY CUSTOMER CONNECT COORDINATOR 2 WEEKS PRIOR TO INSTALLATION DATE FOR PRECONSTRUCTION MEETING.

– FOR INFORMATION ONLY –
CONTACT GAS COMPANY FOR SPECIFIC DETAILS FOR THIS SITE.

TYPICAL GAS SERVICE SECTION
(NOT TO SCALE)

nrg
Power to be free™

FILE: 2796.03 DET

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by : _____
Drawn by : _____
Checked by : _____
Survey chk. by : _____
Approved by : _____

SCALE
AS NOTED

DATE

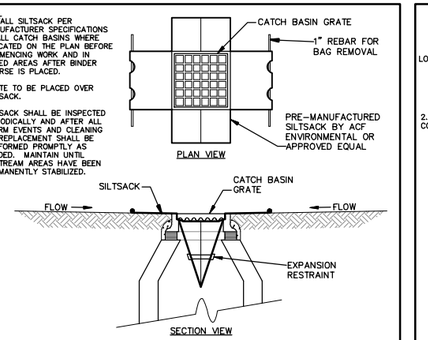
NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

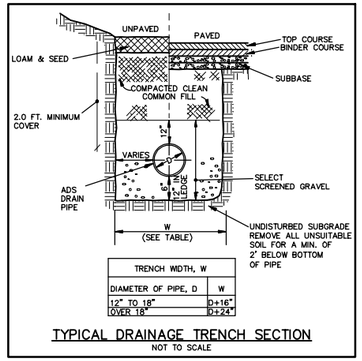
DETAILS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 14 of 15
JOB NUMBER 2796.03

NOTES:
1. INSTALL SILTSACK PER MANUFACTURER SPECIFICATIONS IN ALL CATCH BASINS WHERE INDICATED ON THE PLAN BEFORE COMMENCING WORK AND IN PAVED AREAS AFTER BINDER COURSE IS PLACED.
2. GRATE TO BE PLACED OVER SILTSACK.
3. SILTSACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED. MAINTAIN UNTIL UPSTREAM AREAS HAVE BEEN PERMANENTLY STABILIZED.

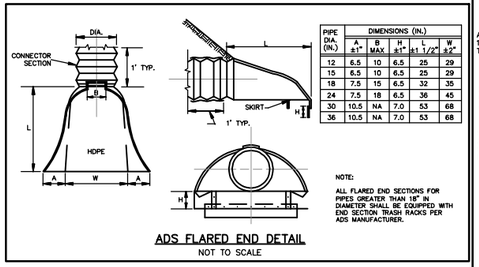


SILTSACK SEDIMENT TRAP DETAIL
(NOT TO SCALE)



TRENCH WIDTH, W	
DIAMETER OF PIPE, D	W
12" TO 18"	D+16"
OVER 18"	D+24"

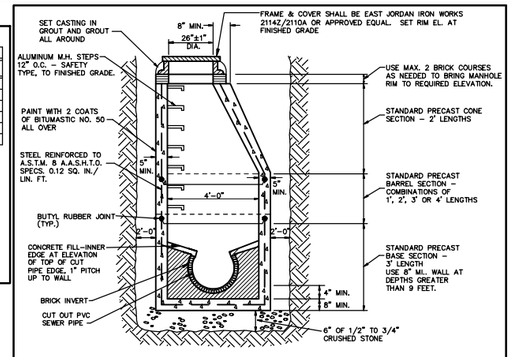
TYPICAL DRAINAGE TRENCH SECTION
NOT TO SCALE



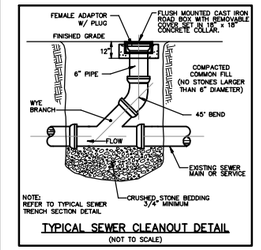
PIPE DIA. (IN.)	DIMENSIONS (IN.)					
	A ±1"	B MAX.	H ±1"	L ±1 1/2"	W ±2"
12	6.5	10	6.5	25	29
15	6.5	10	6.5	25	29
18	7.5	15	6.5	32	35
24	7.5	18	6.5	36	45
30	10.5	NA	7.0	53	68
36	10.5	NA	7.0	53	68

NOTE:
ALL FLARED END SECTIONS FOR PIPES GREATER THAN 18" IN DIAMETER SHALL BE EQUIPPED WITH END SECTION TRASH RACKS PER ADS MANUFACTURER.

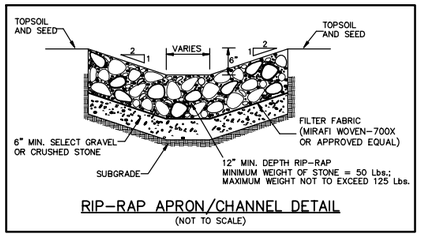
ADS FLARED END DETAIL
NOT TO SCALE



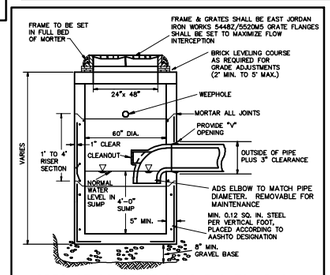
PRECAST CONCRETE SEWER MANHOLE
(NOT TO SCALE)



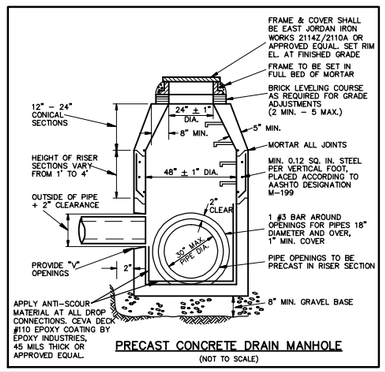
TYPICAL SEWER CLEANOUT DETAIL
(NOT TO SCALE)



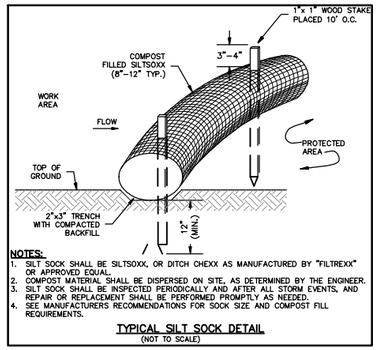
RIP–RAP APRON/CHANNEL DETAIL
(NOT TO SCALE)



PRECAST CONCRETE DOUBLE CATCH BASIN WITH GAS TRAP AND CLEANOUT
(NOT TO SCALE)

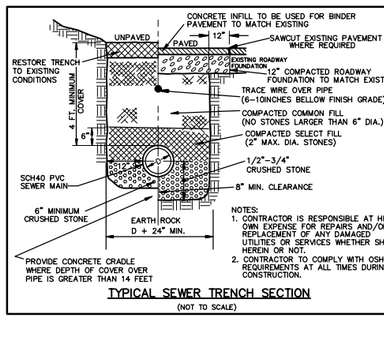


PRECAST CONCRETE DRAIN MANHOLE
(NOT TO SCALE)



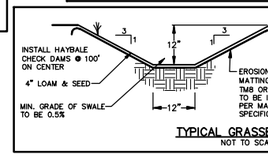
NOTES:
1. SILT SOCK SHALL BE SILTSOXX, OR DITCH CHEXX AS MANUFACTURED BY "FILTREXX" OR APPROVED EQUAL.
2. COMPOST MATERIAL SHALL BE DISPERSED ON SITE, AS DETERMINED BY THE ENGINEER.
3. SILT SOCK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS, AND REPAIR OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED.
4. SEE MANUFACTURERS RECOMMENDATIONS FOR SOCK SIZE AND COMPOST FILL REQUIREMENTS.

TYPICAL SILT SOCK DETAIL
(NOT TO SCALE)



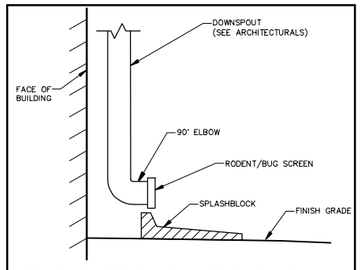
NOTES:
1. CONTRACTOR IS RESPONSIBLE AT HIS OWN EXPENSE FOR REPAIRS AND/OR REPLACEMENT OF ANY DAMAGED UTILITIES OR SERVICES WHETHER SHOWN HEREIN OR NOT.
2. CONTRACTOR TO COMPLY WITH OSHA REQUIREMENTS AT ALL TIMES DURING CONSTRUCTION.

TYPICAL SEWER TRENCH SECTION
(NOT TO SCALE)

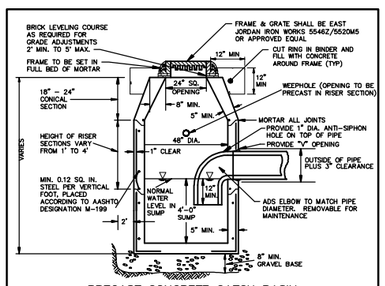


NOTES:
1. LOAM AND SEED AND EROSION CONTROL MEASURES TO BE INSTALLED IMMEDIATELY UPON CONSTRUCTION OF SWALE.
2. CONTRACTOR TO CHECK SWALE WEEKLY AND AFTER ALL RAIN EVENTS DURING CONSTRUCTION FOR SIGNS OF EROSION/BARE SPOTS AND RESEED IMMEDIATELY, UNTIL STABILIZED.
3. SEE STORMWATER O+M SCHEDULE FOR LONG TERM MEASURES.

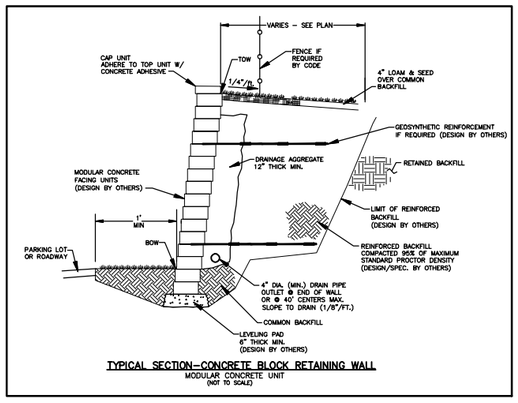
TYPICAL GRASSED SWALE
NOT TO SCALE



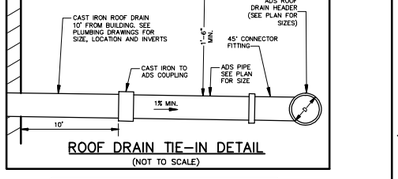
ROOF GUTTER DOWNSPOUT DETAIL
(NOT TO SCALE)



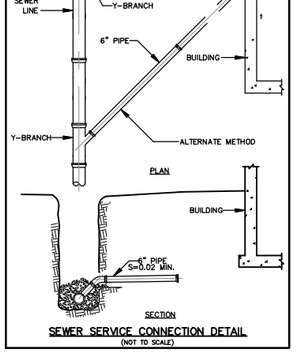
PRECAST CONCRETE CATCH BASIN WITH GAS TRAP AND CLEANOUT
(NOT TO SCALE)



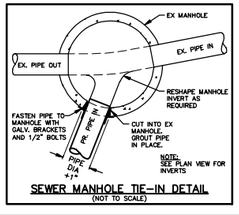
TYPICAL SECTION–CONCRETE BLOCK RETAINING WALL
MODULAR CONCRETE UNIT
(NOT TO SCALE)



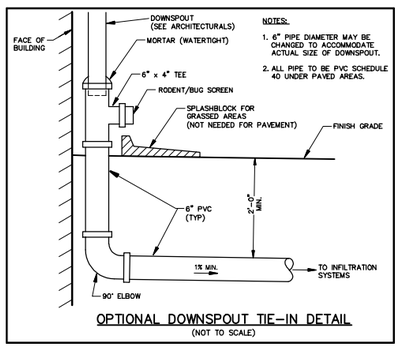
ROOF DRAIN TIE–IN DETAIL
(NOT TO SCALE)



SEWER SERVICE CONNECTION DETAIL
(NOT TO SCALE)

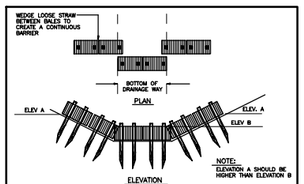


SEWER MANHOLE TIE–IN DETAIL
(NOT TO SCALE)

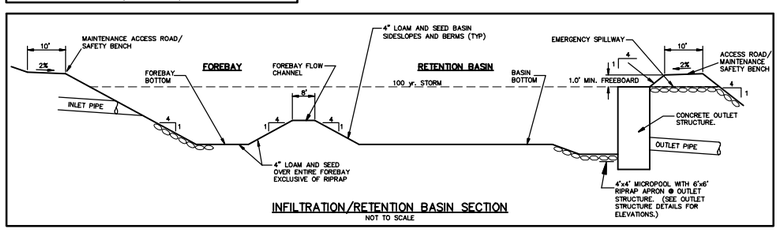


NOTES:
1. 6" PIPE DIAMETER MAY BE CHANGED TO ACCOMMODATE ACTUAL SIZE OF DOWNSPOUT.
2. ALL PIPE TO BE PVC SCHEDULE 40 UNDER PAVED AREAS.

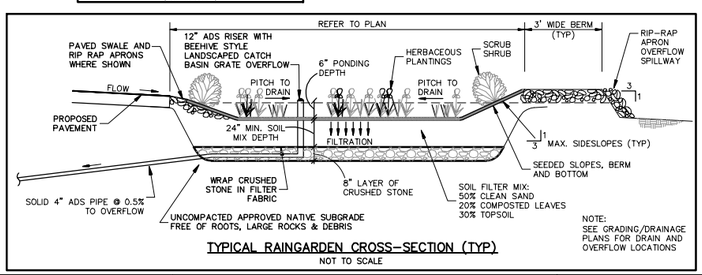
OPTIONAL DOWNSPOUT TIE–IN DETAIL
(NOT TO SCALE)



HAY BALE CHECK DAM
(NOT TO SCALE)



INFILTRATION/RETENTION BASIN SECTION
NOT TO SCALE



TYPICAL RAINGARDEN CROSS–SECTION (TYP)
NOT TO SCALE

CONSTRUCTION NOTES:

1. PROPERTY LINES AND EXISTING CONDITIONS FROM PLANS ENTITLED LAND TITLE SURVEY PREPARED BY SURVEYING AND MAPPING CONSULTANTS, DATED SEPTEMBER 15, 1998 AND SUPPLEMENTED BY ATLANTIC DESIGN ENGINEERS, INC. IN 2015.
2. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS SHOWN AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES THAT MAY BE FOUND IN THE PLAN.
3. CONTRACTOR SHALL VERIFY ALL CRITICAL ELEVATIONS AND INVERTS PRIOR TO CONSTRUCTION.
4. WHERE AN EXISTING PUBLIC UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED AND THE INFORMATION FURNISHED TO THE UTILITY COMPANY AND OWNER FOR RESOLUTION OF THE CONFLICT.
5. SUBSURFACE AND ENVIRONMENTAL CONDITIONS WERE NOT EXAMINED OR CONSIDERED AS PART OF THIS SURVEY. NO STATEMENT IS MADE CONCERNING THE EXISTENCE OF UNDERGROUND OR OVERHEAD CONTAINERS OR FACILITIES THAT MAY AFFECT THE USE OR DEVELOPMENT OF THIS SITE.
6. IT IS THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY DIGSAFE, THE TOWN OF SANDWICH DEPARTMENT OF PUBLIC WORKS, AND ALL UTILITY COMPANIES A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION ACTIVITIES FOR LOCATION OF ALL UNDERGROUND UTILITIES AND UTILITY COMPANY APPROVALS.
7. ALL BUILDINGS, SURFACE, AND SUBSURFACE IMPROVEMENTS ON AREAS ADJACENT TO THE SITE ARE NOT NECESSARILY SHOWN HEREON.
8. THE LOCATION OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVES. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL UTILITIES AND RIM AND INVERTS BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES THAT MIGHT OCCUR BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.
9. THE CONTRACTOR SHALL MAKE ALL ARRANGEMENTS FOR THE ALTERATION AND ADJUSTMENTS OF ELECTRIC, TELEPHONE AND ANY OTHER PRIVATE UTILITIES WITH THE UTILITY COMPANY, IF NECESSARY. IF ANY INTERRUPTIONS IN SERVICE ARE NECESSARY TO ABUTTING PROPERTY OWNERS, A MINIMUM OF 48 HOURS NOTICE SHALL BE GIVEN.
10. THE CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL MEASURES IN ACCORDANCE WITH THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES AND MASSACHUSETTS HIGHWAY DEPARTMENT REQUIREMENTS FOR ALL WORK WITHIN PUBLIC STREETS.
11. AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATION SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE.
12. ALL DISTURBED AREAS SHALL BE PAVED, LANDSCAPED, OR REVEGETATED WITH 4" (MIN) LOAM AND SEED IMMEDIATELY UPON COMPLETION OF CONSTRUCTION.
13. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT ALL REQUIRED INSPECTIONS AND/OR CERTIFICATIONS REQUIRED BY CODES AND/OR UTILITY COMPANIES ARE COMPLETED PRIOR TO INSTALLATION, BACKFILLING, ANNOUNCED BUILDING POSSESSION, AND THE FINAL CONNECTION OF SERVICES.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL SURVEY CONTROL POINTS AND BENCHMARKS NECESSARY FOR THE PROPOSED WORK.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ADEQUATE RECORDS OF THE LOCATION AND ELEVATION OF ALL WORK INSTALLED.
16. THE CONTRACTOR SHALL INSTITUTE AND MAINTAIN ALL SAFETY MEASURES NECESSARY TO PROTECT THE PUBLIC DURING CONSTRUCTION, INCLUDING, BUT NOT LIMITED TO BARRICADES, SIGNS, FENCES, FLAGGERS, LIGHTING, POLICE DETAIL, AND ANY OTHER MEANS AS DIRECTED BY THE TOWN. NO TRENCHES ARE TO REMAIN OPEN OVERNIGHT.
17. THE CONTRACTOR SHALL KEEP THE PREMISES FREE FROM THE ACCUMULATION OF WASTE MATERIAL AND OTHER DEBRIS RESULTING FROM THE WORK. AT THE END OF CONSTRUCTION THE CONTRACTOR SHALL REMOVE ALL CONSTRUCTION DEBRIS AND SURPLUS MATERIALS FROM THE SITE. A THOROUGH INSPECTION OF THE WORK PERIMETER IS TO BE MADE AND ALL DISCARDED MATERIALS, BLOWN OR WATER CARRIED DEBRIS, SHALL BE COLLECTED AND REMOVED FROM THE SITE.
18. THE CONTRACTOR SHALL REMOVE ALL VEGETATION, TREES, STUMPS, GRASSES, ORGANIC SOILS, DEBRIS AND DELETERIOUS MATERIALS WITHIN THE AREAS SLATED FOR CONSTRUCTION.
19. ALL WORK SHALL BE DONE IN STRICT COMPLIANCE WITH ALL APPROVED PERMITS AND WITH ALL APPLICABLE NATIONAL, STATE, AND LOCAL CODES, STANDARDS, ORDINANCES, RULES AND REGULATIONS.

EROSION CONTROL NOTES:

1. PRIOR TO COMMENCING SITE WORK OR EARTHWORK OPERATIONS, INSTALL EROSION CONTROL BARRIERS AND MAINTAIN THROUGHOUT CONSTRUCTION.
2. ALL DISTURBED AREAS SHALL BE LOAMED AND SEEDED IMMEDIATELY UPON COMPLETION OF CONSTRUCTION.
3. ALL MATERIALS AND STOCKPILES SHALL BE STORED ON LEVEL AREAS OUTSIDE OF ANY FLOOD ZONES, WETLANDS OR BUFFER ZONE AREAS. ALL STOCKPILES SHALL BE SURROUNDED BY HAYBALES. SHALL HAVE SIDE SLOPES NO GREATER THAN 30% AND SHALL BE SEEDED OR STABILIZED IF LEFT UNDISTURBED FOR TWO WEEKS OR MORE.
4. SEDIMENTATION CONTROL DEVICES AND EROSION CONTROL BARRIERS SHALL BE INSPECTED WEEKLY AND MAINTAINED AS NECESSARY THROUGHOUT ALL PHASES OF CONSTRUCTION AND PROMPTLY AFTER EACH RAINFALL.
5. ANY SLOPE STEEPER AND 3:1 SHALL BE EQUIPPED WITH SLOPE STABILIZATION FABRIC OR EROSION CONTROL MATTING.
6. ADDITIONAL EROSION CONTROL MEASURES SHALL BE INSTITUTED AS CONDITIONS WARRANT OR AS DIRECTED BY THE ENGINEER AND/OR THE TOWN.
7. THE CONTRACTOR MUST REPAIR OR RE–SEED ANY AREAS THAT DO NOT DEVELOP WITHIN A PERIOD OF ONE YEAR AT NO ADDITIONAL EXPENSE TO THE OWNER.
8. MATERIAL STOCKPILES SHALL NOT BE LOCATED WITHIN THE PATH OF EXISTING OR PROPOSED WATERCOURSES (BOTH TEMPORARY OR PERMANENT) OR THOSE AREAS SUBJECT TO STORM WATER FLOW.
9. SEDIMENT CONTROL DEVICES AND EROSION CONTROL BARRIERS MAY BE REMOVED ONLY AFTER THE SITE HAS BEEN STABILIZED.
10. ALL DISTURBED OR EXPOSED AREAS SUBJECT TO EROSION, WHICH REMAIN DISTURBED BUT INACTIVE FOR AT LEAST THIRTY DAYS, SHALL RECEIVE TEMPORARY SEEDING IN ACCORDANCE WITH THE MASSACHUSETTS EROSION AND SEDIMENT CONTROL GUIDELINES. IN ALL CASES, STABILIZATION MEASURES SHALL BE IMPLEMENTED AS SOON AS POSSIBLE IN ACCORDANCE WITH THE MASSACHUSETTS EROSION AND SEDIMENT CONTROL GUIDELINES.
11. EARTHWORK ACTIVITY ON THE SITE SHALL BE DONE IN A MANNER SUCH THAT RUNOFF IS DIRECTED AWAY FROM ABUTTING STRUCTURES, PROPERTY, ETC.
12. THE CONTRACTOR SHALL KEEP ON SITE AT ALL TIMES ADDITIONAL HAYBALES AND EXTRA SILTATION FENCING FOR INSTALLATION AT THE DIRECTION OF THE ENGINEERS OR THE PLANNING BOARD TO MITIGATE ANY EMERGENCY CONTROL.
13. REFER TO CONSTRUCTION DETAILS FOR ADDITIONAL EROSION CONTROL MEASURES.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SITING, RELOCATION AND AUGMENTATION OF EROSION CONTROL DEVICES AS THE PROJECT PROGRESSES AND THE SITE DRAINAGE CONDITIONS CHANGE.
15. THE CONTRACTOR SHALL MINIMIZE THE AREA OF DISTURBED SOIL. EFFORTS SHALL BE MADE TO LIMIT THE TIME OF EXPOSURE OF DISTURBED AREAS.

nrg
Power to be free

FILE: 2796.03 DET

Atlantic® DESIGN ENGINEERS, INC.
P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

Designed by : _____
Drawn by : _____
Checked by : _____
Survey chk. by : _____
Approved by : _____

SCALE: AS NOTED

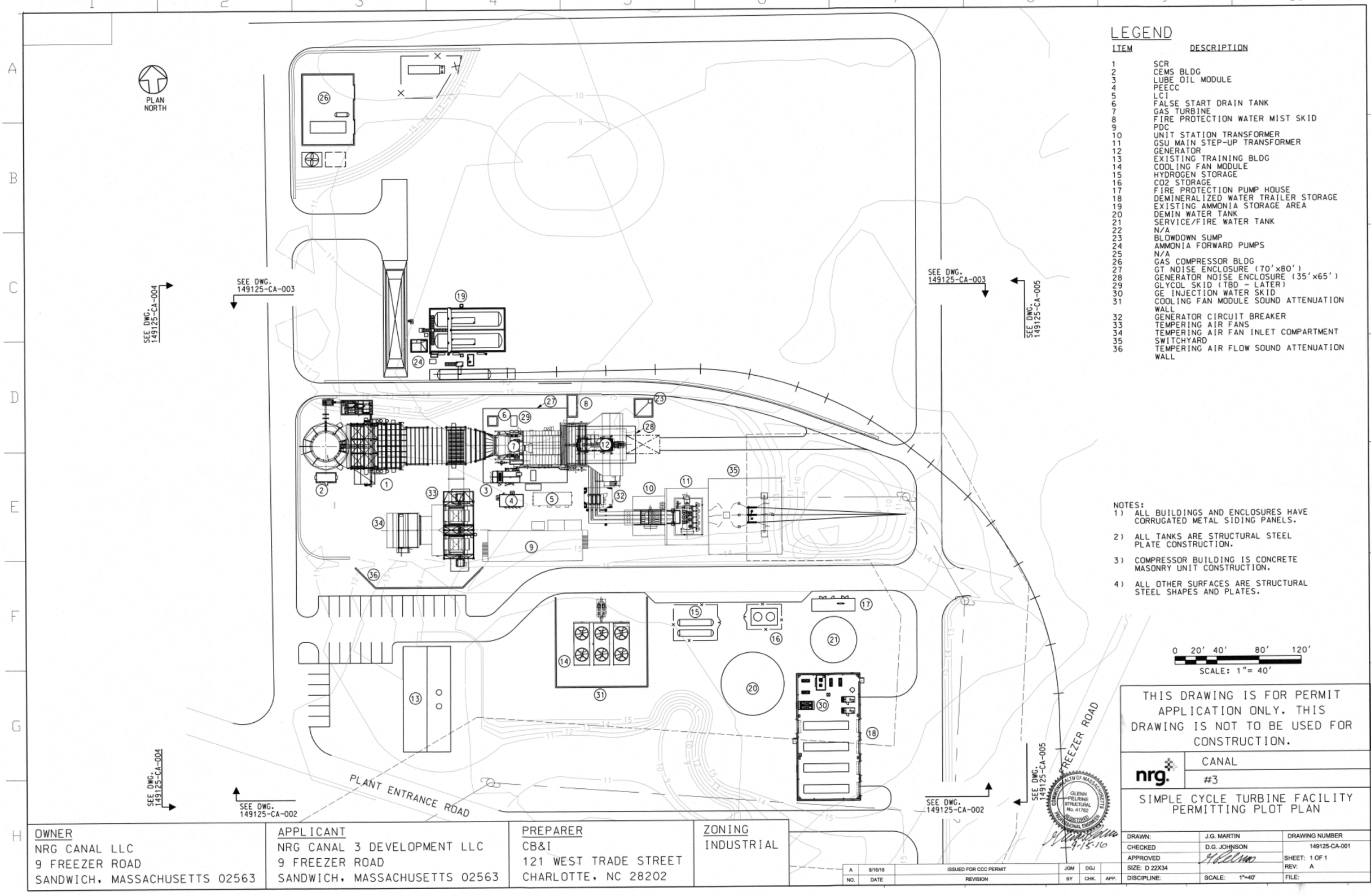
DATE

NO.	BY	DATE	REVISION

PREPARED FOR:
NRG CANAL 3 DEVELOPMENT, LLC
9 FREEZER ROAD
SANDWICH, MASSACHUSETTS 02563

DETAILS PLAN
FOR
CANAL UNIT 3 PLANT EXPANSION
SANDWICH, MASSACHUSETTS 02563
SEPTEMBER 16, 2016

Sheet 15 of 15
JOB NUMBER 2796.03



LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

NOTES:
1) ALL BUILDINGS AND ENCLOSURES HAVE CORRUGATED METAL SIDING PANELS.
2) ALL TANKS ARE STRUCTURAL STEEL PLATE CONSTRUCTION.
3) COMPRESSOR BUILDING IS CONCRETE MASONRY UNIT CONSTRUCTION.
4) ALL OTHER SURFACES ARE STRUCTURAL STEEL SHAPES AND PLATES.

0 20' 40' 80' 120'
SCALE: 1"= 40'

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

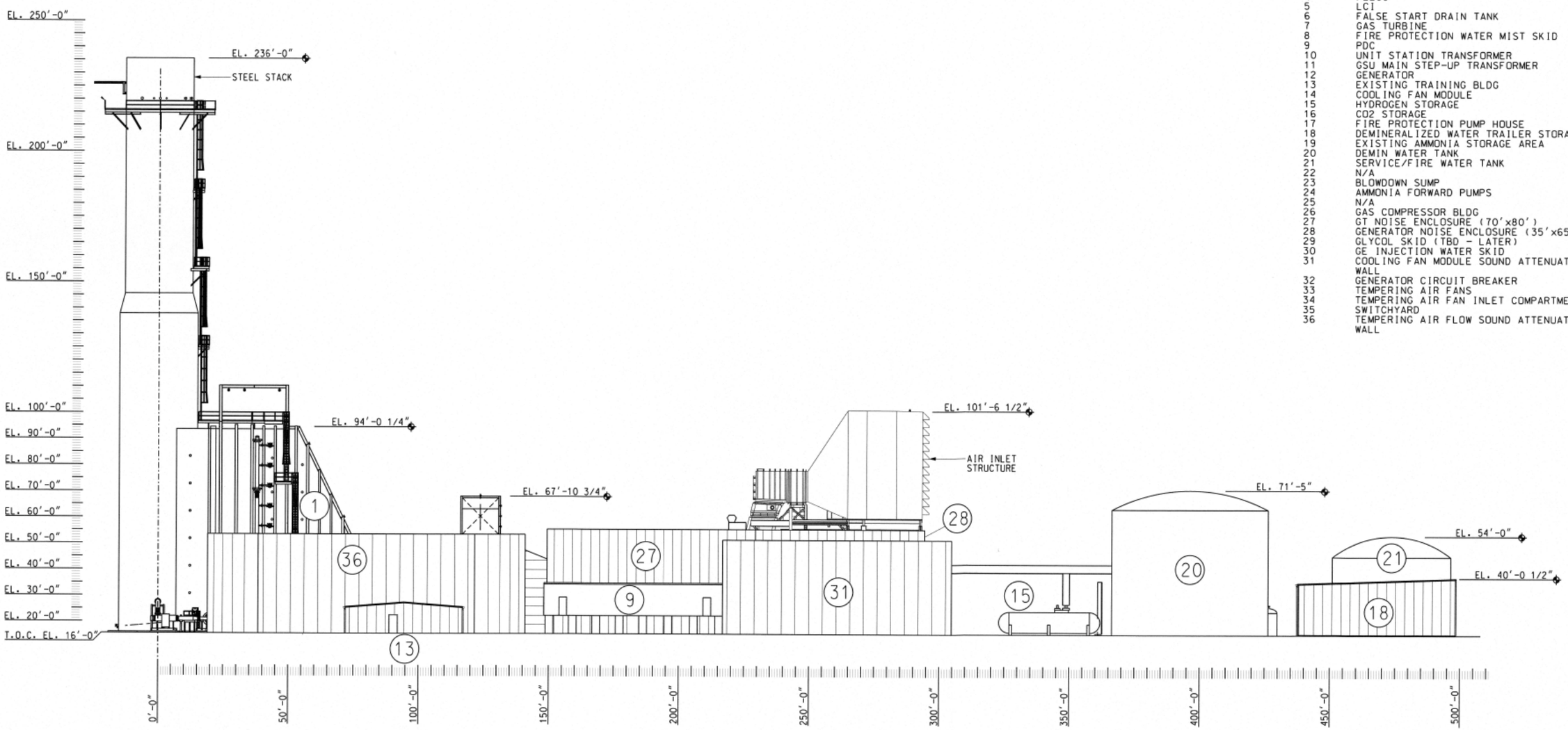
SIMPLE CYCLE TURBINE FACILITY PERMITTING PLOT PLAN

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
9-15-16

A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ		
NO.	DATE	REVISION	BY	CHK.	APP.	

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-001
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=40'	FILE:

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



PROJECT SOUTH ELEVATION (LOOKING NORTH)
SCALE: 1"=20'

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg. | CANAL #3

SIMPLE CYCLE TURBINE FACILITY
PROJECT SOUTH ELEVATION
(LOOKING NORTH)

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-002
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:

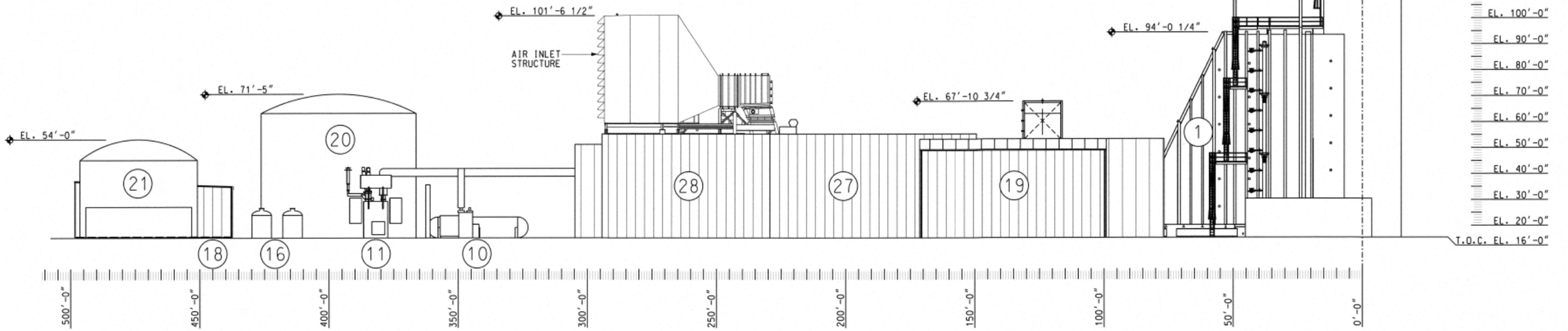
COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41752
REGISTERED
PROFESSIONAL ENGINEER
9-15-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL



PROJECT NORTH ELEVATION (LOOKING SOUTH)
SCALE: 1"=20'

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.	CANAL #3

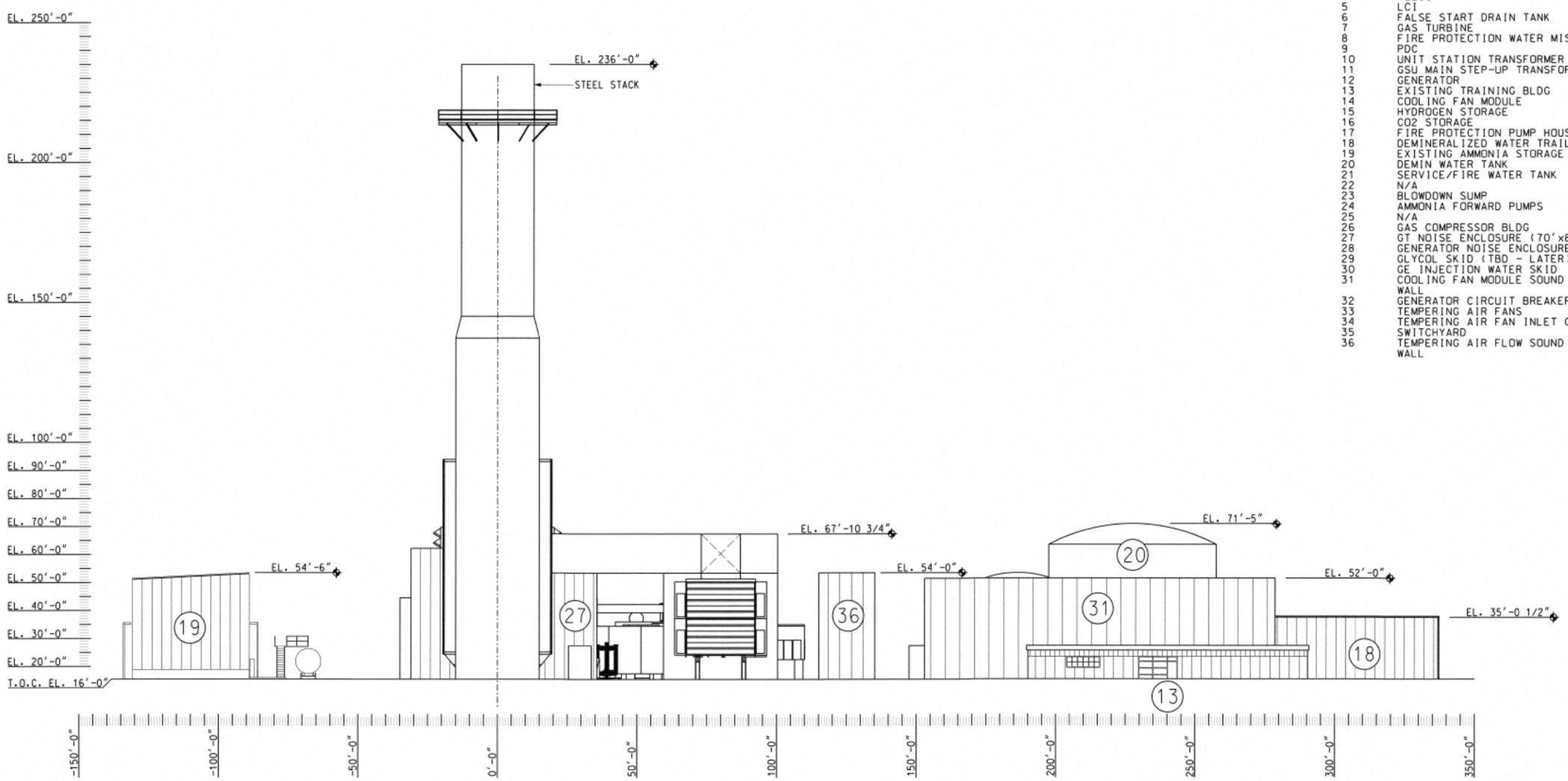
SIMPLE CYCLE TURBINE FACILITY
PROJECT NORTH ELEVATION
(LOOKING SOUTH)

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-003
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41762
REGISTERED PROFESSIONAL ENGINEER
9-15-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



PROJECT WEST ELEVATION (LOOKING EAST)
SCALE: 1"=20'

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
9-15-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

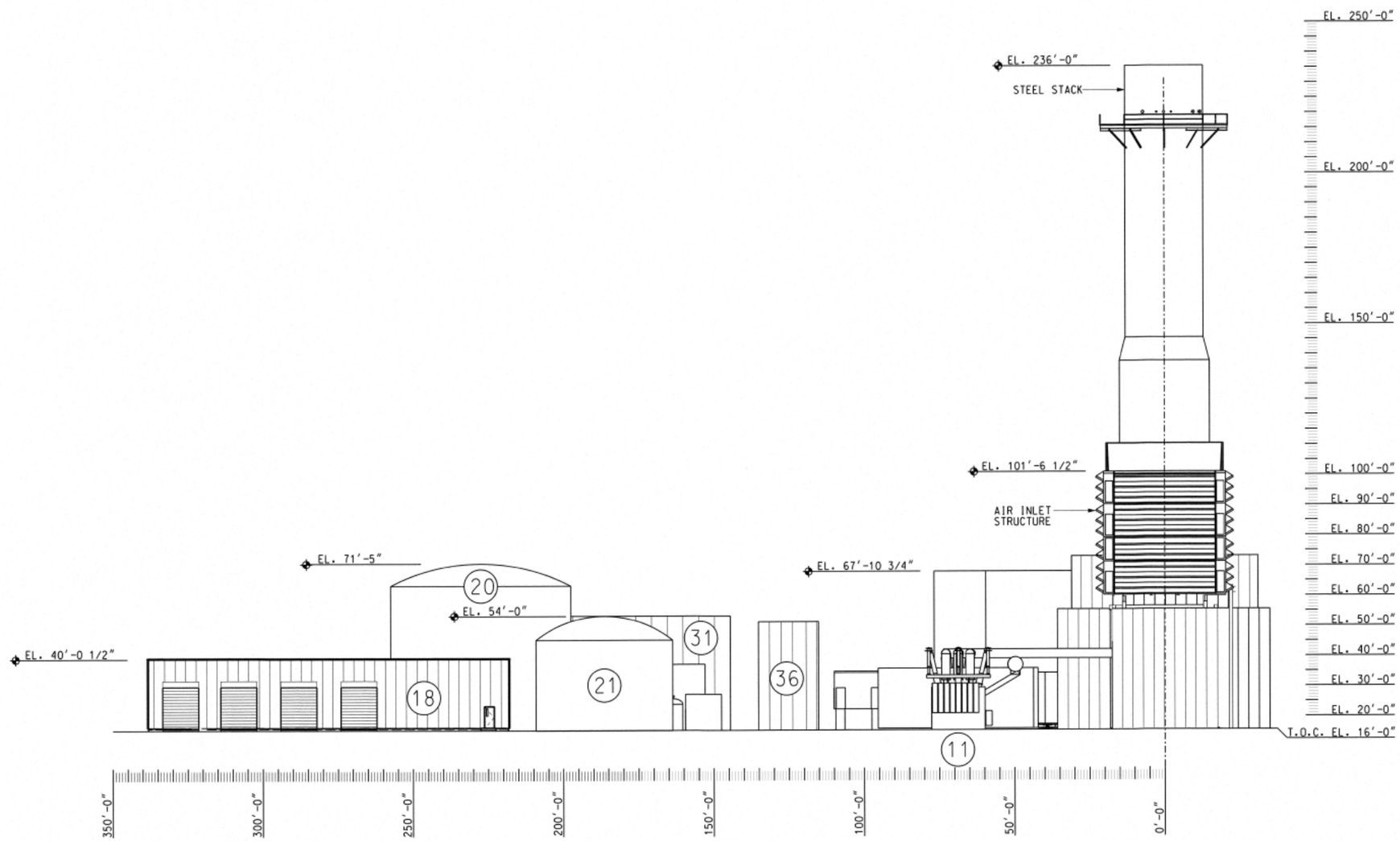
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
PROJECT WEST ELEVATION
(LOOKING EAST)

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-004
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:



PROJECT EAST ELEVATION (LOOKING WEST)
SCALE: 1"=20'

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

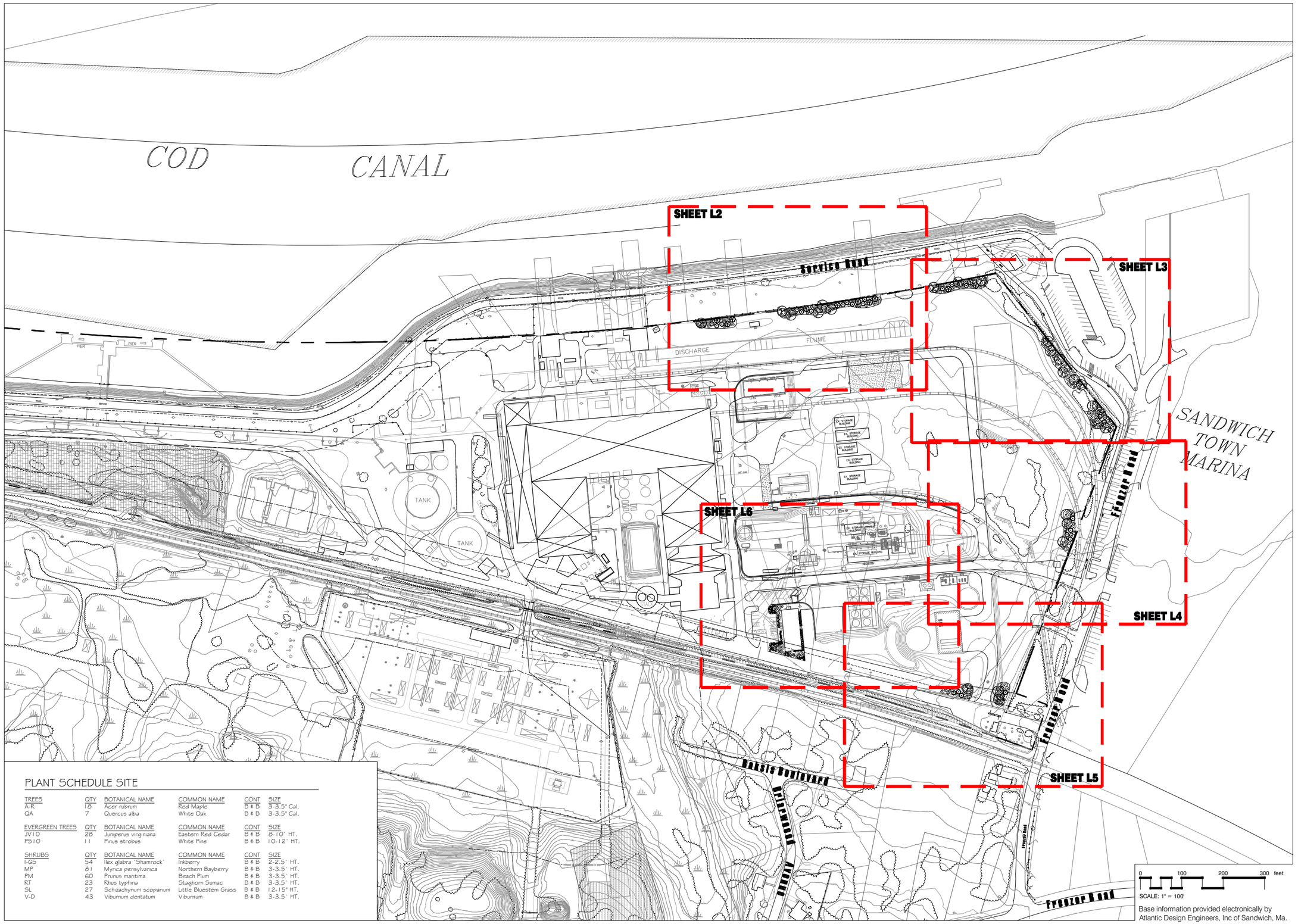
nrg. | CANAL #3

SIMPLE CYCLE TURBINE FACILITY
PROJECT EAST ELEVATION
(LOOKING WEST)

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
9-15-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-005
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:



PLANT SCHEDULE SITE

TREES	QTY	BOTANICAL NAME	COMMON NAME	CONT	SIZE
A-R	18	Acer rubrum	Red Maple	B & B	3-3.5" Cal.
QA	7	Quercus alba	White Oak	B & B	3-3.5" Cal.

EVERGREEN TREES	QTY	BOTANICAL NAME	COMMON NAME	CONT	SIZE
JV10	28	Juniperus virginiana	Eastern Red Cedar	B & B	8-10` HT.
PS10	11	Pinus strobus	White Pine	B & B	10-12` HT.

SHRUBS	QTY	BOTANICAL NAME	COMMON NAME	CONT	SIZE
I-GS	54	Ilex glabra `Shamrock`	Inkberry	B & B	2-2.5` HT.
MP	81	Myrica pensylvanica	Northern Bayberry	B & B	3-3.5` HT.
PM	60	Prunus maritima	Beach Plum	B & B	3-3.5` HT.
RT	23	Rhus typhina	Staghorn Sumac	B & B	3-3.5` HT.
SL	27	Schizachyrium scopanum	Little Bluestem Grass	B & B	12-15" HT.
V-D	43	Viburnum dentatum	Viburnum	B & B	3-3.5` HT.

Base information provided electronically by Atlantic Design Engineers, Inc of Sandwich, Ma.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:
Num. Date Description

NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: JP | Checked By: DH

Overall Planting Plan

Scale: 1" = 100'-0"

Sheet: **L1**

TOP OF COASTAL BANK

Service Road

EOP

SERVICE

10

PROPERTY LINE, TYP.

100' FROM COASTAL BANK

EXISTING FENCE, TYP.

1-P8Ø
2-JV1Ø
HMP
2-P8Ø
3-V-D
1-A-R
3-FM
1-JV1Ø
3-MP
1-V-D
2-V-D
3-JV1Ø
APPROX. EDGE OF EXISTING VEGETTION, TYP.

PLANT BED EDGE, TYP.

TRIPLE SHREDDED MULCH BED, TYP.

EOD

FLUME

DISCHARGE

11

EOP

*See Sheet L1 for Plant Schedule

0 20 40 60 feet
SCALE: 1" = 20'

Base information provided electronically by Atlantic Design Engineers, Inc of Sandwich, Ma.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:
Num. Date Description

NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dh

North Property Planting Plan

Scale: 1" = 20'-0"

Sheet: L2

100' FROM COASTAL BANK

BIKE

PROPERTY LINE, TYP.

EXISTING FENCE, TYP.

APRROX. EDGE OF EXISTING VEGETTION, TYP.

PLANT BED EDGE, TYP.

TRIPLE SHREDDED MULCH BED, TYP.

EOP

PATH

Freezer Road

PLANT BED EDGE, TYP.

TRIPLE SHREDDED MULCH BED,TYP.

0 20 40 60 feet

SCALE: 1" = 20'

See Sheet L1 for Plant Schedule

Base information provided electronically by Atlantic Design Engineers, Inc of Sandwich, Ma.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:

Num.	Date	Description

NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dlh

North East Planting Plan

Scale: 1" = 20'-0"

Sheet: L3

APRROX. EDGE OF EXISTING VEGETTION, TYP.

PROPERTY LINE, TYP.

EXISTING FENCE, TYP.

PLANT BED EDGE, TYP.

TRIPLE SHREDDED MULCH BED, TYP.

GUARD HOUSE

3-V-D
1-QA
3-MP
HRT
3-JVIØ
1-QA
3-FM
3-V-D
3-RT
3-JVIØ
1-MP
1-QA
3-FM
3-V-D

Freezer Road

BIKE PATH

EOP

*See Sheet L1 for Plant Schedule

0 20 40 60 feet
SCALE: 1" = 20'

Base information provided electronically by Atlantic Design Engineers, Inc of Sandwich, Ma.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:

Num.	Date	Description

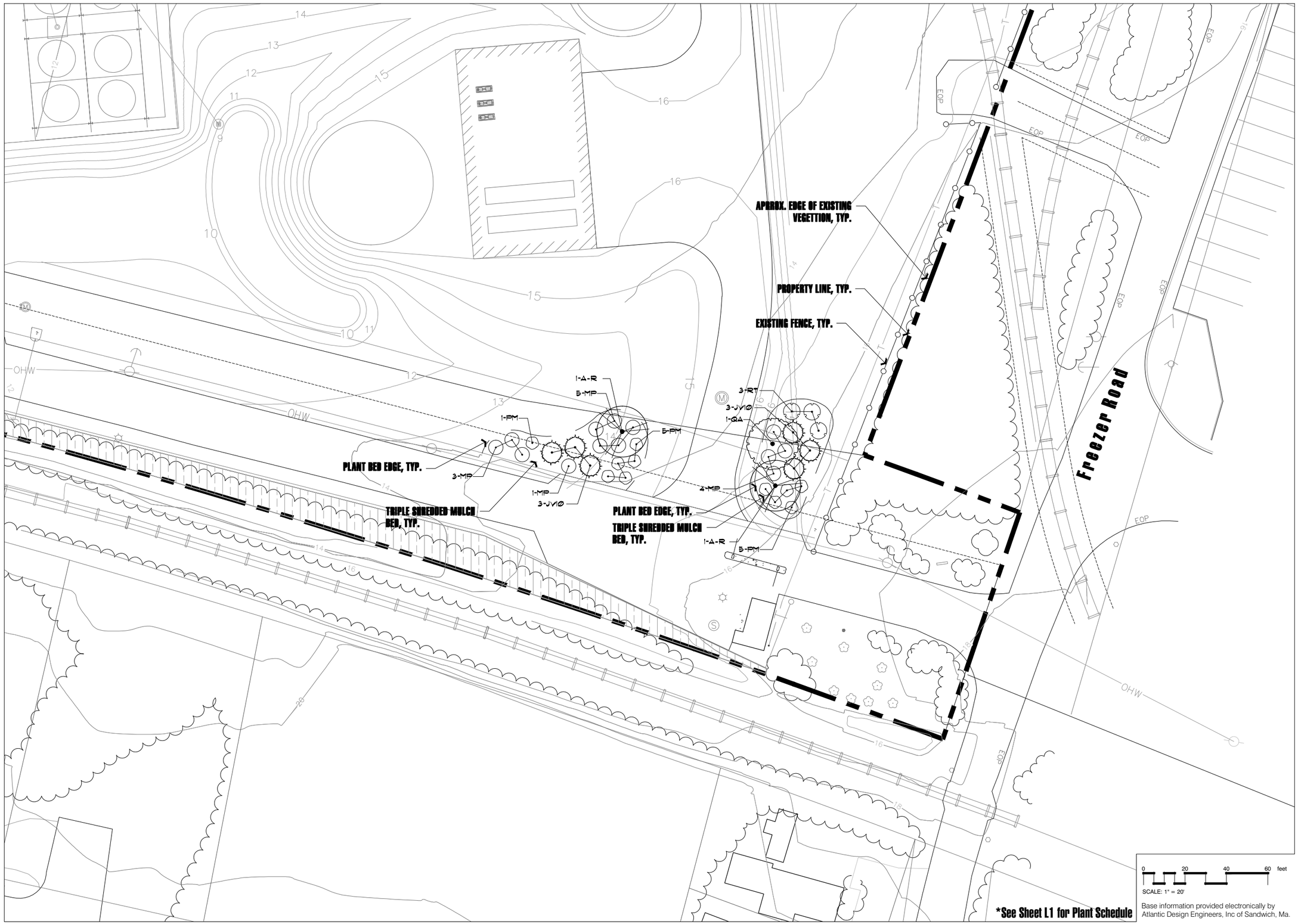
NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dh

East Property Planting Plan

Scale: 1" = 20'-0"

Sheet: L4



*See Sheet L1 for Plant Schedule

Base information provided electronically by Atlantic Design Engineers, Inc of Sandwich, Ma.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:

Num.	Date	Description

NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dh

New Entry Planting Plan

Scale: 1" = 20'-0"

Sheet: L5

EX. STORAGE BUILDING

EX. STORAGE BUILDING

ADMIN. BUILDING

6-I-GS
8-BL
7-I-GS
5-MP
6-I-GS
3-BL
3-BL
10-I-GS
7-I-GS
7-BL
6-BL
7-I-GS
3-PM
5-MP
5-I-GS
3-PM
3-MP
6-I-GS

PROPERTY LINE, TYP.

EXISTING FENCE, TYP.

OHW

*See Sheet L1 for Plant Schedule

0 20 40 60 feet
SCALE: 1" = 20'

Base information provided electronically by Atlantic Design Engineers, Inc of Sandwich, Ma.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:
Num. Date Description

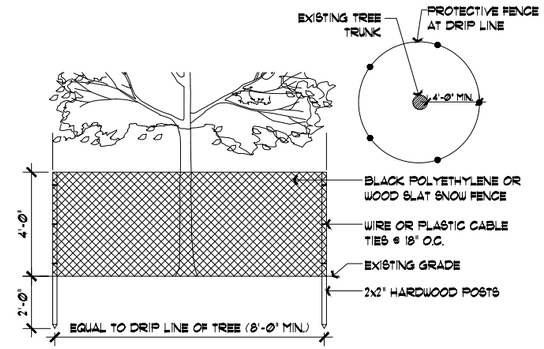
NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dh

Admin. Building Planting Plan

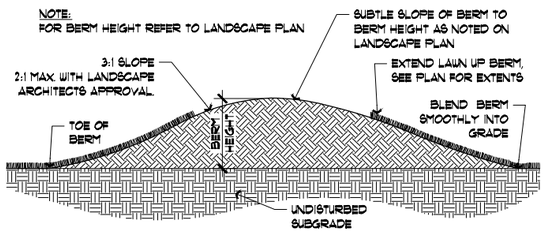
Scale: 1" = 20'-0"

Sheet: L6



NOTES:
1. PROTECTIVE FENCE TO REMAIN UNTIL CONSTRUCTION IS COMPLETE.
2. NO TREE SHALL BE REMOVED UNLESS SPECIFICALLY TAGGED FOR REMOVAL BY THE LANDSCAPE ARCHITECT.
3. CONTRACTOR SHALL TAKE CARE NOT TO DAMAGE TREES THAT ARE TO REMAIN.
4. DO NOT NAIL BOARDS OR FENCING TO TREES DURING CONSTRUCTION.
5. ANY EXCAVATING WITHIN DRIPLINE MUST BE APPROVED BY LANDSCAPE ARCHITECT AND MUST BE HAND-DUG. CONTRACTOR SHALL NOT CUT ANY ROOTS AND/OR BRANCHES UNLESS APPROVED BY LANDSCAPE ARCHITECT.
6. ROOTS EXPOSED AND/OR DAMAGED DURING GRADING & CONSTRUCTION OPERATIONS SHALL BE CUT OFF CLEANLY INSIDE THE EXPOSED OR DAMAGED AREA AND TOPSOIL BE PLACED OVER THE ROOTS IMMEDIATELY. FEEDER ROOTS SHALL NOT BE CUT IN AN AREA INSIDE DRIP LINE OF THE TREE BRANCHES.
7. ROOTS GREATER THAN 1" DIAMETER SHALL NOT BE CUT UNLESS OTHERWISE APPROVED BY THE LANDSCAPE ARCHITECT.
8. STOCKPILED MATERIALS OR UNNECESSARY VEHICULAR TRAFFIC SHALL NOT BE ALLOWED OVER ANY TREE ROOT SYSTEM.
9. INSPECT FENCE ON WEEKLY BASIS AND REPAIR DAMAGE IMMEDIATELY.

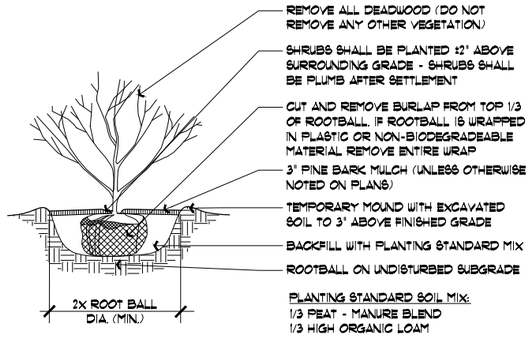
Tree Protection
Not to Scale



Landscape Berm
Not to Scale

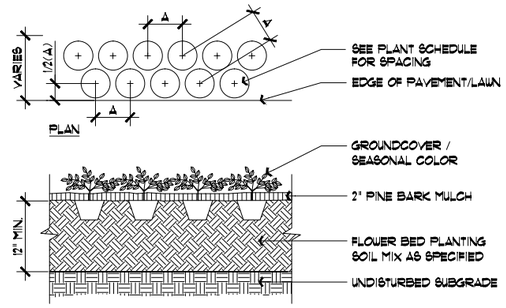
SCHEDULE OF TOPSOILS & ADDITIVES

LOCATION	DEPTH	DESCRIPTION
GENERAL PLANTING BEDS	6"	1/3 PEAT - MANURE BLEND 1/3 HIGH ORGANIC LOAM 1/3 EXISTING SOIL
FLOWER BEDS	6"	SCREENED LOAM 1/3 PEAT - MANURE BLEND LIME - PELATIZED OR GROUND (50 LB. PER 100 SF.) GROUND BONE MEAL (50 LB. PER 100 SF.) 10-10-10 INORGANIC FERTILIZER (50 LB. PER 5000 SF.)
LAWNS - SOD & SEED	6"	6" SCREENED LOAM
PITS/TREE WELLS "STANDARD MIX" FOR BACKFILL	12"	1/3 PEAT - MANURE BLEND SOIL MIX 'A' - 1/3 HIGH ORGANIC LOAM 1/3 EXISTING SOIL
PITS/TREE WELLS "LITE WEIGHT MIX"	12"	70% LIGHT WEIGHT SHALE SOIL MIX 'B' - 20% SAND 10% COMPOST
PITS/TREE WELLS "STRUCTURAL MIX"	12"	SOIL MIX 'C' - MIX COMPOSITION TO BE SUPPLIED BY LANDSCAPE ARCHITECT.



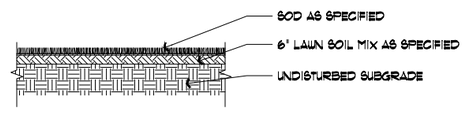
PLANTING STANDARD SOIL MIX:
1/3 PEAT - MANURE BLEND
1/3 HIGH ORGANIC LOAM
1/3 EXISTING SOIL

SHRUB DETAIL
NTS



SEASONAL COLOR / PERENNIAL / GROUNDCOVER PLANTING
NTS

NOTES:
1) LAY SOD TO FORM A SOLID MASS WITH TIGHTLY FITTED JOINTS
2) BUTT ENDS AND SIDES OF SOD STRIPS
3) DO NOT OVERLAY EDGES
4) STAGGER STRIPS TO OFFSET JOINTS IN ADJACENT COURSES
5) REMOVE EXCESS SOD TO AVOID SMOTHERING OF ADJACENT GRASS
6) PROVIDE SOD PAD TOP FLUSH WITH ADJACENT STEEL EDGING AND PAVEMENT

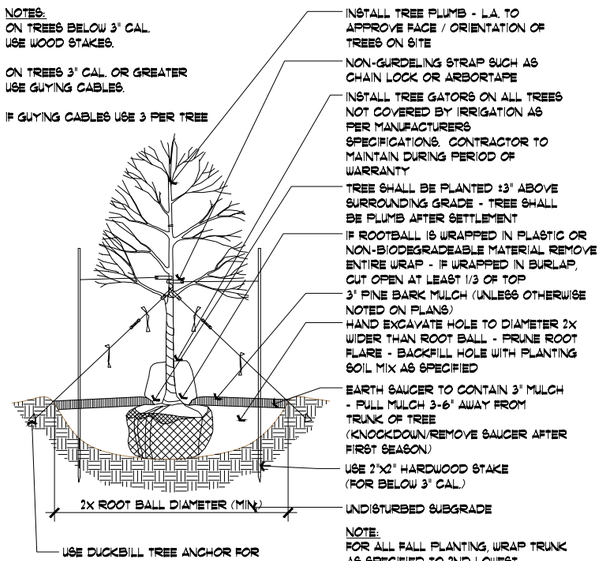


SOD LAWN DETAIL
NTS

NOTES:
ON TREES BELOW 3" CAL. USE WOOD STAKES.

ON TREES 3" CAL. OR GREATER USE GUYING CABLES.

IF GUYING CABLES USE 3 PER TREE

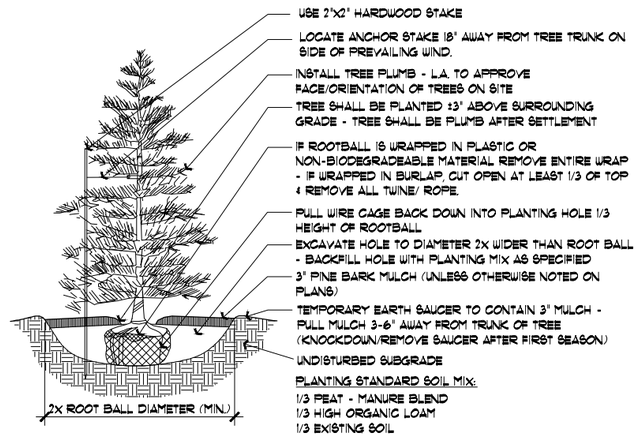


NOTE:
FOR ALL FALL PLANTING, WRAP TRUNK AS SPECIFIED TO 2ND LOWEST BRANCH - REMOVE THE FOLLOWING SPRING

ALL TREES SHALL BE FLOODED TWICE DURING THE FIRST 24 HOURS AFTER PLANTING

PLANTING SOIL MIX:
1/3 PEAT - BLEND MANURE
1/3 HIGH ORGANIC LOAM
1/3 EX. SOIL

SHADE / FLOWERING TREE DETAIL
NTS



PLANTING STANDARD SOIL MIX:
1/3 PEAT - MANURE BLEND
1/3 HIGH ORGANIC LOAM
1/3 EXISTING SOIL

EVERGREEN TREE DETAIL
NTS

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:
Num. Date Description

NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dh

Planting Details

Scale: NTS

Sheet: L7

General Landscape Notes:

1.) CONTRACTOR REQUIREMENTS:
A) ALL WORK SHALL COMPLY WITH APPLICABLE CODES AND REGULATIONS, FROM ALL FEDERAL, STATE AND LOCAL AUTHORITIES.

B) THE CONTRACTOR SHALL ARRANGE FOR AND OBTAIN ALL PERMITS AND LICENSES REQUIRED FOR THE COMPLETE WORK SPECIFIED HEREIN AND SHOWN ON ALL THE DRAWINGS. THE CONTRACTOR SHALL PAY FOR ANY FEES NOT WAIVED.

1.2.) UTILITIES:
A) LANDSCAPE CONTRACTOR IS REQUIRED TO CONTACT THE RELEVANT UTILITY COMPANIES PRIOR TO DOING ANY EXCAVATION ON THE SITE. IF ANY WORK IS TO BE DONE AROUND UNDERGROUND UTILITIES, THE APPROPRIATE AUTHORITY OF THAT UTILITY MUST BE NOTIFIED OF THE IMPENDING WORK.

B) UTILITIES SHALL BE LOCATED AND MARKED PRIOR TO ANY INSTALLATION. ADJUSTMENTS MAY BE NECESSARY IN THE FIELD TO ACCOMMODATE UTILITY LOCATIONS. REPORT ANY CONFLICTS TO THE LANDSCAPE ARCHITECT PRIOR TO INSTALLATION.

C) THE LANDSCAPE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGES DONE TO EXISTING UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF SATISFACTORY REPAIR OF ALL DAMAGE IN KIND RESULTING FROM THEIR FAILURE TO COMPLY.

1.3.) PROTECTION OF EXISTING WORK: IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PERFORM ALL WORK IN A MANNER THAT PROTECTS WORK COMPLETED BY OTHERS, SUCH AS CURBS, UTILITIES, STORM DRAINAGE, FENCES, DRIVEWAY APRONS, DRIVES, VEGETATION, ETC. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF SATISFACTORY REPAIR OF ALL DAMAGE IN KIND RESULTING FROM THEIR FAILURE TO COMPLY.

1.4.) QUANTITIES: A COMPLETE LIST OF PLANTS INCLUDING A SCHEDULE OF QUANTITIES, SIZES, TYPES, AND NAMES IS INCLUDED IN THIS SET OF DRAWINGS. IN THE EVENT OF DISCREPANCIES BETWEEN QUANTITIES OF PLANT IN THE PLANT LIST AND THE QUANTITIES SHOWN ON THE DRAWINGS, THE PLAN SHALL GOVERN. THE LANDSCAPE CONTRACTOR SHALL NOTIFY THE LANDSCAPE ARCHITECT OF UNLABELED PLANTS IN PLAN FOR CLARIFICATION. THE LANDSCAPE ARCHITECT SHALL BE ALERTED BY THE CONTRACTOR OF ANY DISCREPANCIES PRIOR TO FINAL BID NEGOTIATION.

1.5.) APPLICABLE PLANT MATERIALS STANDARDS: ALL PLANT MATERIALS ARE TO COMPLY WITH THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK AS PUBLISHED BY THE AMERICAN ASSOCIATION OF NURSERYMEN. PLANTING METHODS WILL BE IN ACCORDANCE WITH SITE-SPECIFIC REQUIREMENTS.

1.6.) PLANT HARDINESS: ALL TREES AND SHRUBS SHALL BE NURSERY GROWN WITHIN A USDA PLANT HARDINESS ZONE, WHICH IS THE SAME AS, OR COLDER THAN, THE ZONE IN WHICH THE PROJECT IS LOCATED.

1.7.) PLANTING SEASONS: PLANTING SHALL ONLY OCCUR DURING SPECIFIED SEASONS. SPRING SEASON SHALL BE FROM MARCH 1 TO JUNE 15. FALL PLANTING SEASON SHALL BE FROM SEPTEMBER 15 THROUGH NOVEMBER 15. NO PLANTING SHALL OCCUR WHEN THE GROUND IS FROZEN.

1.8.) PLANT SUBSTITUTIONS: NO SUBSTITUTIONS OF PRODUCTS, PLANT TYPES OR SIZES SHALL BE MADE WITHOUT THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT. REQUESTS FOR SUBSTITUTION SHALL BE IN WRITING, AND SHALL STATE THE REASON FOR THE SUBSTITUTION REQUEST, THE SUGGESTED ALTERNATIVE AND THE CHANGES IN COST. REQUESTS FOR SUBSTITUTION IN PLANT MATERIALS SHALL STATE THE NAMES OF NURSERIES THAT HAVE BEEN UNABLE TO SUPPLY THE ORIGINALLY SPECIFIED MATERIAL.

1.9.) THE LANDSCAPE ARCHITECT SHALL RESERVE THE RIGHT TO INSPECT ALL PLANT MATERIALS AT THE NURSERY, UPON SITE DELIVERY AND DURING INSTALLATION TO INSURE SPECIFICATIONS AND PROCEDURES ARE ADHERED TO.

1.10.) MINIMUM SIZES: ALL PLANTS 3' OR GREATER IN HEIGHT OR SPREAD SHALL BE BALLED AND BURLAPPED. SIZES SPECIFIED IN THE PLANT LIST ARE MINIMUMS ON WHICH THE PLANTS ARE TO BE JUDGED.

1.11.) DEAD PLANTS: DEAD PLANTS ARE TO BE REMOVED FROM THE SITE IMMEDIATELY, AND REPLACED WITH THE SAME PLANT 4 SIZE REGARDLESS OF SEASON, WEEKLY FROM THE JOB BY THE CONTRACTOR. THE CONTRACTOR SHALL MAINTAIN AN UPDATED COMPREHENSIVE LIST OF ALL DEAD MATERIALS REMOVED AND PRESENT A COPY OF THE LIST TO THE OWNER AND LANDSCAPE ARCHITECT AT THE END OF EVERY MONTH DURING THE CONTRACT PERIOD.

1.12.) PLANT MATERIAL REMOVAL: NO EXISTING TREES SHALL BE REMOVED WITHOUT THE WRITTEN AUTHORIZATION FROM THE LANDSCAPE ARCHITECT EXCEPT WHERE NOTED ON THE PLANS. CONTRACTORS WHO REMOVE EXISTING TREES WITHOUT WRITTEN APPROVAL WILL BE REQUIRED TO MAKE REMEDIES DETERMINED BY THE GOVERNING URBAN FORESTER OR EQUIVALENT AUTHORITY. NO GRUBBING SHALL OCCUR WITHIN EXISTING TREE AREAS UNLESS SPECIFICALLY NOTED ON THE PLANS.

1.13.) ALL DISTURBED AREAS NOT TO RECEIVE PLANT MATERIALS ARE TO BE LOAMED AND SEEDED AND BLENDED INTO EXISTING GRADE AND CONDITIONS. SEE SECTION 4.0.

1.14.) LEDGE BOULDERS: IF DURING SITE EXCAVATION, LEDGE BOULDERS ARE AVAILABLE, THESE ARE TO BE STOCKPILED FOR USE IN EARTH BERMS IF APPLICABLE, WITH HAWK DESIGN, INC. PRIOR TO INSTALLATION. THIS ITEM WILL ONLY APPLY IF SO SPECIFIED ON DRAWINGS. BOULDERS SIZES TO BE STOCKPILED WILL RANGE FROM TWO TO FIVE FEET IN DIAMETER. SEE APPROPRIATE DETAIL FOR INSTALLATION COORDINATION.

1.15.) SLEEVES: LANDSCAPE OR SITE CONTRACTOR SHALL PLACE INDIVIDUAL SLEEVES FOR LIGHTING AND IRRIGATION UNDER ANY PROPOSED WALKWAY OR VEHICULAR ROADWAY PRIOR TO INSTALLATION. COORDINATE SLEEVE LOCATIONS WITH IRRIGATION AND LIGHTING CONTRACTORS PRIOR TO INSTALLATION.

1.16.) DO NOT CLOSE OR OBSTRUCT ANY STREET, SIDEWALK, ALLEY OR PASSAGEWAY WITHOUT PRIOR NOTIFICATION AND PERMISSION. CONDUCT OPERATIONS AS TO INTERFERE AS LITTLE AS POSSIBLE WITH THE USE ORDINARILY MADE OF ROADS, DRIVEWAYS, ALLEYS, SIDEWALKS OR OTHER FACILITIES NEAR ENOUGH TO THE WORK TO BE EFFECTED THEREBY.

Planting Materials:

2.1 PLANTING MATERIAL ITEMS IN SECTION 2.0 ARE TO BE INCORPORATED DURING PLANT INSTALLATION UNLESS OTHERWISE DEEMED UNNECESSARY IN ACCORDANCE WITH SOIL TEST RECOMMENDATIONS. SEE SECTION 3.1.

MULCH - MULCH WILL BE DOUBLE-SHREDDED PINE BARK MULCH.
- TREES AND SHRUBS SHALL RECEIVE AN EVEN 3" MULCH LAYER.
- GROUNDCOVERS, PERENNIALS AND ANNUALS SHALL RECEIVE AN EVEN 2" MULCH LAYER.

MANURE- TO BE WELL ROTTED, ODORLESS, UNLEACHED COW MANURE, CONTAINING NOT MORE THAN 15% BEDDED MATERIALS SUCH AS STRAW, WOOD CHIPS OR SHAVINGS, AGED NOT LESS THAN TWO YEARS OLD.

TOPSOIL- ACCEPTABLE TOPSOIL SHALL BE FERTILE, FRIABLE NATURAL LOAM, UNIFORM IN COMPOSITION, FREE OF STONES, LIMBS, PLANTS AND THIER ROOTS, DEBRIS AND OTHER EXTRANEOUS MATTER OVER ONE INCH IN DIAMETER. THE SOIL SHALL BE CAPABLE OF SUSTAINED PLANT GROWTH AND HAVE A 5% MINIMUM ORGANIC CONTENT. IN SITUATIONS WHICH REQUIRE A CUSTOM TOPSOIL OR STRUCTURAL SOIL, THE SOIL MIXTURE SPECIFICATION WILL BE PROVIDED BY THE LANDSCAPE ARCHITECT.

SOIL AMENDMENTS: APPLY AS NECESSARY ACCORDING TO SOIL TEST RESULTS, AS PER MANUFACTURES SPECIFICATIONS.

ANTI-DESICCANT- "WILT PRUF" NCF OR EQUAL APPLY AS PER MANUFACTURERS' SPECIFICATIONS.

Plant Installation:

3.1) SOIL TESTING: LANDSCAPE CONTRACTOR SHALL PROVIDE A CERTIFIED SOIL ANALYSIS PRIOR TO ANY PLANT INSTALLATION TO DETERMINE ANY NECESSARY AMENDMENTS TO THE EXISTING SOIL CONDITIONS FOR SEEDING AND PLANTING. THE ANALYSIS WILL ALSO BE REQUIRED FOR ESTABLISHING THE FERTILIZER PROGRAM REQUIRED. COORDINATE RESULTS AND PROVIDE WRITTEN RECOMMENDATIONS TO HAWK DESIGN, INC. 15 DAYS PRIOR TO INSTALLATION.

3.2) ALL PLANTS SHALL BE TRANSPORTED TO THE SITE IN COVERED TRUCKS, TARPAULIN COVERS SHALL BE UTILIZED TO PREVENT WIND DAMAGE OF LOAD.

3.3) DELIVER PLANT MATERIALS IMMEDIATELY PRIOR TO PLACEMENT. KEEP PLANT MATERIALS MOIST. DO NOT STORE PLANT MATERIAL ON PAVED AREAS. ROOTS OR BALLS SHALL BE PROTECTED FROM THE SUN OR DRYING WINDS, AS REQUIRED BY TEMPERATURE OR WIND CONDITIONS, APPLY ANTI-DESICCANT EMULSION TO PREVENT DRYING OUT OF PLANT MATERIALS.

3.4) CONDITIONS FOR PLANT REJECTION:
A) REJECT PLANTS WHEN BALL OF EARTH SURROUNDING ROOTS HAS BEEN CRACKED OR BROKEN PREPARATORY TO OR DURING THE PROCESS OF PLANTING.

B) WHEN BURLAP, STAVES AND ROPES REQUIRED IN CONNECTION WITH TRANSPLANTING HAVE BEEN DISPLACED PRIOR TO ACCEPTANCE.

C) WIND DAMAGED PLANT MATERIAL FROM POOR TARPAULIN COVER PROCEDURES ARE SUBJECT TO REJECTION.

3.5.) ALL PLANT MATERIAL, WHICH CANNOT BE PLANTED IMMEDIATELY ON DELIVERY, SHALL BE SET ON THE GROUND IN A SHADED LOCATION AND SHALL BE TEMPORARILY PROTECTED WITH SOIL OR OTHER ACCEPTABLE MATERIAL. TEMPORARY WATERING OR IRRIGATION SHALL BE INCORPORATED AND REGULARLY CONDUCTED ON PLANTINGS IN HOLD AREAS.

3.6.) IN CASE OF CONFLICTS DURING CONSTRUCTION WITH UTILITIES, ROCK MATERIALS, TREE ROOTS OR OTHER OBSTRUCTIONS FOR THE EXCAVATION OF SHRUB BEDS AND TREE PITS, CONTACT LANDSCAPE ARCHITECT FOR APPROVED ALTERNATE LOCATIONS.

3.7.) SOIL PERMEABILITY: TEST DRAINAGE OF PLANTING BEDS AND PITS BY FILLING WITH WATER TWICE IN SUCCESSION. CONDITIONS PERMITTING THE RETENTION OF WATER FOR MORE THAN 24 HOURS SHALL BE BROUGHT TO THE ATTENTION OF THE LANDSCAPE ARCHITECT.

3.8.) SOIL EXCAVATIONS:
A) EXCAVATE TREE PITS AND SHRUB BEDS TO DEPTHS REQUIRED BY PLANTING DETAILS. ALL PITS SHALL BE CIRCULAR IN OUTLINE, EXCEPT FOR WHOLE BEDS, SEE APPROPRIATE PLANTING DETAILS.

B) SOIL EXCAVATIONS FOR BALLED & BURLAP AND CONTAINER PLANTINGS MUST BE NO LESS THAN 2X ROOT BALL DIAMETER, SEE PLANTING DETAILS. IF QUESTIONABLE SUBSURFACE SOIL CONDITIONS EXIST SUCH AS POOR DRAINAGE CONDITIONS, RUBBLE OR OBSTRUCTIONS, REPORT TO THE LANDSCAPE ARCHITECT AND CONSTRUCTION MANAGER BEFORE PLANTING.

3.9.) GRADING:
A) VERIFY GRADES PRIOR TO PLANTING, THE CONTRACTOR SHALL VERIFY THAT CONSTRUCTED GRADES ARE AS INDICATED ON PLANS. THE CONTRACTOR SHALL NOTIFY THE LANDSCAPE ARCHITECT IF ADJUSTMENTS TO PLANT PLACEMENT MAY BE REQUIRED DUE TO FIELD CONDITIONS AND FINAL GRADING.

B) POSITIVE DRAINAGE SHALL BE MAINTAINED AWAY FROM AND AROUND BUILDINGS (REFER TO ENGINEERS GRADING PLANS). REPORT ANY CONFLICTS TO HAWK DESIGN, INC. PRIOR TO INSTALLATION.

C) FINISH GRADE OF PLANTINGS SHALL BE EQUIVALENT TO FORMER EXISTING GRADE OF PLANT IN THE NURSERY.

3.10) BALLED AND BURLAPED (B&B) MATERIALS:
A) CUT WIRE BASKETS ONCE IN THE PLANT PIT AND PEEL WIRE BACK.

B) TAGS AND TWINE ARE TO BE REMOVED AND BURLAP IS TO BE ROLLED BACK ONE-THIRD ON ALL B&B PLANT MATERIAL. ANY SYNTHETIC BURLAP SHALL BE COMPLETELY REMOVED FROM ANY PLANT MATERIAL

Plant Installation Cont'd

3.11) CONTAINER GROWN STOCK: SHALL BE REMOVED FROM CONTAINER BY CUTTING CONTAINER AWAY TO AVOID ROOT DAMAGE TO PLANT ROOT SYSTEM. IF PLANT ROOT IS BOUND, SLICE ROOT BALLS APPROXIMATELY 2" DEEP WITH KNIFE OR SHARP SPADE.

3.12.) DO NOT USE MUDDY OR FROZEN SOIL TO BACKFILL PLANTINGS.

3.13.) WATERING: THOROUGHLY WATER UNTIL SOIL IS SATURATED AROUND ALL TREES AND SHRUBS AFTER PLANTING AND THROUGHOUT THE TIME PERIOD UNTIL FINAL ACCEPTANCE FROM CLIENT. DURING DRY CONDITIONS, WATER AS REQUIRED TO MAINTAIN PLANTS IN A WILT-FREE CONDITION.

3.14.) PRUNING: TREES SHALL BE PRUNED TO BALANCE TOP GROWTH WITH ROOTS AND TO PRESERVE THEIR NATURAL CHARACTER AND TYPICAL GROWTH HABIT. PRUNING SHALL BE RESTRICTED IN GENERAL TO THE SECONDARY BRANCHES AND SUCKER GROWTH. ALL CUTS TO BE FLUSH WITH TRUNK. DO NOT CUT A LEADER. THE LANDSCAPE ARCHITECT WILL REJECT ALL PLANTS DISFIGURED BY POOR PRUNING PRACTICES. ALL PRUNING CUTS SHALL REMAIN UNPAINTED.

3.15.) STAKING AND GUYING: ALL TREES TO BE STAKED AND GUYED WITHIN 48 HOURS OF PLANTING. METHODS AND MATERIALS FOR STAKING AND GUYING ARE ILLUSTRATED IN INDIVIDUAL PLANTING DETAILS. NEATLY FLAG ALL GUY WIRES WITH ROT RESISTANCE YELLOW TREE MARKING RIBBON.

3.16.) STAKE OUT PLANT LOCATIONS: PRIOR TO PLANTING THE CONTRACTOR SHALL LAYOUT THE EXTENT OF THE PLANT BEDS AND PROPOSED LOCATIONS FOR B&B PLANTS FOR REVIEW BY THE OWNER AND LANDSCAPE ARCHITECT.

3.17.) PLANTING FIELD ADJUSTMENTS:
A) THE CONTACTOR IS TO SLIGHTLY ADJUST PLANT LOCATIONS IN THE FIELD AS NECESSARY TO BE CLEAR OF DRAINAGE SWALES AND UTILITIES.

B) LARGE GROWING PLANTS ARE NOT TO BE PLANTED IN FRONT OF WINDOWS OR UNDER BUILDING OVERHANGS. NOTIFY THE LANDSCAPE ARCHITECT OF DISCREPANCIES IN PLANTING PLAN VS. FIELD CONDITIONS.

C) SHRUBS PLANTED NEAR HVAC UNITS ARE TO BE LOCATED SO THAT SHRUBS AT MATURITY WILL MAINTAIN ONE FOOT (1') AIRSPACE BETWEEN THE UNIT AND THE PLANT. ANY PLANTING SHOWN ADJACENT TO CONDENSER UNITS SHALL BE PLANTED TO SCREEN THE UNITS. SHOULD THE CONDENSER UNITS BE INSTALLED IN LOCATIONS DIFFERENT FROM THOSE SHOWN ON THE PLAN, IT WILL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY THE LANDSCAPE ARCHITECT AND INSTALL THE MATERIAL AROUND THE CONDENSERS AND ADJUST THE OTHER PLANTING ACCORDINGLY.

3.18.) PLANT BED EDGES/LINES: GROUPS OF SHRUBS, PERENNIALS AND GROUNDCOVERS SHALL BE PLACED IN A CONTINUOUS MULCH BED WITH SMOOTH CONTINUOUS LINES. ALL MULCHED BED EDGES SHALL BE CURVILINEAR IN SHAPE, FOLLOWING THE CONTOUR OF THE PLANT MASS. TREES LOCATED WITHIN 4 FEET OF PLANT BEDS SHALL SHARE THE SAME MULCH BEDS.

3.19.) A.D.A. - THE AMERICAN WITH DISABILITIES ACT STANDARDS REQUIRE THAT A 7 FOOT VERTICAL CLEARANCE BE MAINTAINED FROM TREE BRANCHES TO FINISHED GRADE WHERE PEDESTRIANS SIDEWALKS AND/OR TRAILS ARE LOCATED. THE CONTRACTOR IS TO ADJUST TREE PLANTINGS IN FIELD TO SLIGHTLY MINIMIZE BRANCH OVERHANG AND COMPLY WITH THE A.D.A. ACT.

3.20.) TREE SPACING MINIMUMS: TREES SHALL BE LOCATED A MINIMUM OF 4 FEET FROM RETAINING WALLS AND WALKS WITHIN THE PROJECT. IF A CONFLICT ARISES BETWEEN ACTUAL SIZE OF AREA AND PLANS, THE CONTRACTOR SHALL CONTACT THE LANDSCAPE ARCHITECT FOR RESOLUTION. FAILURE TO MAKE SUCH CONFLICTS KNOWN TO LANDSCAPE ARCHITECT WILL RESULT IN CONTRACTOR'S LIABILITY TO RELOCATE MATERIALS.

Seeding and Sodding:

4.1) SEEDING OF LAWN AREAS: GRASS SEED APPLICATION SHALL BE SPREAD AT THE RATE OF 5 LBS. PER 1,000 SQUARE FEET, SEEDING SHALL BE ACCOMPLISHED BY MEANS OF A HYDRO-SEEDING PROCESS.

4.2.) WATERING OF SEEDED AREAS: 24 HOURS AFTER HYDRO SEEDING, THE CONTRACTOR SHALL WATER THE SEEDED AREA LIGHTLY AND SUFFICIENTLY TO A DEPTH OF TWO INCHES (2") 2 TIMES A DAY (BETWEEN THE HOURS OF 7 PM AND 7 AM), UNTIL THE SEEDS ARE ESTABLISHED.

4.3.) SEEDED AREA PROTECTION: THE CONTRACTOR SHALL ERECT SUITABLE SIGNS AND BARRICADES NOTIFYING THE PUBLIC TO KEEP OFF THE SEEDED AREAS UNTIL WELL ESTABLISHED. ANY TRAFFIC DAMAGE AND VANDALISM THAT MAY OCCUR PRIOR TO FINAL ACCEPTANCE OF THE WORK SHALL BE REPAIRED AND RESEEDED AT THE OWNER'S EXPENSE. ANY DISTURBED OR DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED IN ACCORDANCE WITH THE SPECIFICATIONS AT THE CONTRACTOR'S EXPENSE.

4.4.) LAYING OF SOD: A KENTUCKY BLUEGRASS SOD MIX - BY LOCAL SOURCE AS SELECTED BY CONTRACTOR, SHALL BE FRESHLY CUT FROM THE SAME FIELD WITH 1/2 -3/4 INCHES OF SOIL. SOD SHALL BE LAID IMMEDIATELY WITH ANY STORED SOD BEING UNROLLED GRASS SIDE UP AND KEPT WATERED. LAY COURSES TIGHTLY TOGETHER WITHOUT OVERLAPPING WITH THE JOINTS STAGGERED. AFTER SODDING IS COMPLETE, ROLL LIGHTLY. THE CONTRACTOR SHALL WATER THE SODDED AREAS TO A DEPTH OF AT LEAST SIX INCHES AFTER THE SODDING PROCESS. OWNER SHALL THEN BE RESPONSIBLE FOR WATERING. THE FREQUENCY SHALL BE DETERMINED BY RAIN FALL AND WINDS WITH THE UPPER TWO OR THREE INCHES OF SOIL NOT DRYING OUT MARKEDLY.

4.5.) SODDED AREA: INSPECTION AND ACCEPTANCE: FOUR WEEKS AFTER CONTRACTOR COMPLETES INSTALLATION, LANDSCAPE ARCHITECT SHALL INSPECT THE LAWN TO DETERMINE THE ACCEPTABILITY OF THE INSTALLATION. SODDED AREAS FAILING TO SHOW ADEQUATE ROOTING INTO THE SUBSOIL, OVERLAPPING, COURSE SEPARATION, UNEVENNESS OF THE SURFACE, UNEVEN COURSE COLOR AND EXCESSIVE BROADLEAF WEED CONTENT SHALL BE REPLACED. THE COST SHALL BE BORNE BY THE CONTRACTOR EXCEPT WHERE VANDALISM OR NEGLECT ON THE PART OF OTHERS NOT UNDER THE CONTRACTOR'S CONTROL HAS RESULTED IN DAMAGE.

4.6.) FINAL APPROVAL: SEEDED AND SODDED AREAS WILL RECEIVE FINAL APPROVAL IF COVERAGE IS FULL AND CONSISTENT, FREE OF BARE SPOTS AND WEED FREE. WHEN GRASS IS CUT AT 2" HEIGHT NO SOIL SHOULD BE VISIBLE. SOD AREAS MUST HAVE RECEIVED A MINIMUM OF TWO MOWINGS. AREAS SODDED AFTER NOVEMBER 1ST WILL BE ACCEPTED THE FOLLOWING SPRING - ONE MONTH AFTER THE START OF THE GROWING SEASON, IF THE ABOVE CRITERIA HAS BEEN MET.

Maintenance:

5.1.) MAINTENANCE DURING INSTALLATION: MAINTENANCE OPERATIONS SHALL BEGIN IMMEDIATELY AFTER EACH PLANT IS PLANTED AND SHALL CONTINUE AS REQUIRED UNTIL FINAL ACCEPTANCE AND THEN FOR THE GUARANTEE PERIOD. PLANTS SHALL BE KEPT IN A HEALTHY, GROWING CONDITION BY WATERING, PRUNING, SPRAYING, WEEDING AND ANY OTHER NECESSARY OPERATIONS OF MAINTENANCE. PLANT SAUCERS AND BEDS SHALL BE KEPT FREE OF WEEDS, GRASS AND OTHER UNDESIRED VEGETATION. PLANTS SHALL BE INSPECTED AT LEAST ONCE PER WEEK BY THE CONTRACTOR DURING THE INSTALLATION PERIOD AND ANY NEEDED MAINTENANCE IS TO BE PERFORMED PROMPTLY.

5.2.) GRASS AND WEED CONTROL: THE CONTRACTOR SHALL BE RESPONSIBLE FOR MOWING ALL GRASS AROUND LANDSCAPE BEDS AND INDIVIDUAL TREES AND SHRUBS UNTIL FINAL ACCEPTANCE. WEED CONTROL AREAS SHALL INCLUDE ALL LANDSCAPE BEDS AND THE AREA WITHIN 2 FEET OF THE OUTER EDGE OF THE MULCH AREA OR INDIVIDUAL TREE/SHRUBS.

5.3.) THE CONTRACTOR SHALL WATER, FERTILIZE, WEED, CULTIVATE, REMULCH, SPRAY TO CONTROL INSECT INFESTATION AND DISEASE AND PERFORM ANY OTHER GOOD HORTICULTURAL PRACTICE NECESSARY TO MAINTAIN THE PLANTS IN A LIVING HEALTHY CONDITION UPON THE TIME FOR TERMINATION OF HIS RESPONSIBILITY FOR CARE AS SET OUT HEREIN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PLANTS THROUGHOUT LIFE OF THE CONTRACT.

5.4.) ALL PLANTS STOLEN, DAMAGED OR DESTROYED BY FIRE, AUTOMOBILES, VANDALISM OR ANY OTHER CAUSE, WITH THE EXCEPTION OF PLANTS DAMAGED OR DESTROYED BY THE OWNERS MAINTENANCE OPERATIONS, SHALL BE REPLACED BY THE OWNER PRIOR TO THE DATE OF FINAL ACCEPTANCE.

5.5.) LANDSCAPE CONTRACTOR SHALL PREPARE MAINTENANCE SPECIFICATIONS AND SCHEDULE ANNUAL CARE OF ALL PLANTED AND LAWN AREAS INCLUDING FERTILIZING, WEEDING, MULCHING, BED EDGING, PRUNING AND PEST PREVENTION AND TREATMENT.

Plant Material Guarantee:

*CONTRACTOR SHALL GUARANTEE IN WRITING ALL PLANT MATERIAL AND LANDSCAPE IMPROVEMENTS FOR A PERIOD OF ONE YEAR. THE GUARANTEE IS TO INCLUDE THE FOLLOWING:

6.1.) INSPECTIONS: PERFORM PERIODIC INSPECTIONS DURING GUARANTEE PERIOD WITH RESULTING WRITTEN REPORTS TO OWNER, PROJECT ADMINISTRATOR AND LANDSCAPE ARCHITECT STATING CONDITIONS AND RECOMMEND MAINTENANCE MODIFICATIONS. THE CONTRACTOR MUST CONTACT THE OWNER AND LANDSCAPE ARCHITECT AT LEAST 10 DAYS IN ADVANCE TO SCHEDULE ACCEPTANCE INSPECTION(S).

6.2.) REMOVAL AND REPLACEMENT OF PLANTS PROVIDED BY CONTRACTOR TO BE DONE WITHIN THIRTY DAYS OF NOTIFICATION BY OWNER OF THEIR UNSATISFACTORY CONDITION DURING GROWING SEASONS. REPLACEMENT MATERIALS MUST BE EQUAL IN TYPE AND SIZE PER THE PROJECT'S PLANT LIST.

6.3.) WHEN REPLACEMENT PLANT SPECIES IS EITHER NOT READILY AVAILABLE OR NO LONGER SUITABLE TO EXISTING SITE CONDITIONS WRITTEN NOTICE RECOMMENDATION OR SUBSTITUTION TO BE PROVIDED TO THE OWNER AND LANDSCAPE ARCHITECT WITHIN FIFTEEN DAYS FOR APPROVAL.

6.4.) REMOVAL OF TREE'S SUPPORTS AND DEAD LIMBS PRIOR TO END OF GUARANTEE INSPECTION PERIOD.

6.5.) CONTINUE WITH MAINTENANCE, SEE SECTION 5.0

6.6.) GUARANTEE SHALL BEGIN UPON DATE OF FINAL ACCEPTANCE FROM OWNER AND WILL CONTINUE FOR ONE YEAR.

Site Cleanup:

7.1.) SITE WORK CONDITIONS: EXCESS WASTE MATERIAL SHALL BE REMOVED DAILY WHEN PLANTING IN AN AREA HAS BEEN COMPLETED, THE AREA SHALL BE CLEARED OF ALL DEBRIS, SOIL PILES AND CONTAINERS DAILY. WHERE EXISTING GRASS AREAS HAVE BEEN DAMAGED OR SCARRED DURING PLANTING OPERATIONS, THE CONTRACTOR SHALL RESTORE DISTURBED AREAS TO THEIR ORIGINAL CONDITIONS AT HIS EXPENSE.

7.2.) CLEAN PAVED AREAS UTILIZED FOR HAULING OR EQUIPMENT STORAGE AT END OF EACH WORKDAY.

7.3.) MAINTAIN VEHICLES AND EQUIPMENT IN CLEAN CONDITION TO PREVENT SOILING OF ROADS, WALKS OR OTHER PAVED OR SURFACED AREAS.

7.4.) REMOVE PROTECTIVE BARRIERS AND WARNING SIGNS AT TERMINATION OF LAWN ESTABLISHMENT.

Hawk Design, Inc.
Landscape Architecture
Land Planning
Sagamore, MA
508-833-8800
info@hawkdesigninc.com
www.hawkdesigninc.com

Date: 09/14/16

Revisions:
Num. Date Description

NRG Canal Unit 3 Plant Expansion
NRG Canal 3 Development, LLC
9 Freezer Rd Sandwich, Ma

Drawn By: jp | Checked By: dh

Planting Notes

Scale: NTS

Sheet: L8

LANDSCAPE MANAGEMENT PLAN

NRG CANAL UNIT 3 PLANT EXPANSION

SANDWICH, MASSACHUSETTS

SEPTEMBER 16, 2016

General Notes:

1. The owner's designated representative will work with the Contractor for all aspects of the contract.

2. The Contractor shall have a competent, English speaking, on-site Foreman who will be distinguishable from the rest of the Staff for easy identification. The Foreman will communicate with the owner's designated representative and insure that the work is accomplished on schedule in a professional manner.

3. All personnel will be properly trained, neat in appearance, and in Contractor's uniform.

4. Work shall not commence prior to 8:30 a.m. on weekdays or 10:00 a.m. on Saturdays. The Contractor must receive prior approval from the Owner's designated representative to work on a Saturday.

5. The Contractor shall use his expertise and initiative to make any recommendations or offer advice to enhance the appearance and health of the grounds, and to correct any practice which may result in damage or deterioration of the lawn and/or landscaping.

6. Contractor will submit to the owner's designated representative on the day the work is performed, a "Today's Service Sheet" describing the work performed and materials used.

8. An orientation will be held, prior to the commencement of the contract, with the Property Manager and/or the owner's designated representative to discuss with the Contractor the expected performance, policies and practices of the property, and any other relevant information deemed necessary.

Mowing, Trimming and Cleaning:

1. The turf area shall be mowed, trimmed and cleaned **26** times per growing season from **May - November** to maintain a neat appearance. Mowings below or above this number will result in an adjustment to the contract at the specified per service price. Any additional mowings shall receive prior approval by owner.

2. The mowing frequency shall not exceed a 7 - 10 day interval without prior authorization. If grass height reaches 5" or more, a per service cost shall be deducted from the payment.

3. The Contractor shall remove small amounts of surface trash, litter and other debris before mowing. Large amounts of debris will be removed with prior approval and invoiced as an additional charge.

4. Turf areas will be mowed at 2 ½ - 3 inches with height measured on a flat, paved surface. All blades will be sharpened daily. Mowing equipment and patterns shall be employed to permit recycling of clippings where possible and present a neat appearance.

5. All clippings will be removed from roadways, parking areas, sidewalks and other hardscape surfaces after each mowing. Excess grass clippings will be removed from turf by means of raking, bagging or blowing.

6. Contractor shall repair or replace any items damaged by Contractors equipment, to include but not limited to trees, shrubs, irrigation parts, windows, etc. Contractor shall repair or replace any grass damaged by mowing due to but not limited to, scalping or gouging.

7. Contractor shall trim around trees, shrubs, signs, posts, building foundations, electric boxes or man-made interfaces after each mowing using hand labor or mechanical devices. Contractor will repair or replace any items damaged by trimming operation.

8. Once mowing begins, the property will be cut within a **24 hour period** unless inclement weather dictates otherwise and this schedule change is approved by management.

9. Contractor will remove dead plant material at each visit and report such on the service sheet. Plants 50% or more dead will be removed.

10. Natural areas on slope behind compactor and along drive to lower level will be trimmed down once per month.

11. Growth from wooded area adjacent to mailboxes will be cut and removed monthly.

12. Contractor shall mechanically edge all roadway edges, sidewalks, curbs and other locations where turf meets hardscape edges three times per year; at the end of the initial cutting, once in July, and once in October. Nylon string trimmers shall be used during every cutting thereafter to maintain edging.

Weed Control:

1. The Contractor shall remove and control all grass and weeds in mulched areas, parking lots, sidewalk areas and curb lines throughout the contract period. The Contractor shall remove weeds and grass growth by the use of hand labor, and/or mechanical devices at each grass cutting. The Contractor shall refer to the Integrated Pest Management and Turf Grass Management for additional weed control measures.

Leaf Removal:

1. Leaves shall be removed from the site during the contract year.

2. Leaf removal includes mulch beds, paved areas and turf areas. All leaves in the area being worked will be removed by the end of each day.

3. Leaves shall be removed from the property and disposed of properly.

Mulch:

All mulch shall be top quality, double shredded hardwood mulch of a dark brown color. The total mulch depth in any mulched area will be a minimum of 2 1/2 inches and will not exceed 3 inches. All mulched areas shall be even, natural surfaces, with no artificial shapes or forms. There will be no buildup around the trunks of plants or trees. Yellow mold (fungus) will be removed by the Contractor. All stripping, edging, definition, weeding, and mulching shall be completed between April 1 and April 30.

1. Stripping:

   The Contractor shall remove old mulch in excess of 2" and any visible dirt from all mulch bed areas on site, including, but not limited to, the top of the rootballs, shrub beds, flower beds and tot lots. All beds will be weed-free when new mulch is applied.

   The old mulch and/or dirt shall be removed from the site unless directed by the Owner's designated representative to store, use or recycle on site.

2. Mulch Bed Definition:

   The Contractor shall edge or define by digging a small trench, not to exceed three (3) inches deep, to separate the mulch area from the turf area. Contractor will create a smooth slope from the bottom of the trench into the flat area of the mulch bed. The soil removed in the process of edging or defining the beds shall be removed from the site unless directed by the owner's designated representative to recycle on site. In no case should soil be piled on top of the rootball or around the plant material.

3. Turning of Mulch:

   The Contractor shall turn the mulch beds twice a year (July and October).

Pruning:

No shearing of plant material is permitted. Native and mature large trees over 12' in height are not included. Bids should reflect selective hand pruning techniques of trees and shrubs for both the corrective and maintenance pruning and be performed in accordance with the following:

1. Corrective Prune:

   The Contractor shall correctively hand prune ALL of the tree and shrub canopy areas during the dormant or winter season. Pruning may begin any time after the leaves fall and the wood is not frozen. All corrective pruning must be completed by November 30. Spring flowering plants will be pruned after blooming has ceased.

   Corrective pruning requires thinning or selectively removing branches from the tree or shrub in order to encourage and maintain the natural shape of the tree or shrub while encouraging light penetration and air circulation within the plant.

2. Maintenance Prune:

The Contractor shall maintenance prune all tree and shrub canopy areas throughout the season to maintain a good appearance. Maintenance pruning includes removal of dead, off color, broken or diseased branches and shoot growth as they occur during the contract year. Spring flowering plants will NOT be pruned after September 1.

3. Pruning Methods for Trees:

   Mature deciduous trees will be pruned up from the ground plane to allow for light and air penetration to areas under the tree canopy. Evergreen trees WILL NOT be pruned up to 7'-6" unless directed by the Owner's designated representative.

   Use the double cut method when removing limbs larger than one inch in diameter. Do not leave stubs.

   Do not remove central leader of the tree, but establish alternate branches by leaving the limbs that have a strong wide angle crotch. Always thin tree to allow it to develop into its natural shape unless otherwise directed by the owner's designated representative.

   Under no circumstances shall stripping of lower branches ("raising up") of young trees be permitted. Lower branches shall be retained with as much foliage as possible to promote caliper trunk growth (tapered trunk). Lower branches can be cut flush with the trunk only after the tree is able to stand erect without staking or other support.

4. Pruning Methods for Shrubs:

   Hand prune shrubs in natural forms by selective thinning and pruning.

   Remove all dead, dying or broken branches.

   Each year remove about 1/3 of the oldest, thickest branches at ground level or at least to where the branch stems off of the main branch deep inside the shrub. Use sharp, clean, hand pruners.

   Shrubs shall not be pruned into balled or boxed forms.

5. Ground Cover Beds:

   All ground covers will be pruned away from neighboring plants, even with curb and sidewalk edges and off of walls/fences. Pruning will be as needed April- November.

Spring Cleaning:

Turf areas will be cleaned of surface trash and small tree limbs. Dethatch any areas in need. Low growing plantings, such as but not limited to grasses, groundcovers and perennial flowers, will be pruned as needed.

All leaves, branches, and sand shall be removed from the lawn, shrub, tree flower beds, parking and breezeway areas. This will also include dethatching of all areas in need, tying off or cutting back of all early spring flowers.

Fall Cleaning:

After the leaf-drop in the Fall, a final cleanup will be completed. Shrub beds and turf areas will be raked and all collected debris shall be removed from the property and properly disposed of. All remaining weeds shall be manually removed from plant beds at the time of cleanup. The fall cleanup shall be completed by the end of November pending the leaves have dropped.

Irrigation System Service, Start-up and Winterization:

1. Irrigation system start-up shall be completed prior to May 1st. The start-up shall included the initialization of the system, charging the system with water and a full run of the system. All irrigation heads, drip emitters and piping shall be inspected for breaks, leaks and damage. All repairs shall be made immediately to the system.

2. The irrigation system shall be monitored, maintained and adjusted during the months of May, June, July and August.

3. Irrigation system winterization shall occur prior to November 1st. All irrigation components shall have all water fully removed. Water shall be shut-off to the system for the winter months.

TURF MANAGEMENT AND INTEGRATED PEST MANAGEMENT PLAN

NRG CANAL UNIT 3 PLANT EXPANSION

SANDWICH, MASSACHUSETTS

SEPTEMBER 16, 2016

Integrated Pest Management

1. Integrated Pest Management (IPM) is a management and decision-making system that uses cultural practices to promote healthy turfgrass and plants that has a competitive advantage against pests and environmental stress. The IPM system will encourage the use of organic based fertilizers, appropriate irrigation techniques and qualified professionals to ensure to the protection of the surrounding environment and resource areas. The IPM system will focus on: (1) turfgrass and plant establishment, (2) application of all chemicals by a professional, (3) pesticide and herbicide management, (4) fertilizer management, (5) irrigation management, and (6) property owner education.

Turfgrass Establishment

1. All lawn areas will be seeded or sodded with a mix of fescue species. This mix will establish quickly, reducing the need for fertilizers, irrigation and pest management during germination.

2. A minimum of 4-6 inches of organic screened loam will be required prior to planting the turfgrass. This will ensure proper cation exchange sites necessary to hold the nutrients needed for establishment and maintenance.

3. Organic based fertilizers shall be used to provide a slow release nitrogen source, ensuring all available nitrogen will be used by the turfgrass.

4. The turfgrass seed mixture shall contain endophyte enhanced seed whenever commercially available. Endophyte enhanced seed exhibits a higher overall vigor and resists insects feeding on foliar sections of the plant, reducing the use of pesticides.

5. During establishment, turfgrass seedlings shall be irrigated 3-4 times per day for a maximum duration of 5 minutes each time. The goal of irrigation during establishment is to maintain adequate moisture within the top 1 inch of the topsoil. The soil will not be watered beyond its water holding capacity at any time during establishment, minimizing any potential leaching of fertilizer. The irrigation system will be equipped with moisture sensors and a “smart” controller to minimize unnecessary irrigation.

6. Turfgrass will be maintained at an approximate height of 1.5 inches. Turfgrass clippings will be returned to the turf canopy creating a green compost.

Pesticide and Herbicide Management

1. Pesticides and herbicides will not be used on a regular basis within the turfgrass or planted areas. Suspected disease or insects must be confirmed by a qualified

professional. A written report shall document the disease and must be presented to the owner. The report shall contain a justification for the application of a pesticide / herbicide including observation and documentation of signs and /or symptoms of disease or pests, establishment of thresholds which would trigger a pesticide/herbicide application and organic or cultural alternatives to chemical pesticides, if applicable.

2. All applicable alternatives to chemical usage must be considered before application.

3. If a chemical application is deemed necessary the product shall be chosen based upon efficacy, potential environmental toxicity, and health risks.

Fertilizer Management

1. Fertilizer management will focus on an organic based approach. Organic fertilizers provide a slow-release nitrogen source that will be fully utilized by the turfgrass. This system prevents leaching of excess nitrogen into the soil. Additionally, total amounts of nitrogen will be limited and applied only during the active growing season of the turfgrass.

2. Organic fertilizers or water insoluble nitrogen sources of greater than 75 percent will be used on the turfgrass.

3. No more than 1.5 lbs. of nitrogen per 1,000 square feet will be applied during each growing season after the establishment of turfgrass. The growing season is approximately April – October for this property in Sandwich, Massachusetts.

4. The soil shall be tested every year, or as needed, to determine the soil pH to custom tailor the fertilizer program.

Irrigation Management

1. Conservation of the water resources will be the goal of the irrigation of turfgrass and plantings within the site. The timing and quantity of irrigation will be restricted to prevent over-watering and limit potential leaching of fertilizers.

2. Automatic irrigation systems equipped with a “smart” controller and moisture sensing devices shall be set to water turfgrass and plantings during the early morning hours (approximately 3 – 6 a.m.). This will decrease the leaf wetness period, minimizing development of diseases and maximizing the water resources by not watering during the hottest time of the day.

3. Not more than ½ inch per week of supplemental irrigation will be applied to the turfgrass or planted areas. The goal would be to replace the moisture in overly dry areas of the soil.

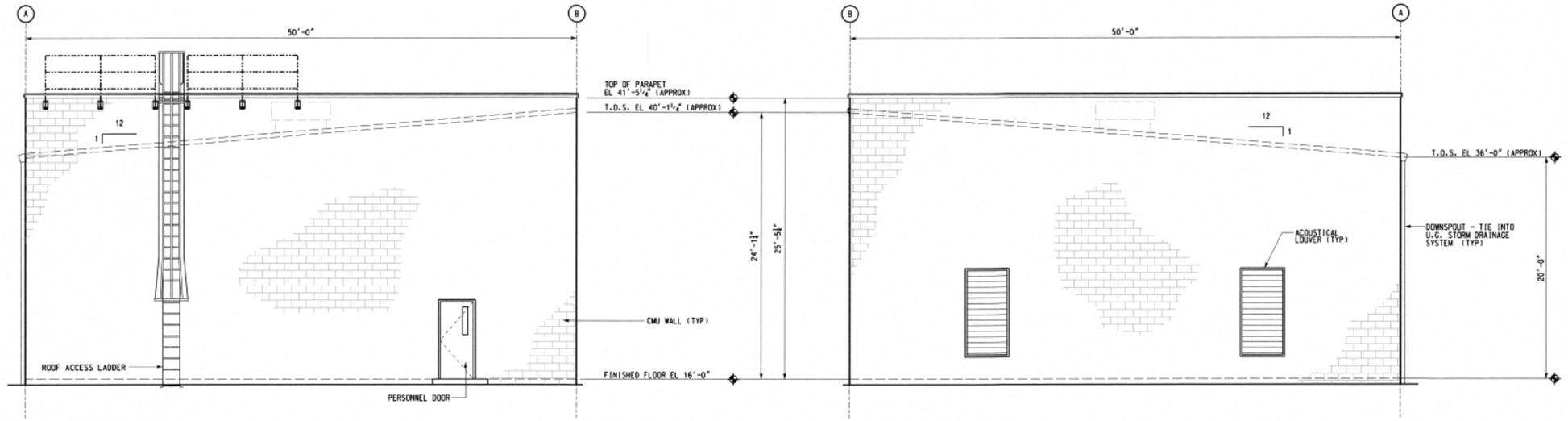
4. All plant bed areas, shrub and tree plantings shall use drip irrigation.

5. The typical irrigation schedule may be 3-4 times per week for 15-20 minutes each period.

Educational Program

1. An important component of a successful IPM system will involve an education of the property owner on the principles, goals and success of the IPM. Documentation of the fertilizer applications will be provided to the owner by the professional providing the application.

2. The goal of the IPM system is to protect the groundwater resources by developing a responsible management system. Appropriate seed / plant selection, cultural practices, and responsible fertilizer management will provide assurance that potential nitrogen leaching is minimized. Additionally, justification for any applications of fertilizer by a professional guarantees responsible management.



LOOKING NORTH

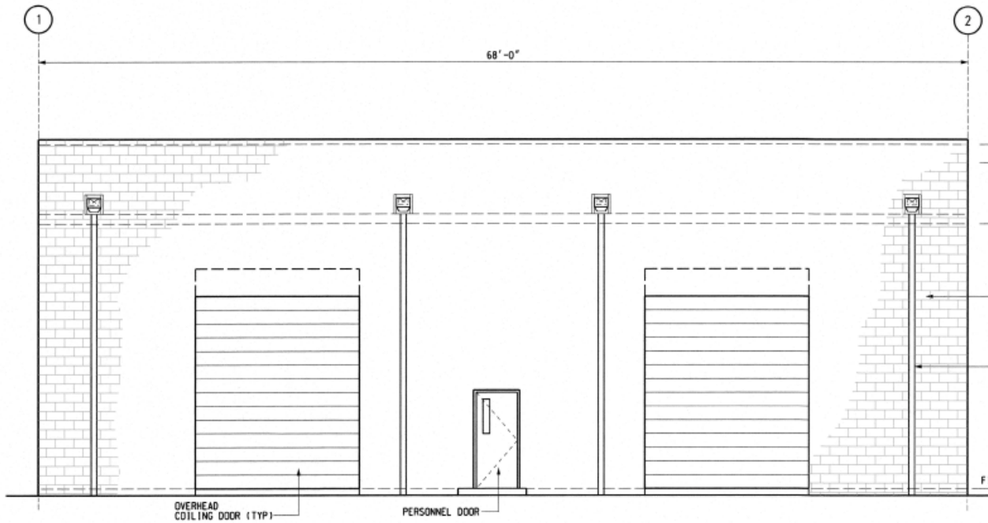
SOUTH ELEVATION

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

LOOKING SOUTH

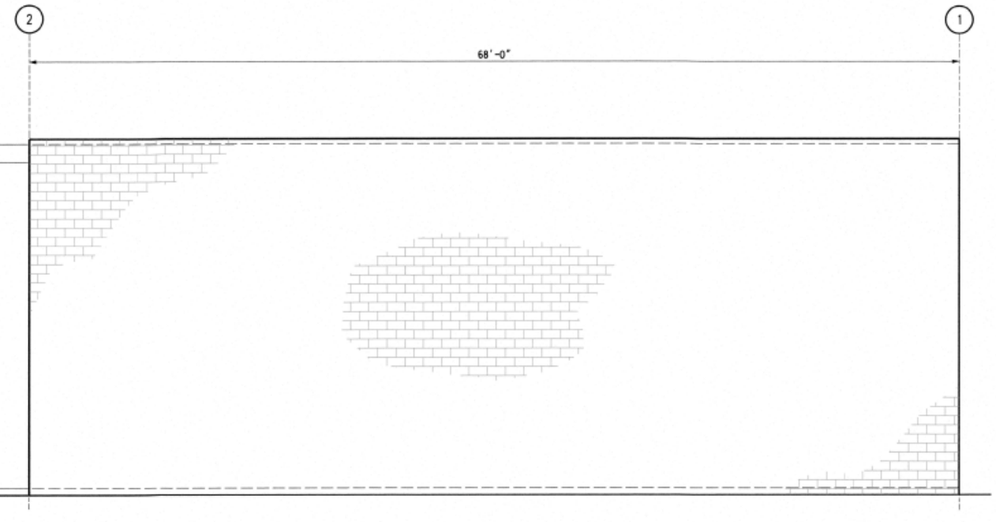
NORTH ELEVATION

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



EAST ELEVATION

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



WEST ELEVATION

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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41762
REGISTERED PROFESSIONAL ENGINEER
9-15-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

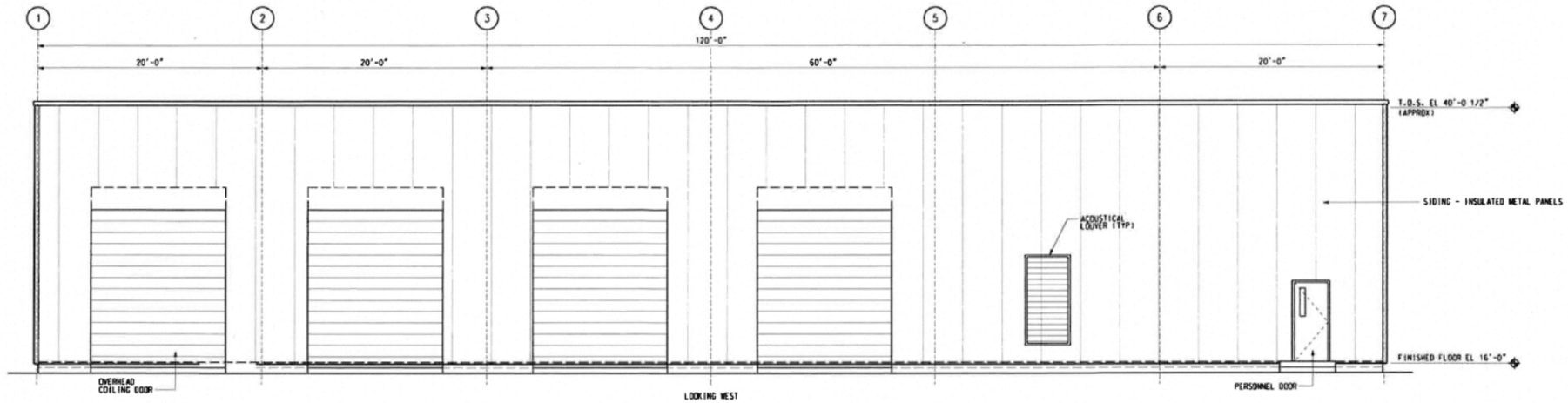
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
GAS COMPRESSOR BUILDING
ELEVATIONS

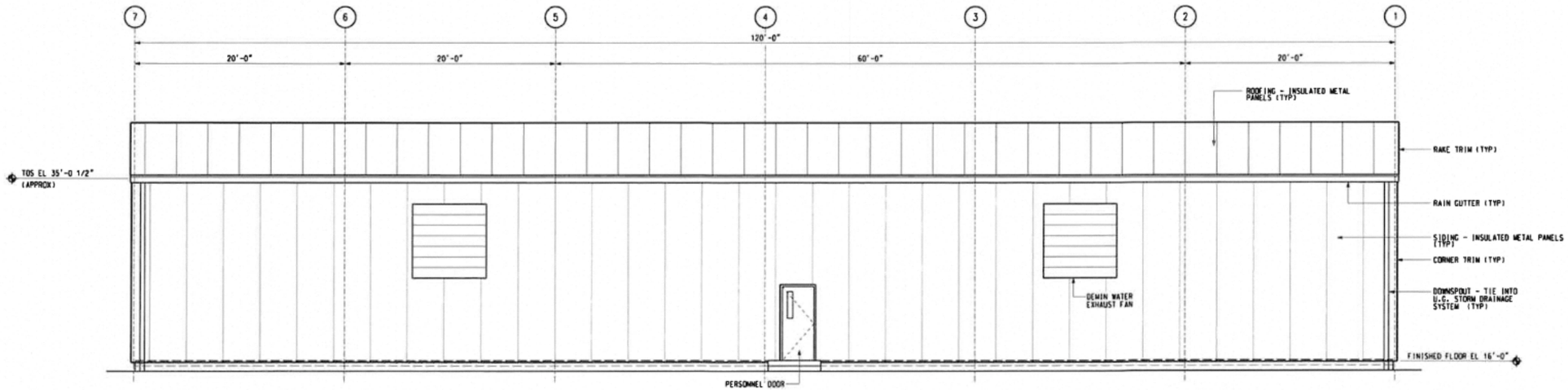
DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-010
APPROVED		SHEET: 3 OF 3
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:



LOOKING WEST

EAST ELEVATION

SCALE: $\frac{3}{16}$" = 1'-0"



WEST ELEVATION

SCALE: $\frac{3}{16}$" = 1'-0"
LOOKING EAST

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.	CANAL
	#3

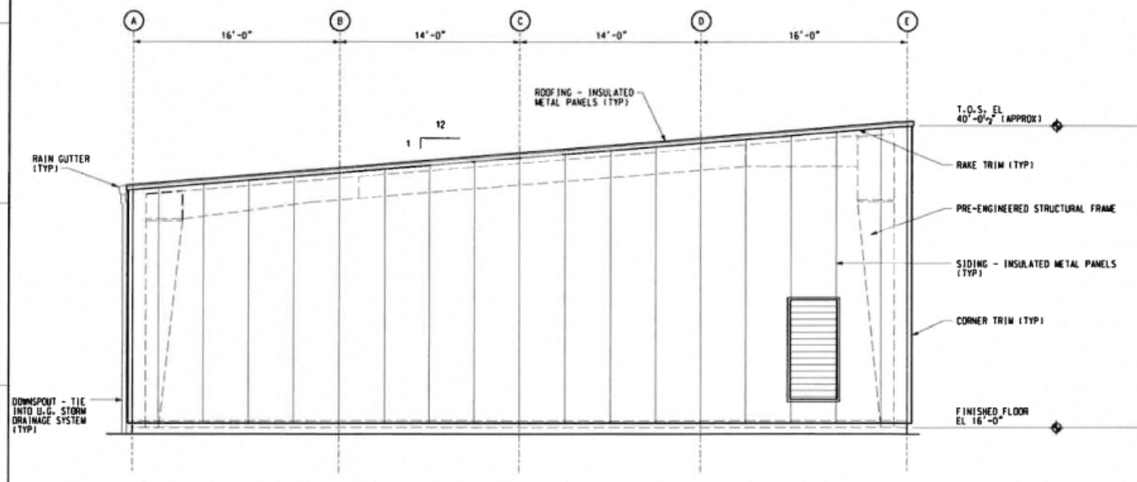
SIMPLE CYCLE TURBINE FACILITY
DEMIN WATER TREATMENT BUILDING
ELEVATIONS

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-011
APPROVED		SHEET: 2
SIZE: D 22X34		REV: B
DISCIPLINE:	SCALE: $\frac{3}{16}$"=1'-0"	FILE:

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
9-22-16

NO.	DATE	REVISION	BY	CHK. APP.
B	9/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ

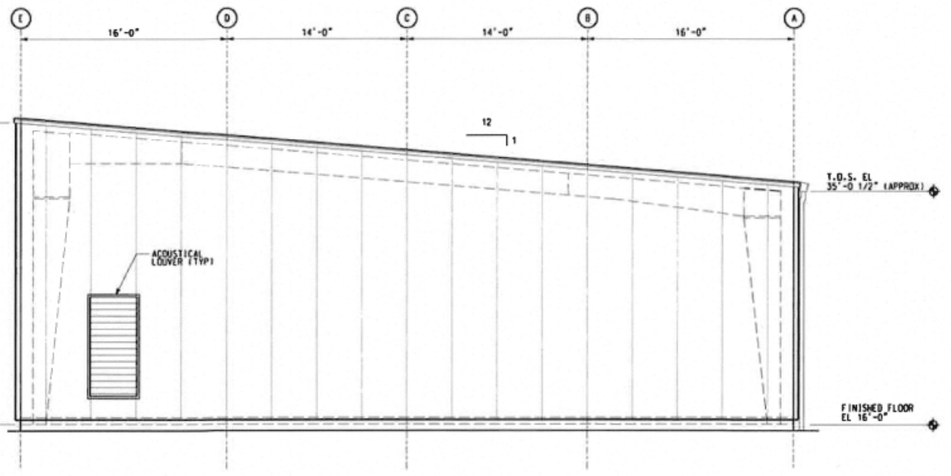
OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



LOOKING NORTH

SOUTH ELEVATION

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



LOOKING SOUTH

NORTH ELEVATION

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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
B	6/21/16	ISSUED FOR CCC PERMIT	JOM	DGJ	
A	6/15/16	ISSUED FOR CCC PERMIT	JOM	DGJ	

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED
PROFESSIONAL ENGINEER

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

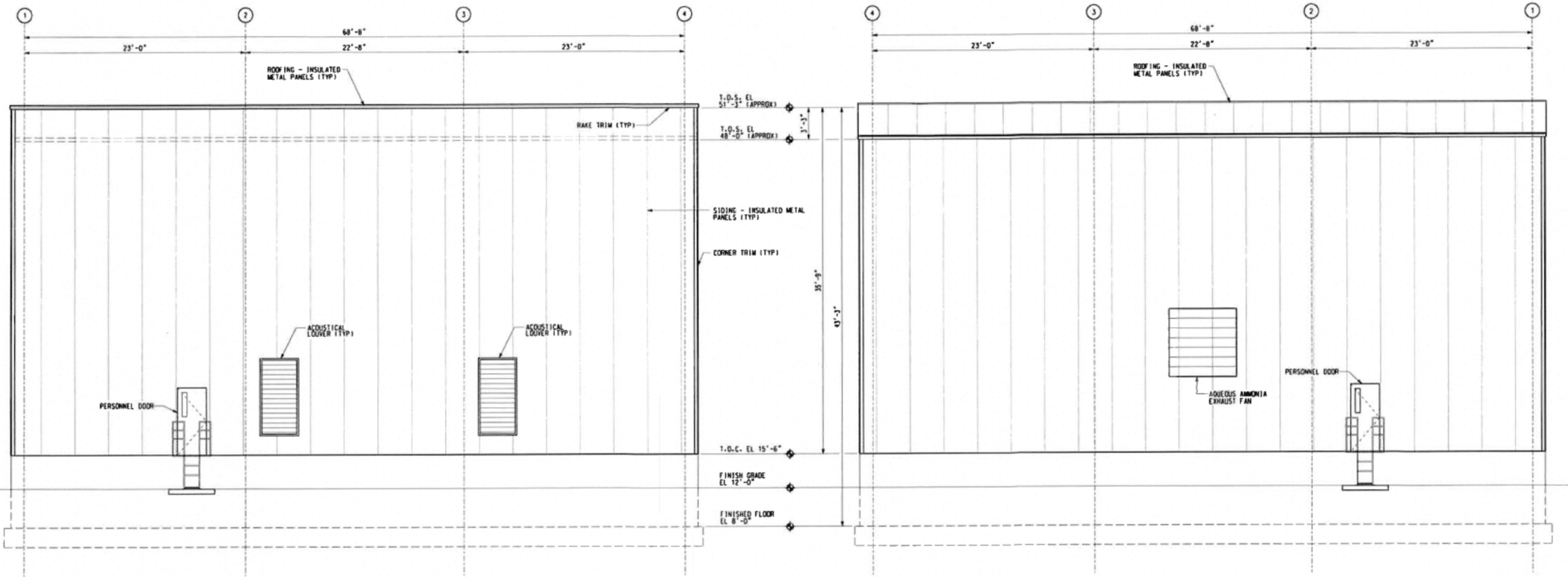
nrg.

CANAL

#3

SIMPLE CYCLE TURBINE FACILITY
DEMIN WATER TREATMENT BUILDING
ELEVATIONS

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-011
APPROVED		SHEET: 3
SIZE: D 22X34		REV: B
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:



NOTE:

1) AMMONIA TANKS, FOUNDATION AND CONTAINMENT ARE EXISTING STRUCTURES TO BE MODIFIED WITH AN ENCLOSURE AND VENTILATION SYSTEM.

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
B	9/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ	
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41702
REGISTERED
PROFESSIONAL ENGINEER
9-22-16

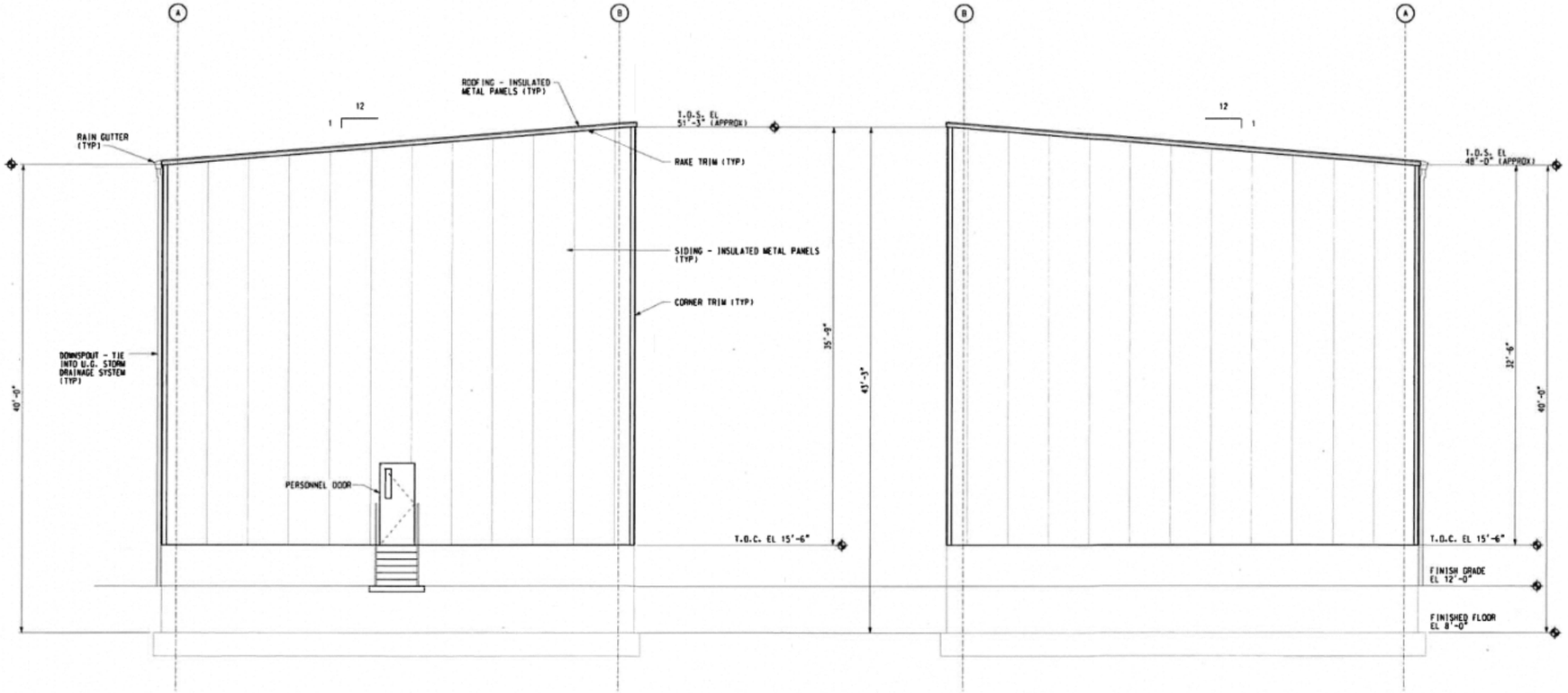
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
AQUEOUS AMMONIA STORAGE
ELEVATIONS

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-012
APPROVED		SHEET: 2
SIZE: D 22X34		REV: B
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:



LOOKING EAST

WEST ELEVATION

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

LOOKING WEST

EAST ELEVATION

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

NOTE:

1) AMMONIA TANKS, FOUNDATION AND CONTAINMENT ARE EXISTING STRUCTURES TO BE MODIFIED WITH AN ENCLOSURE AND VENTILATION SYSTEM.

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
B	6/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ	
A	6/15/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

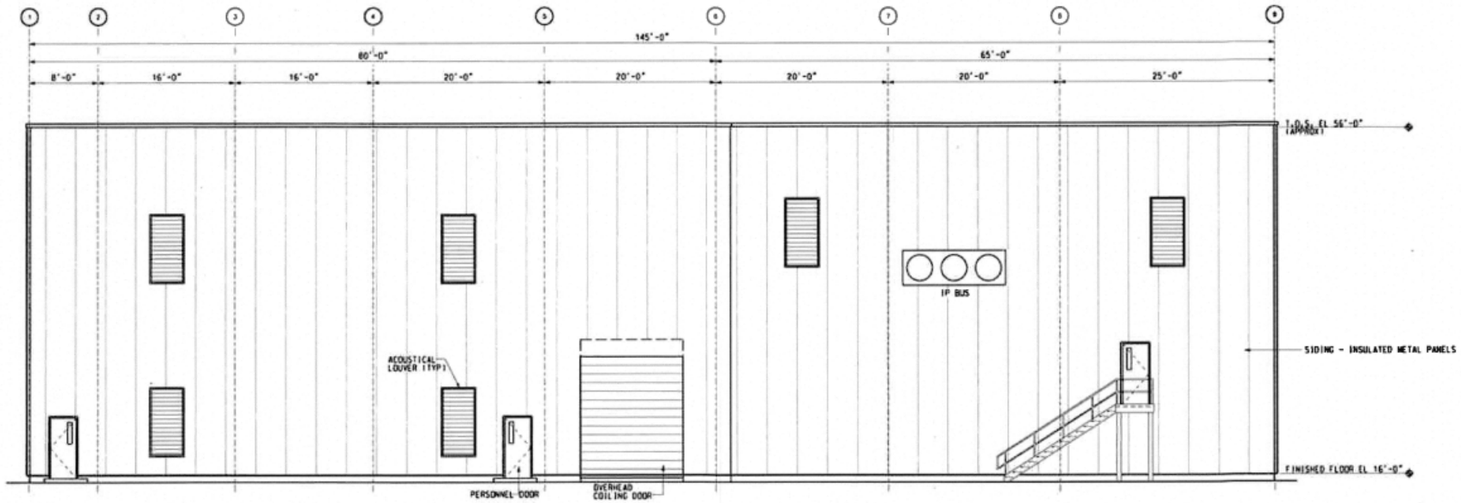
COMMONWEALTH OF MASSACHUSETTS
GLENN PELURINE
STRUCTURAL
No. 41762
REGISTERED PROFESSIONAL ENGINEER

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg. | CANAL #3

SIMPLE CYCLE TURBINE FACILITY
AQUEOUS AMMONIA STORAGE
ELEVATIONS

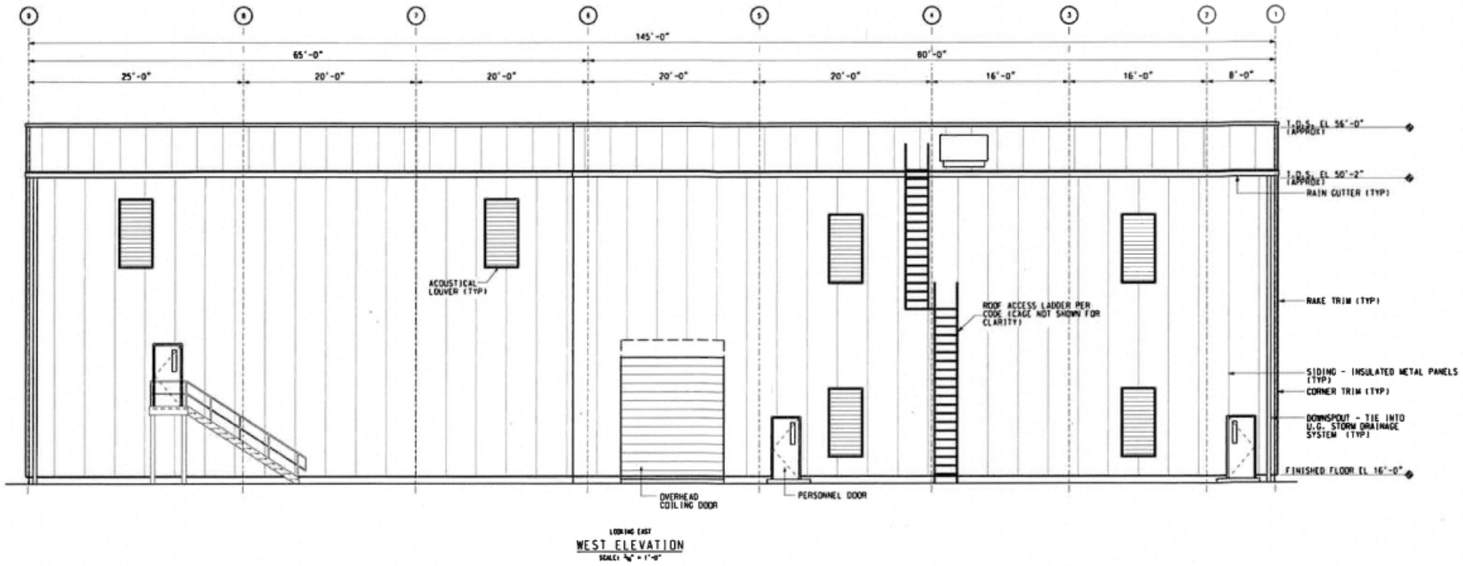
DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-012
APPROVED		SHEET: 3
SIZE: D 22X34		REV: B
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:



LOOKING WEST

EAST ELEVATION

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



LOOKING EAST

WEST ELEVATION

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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/22/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

COMMONWEALTH OF MASSACHUSETTS
GLENN PELKINIE
STRUCTURAL
No. 41752
REGISTERED PROFESSIONAL ENGINEER
9-22-16

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

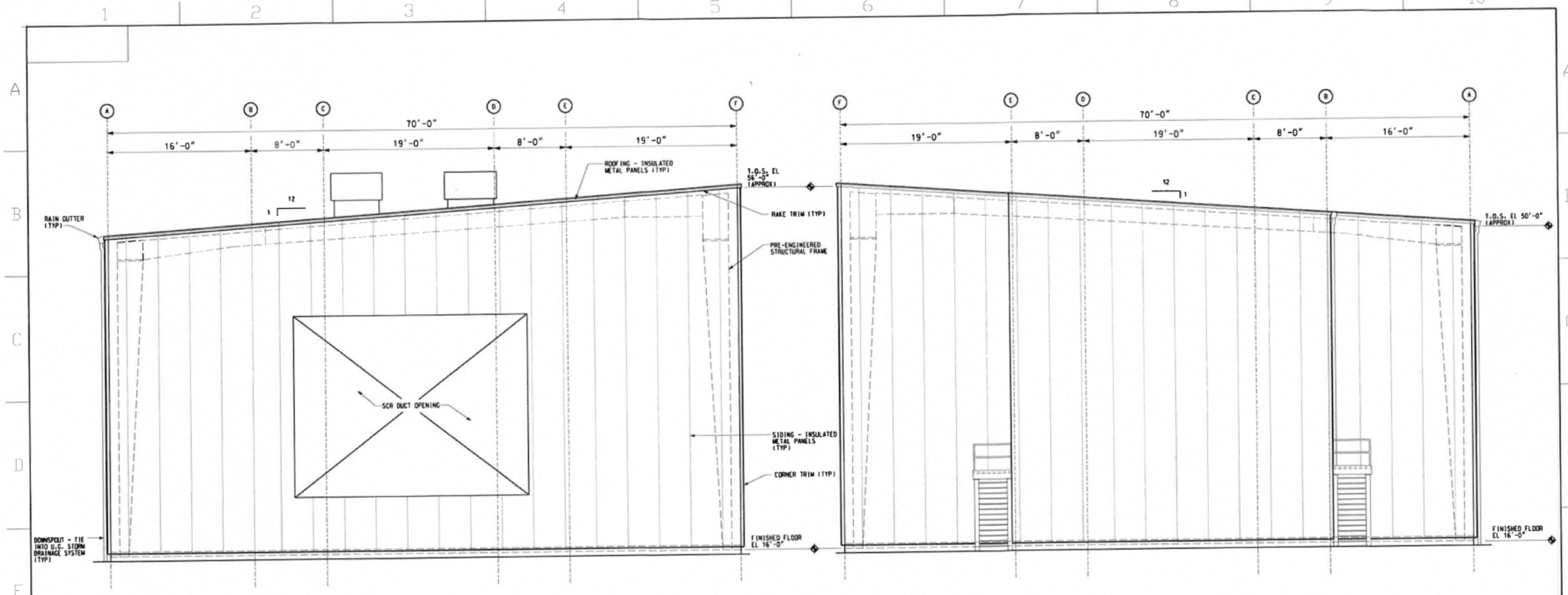
nrg.

CANAL

#3

SIMPLE CYCLE TURBINE FACILITY
GAS TURBINE & GENERATOR ENCLOSURE
ELEVATIONS

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-013
APPROVED		SHEET: 2
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1/8"=1'-0"	FILE:



OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

COMMONWEALTH OF MASSACHUSETTS
GLENN PELLERINE
STRUCTURAL
No. 41752
REGISTERED PROFESSIONAL ENGINEER
9-22-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/22/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

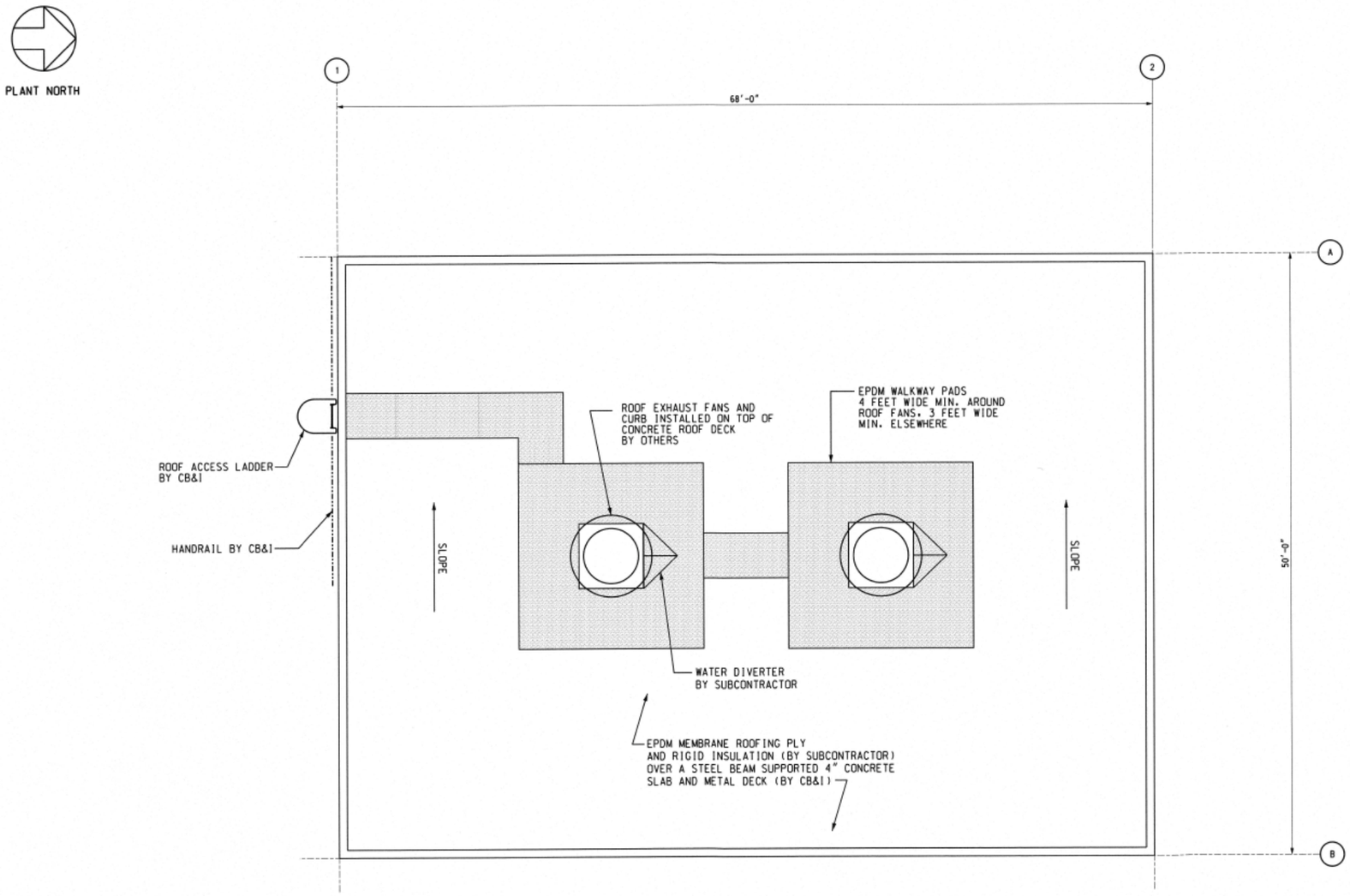
nrg. CANAL #3

SIMPLE CYCLE TURBINE FACILITY
GAS TURBINE & GENERATOR ENCLOSURE ELEVATIONS

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-013
APPROVED		SHEET: 3
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:

GENERAL NOTES:

1. THE FUEL GAS COMPRESSOR ENCLOSURE IS A SOUND ATTENTUATED STRUCTURE DESIGNED TO CONTAIN COMPRESSOR NOISE DURING OPERATION. ALL PENETRATIONS AND INTERFACES MUST BE SEALED TO MINIMIZE INTERNAL NOISE TO ESCAPE INTO THE ENVIRONMENT.



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

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg. CANAL #3

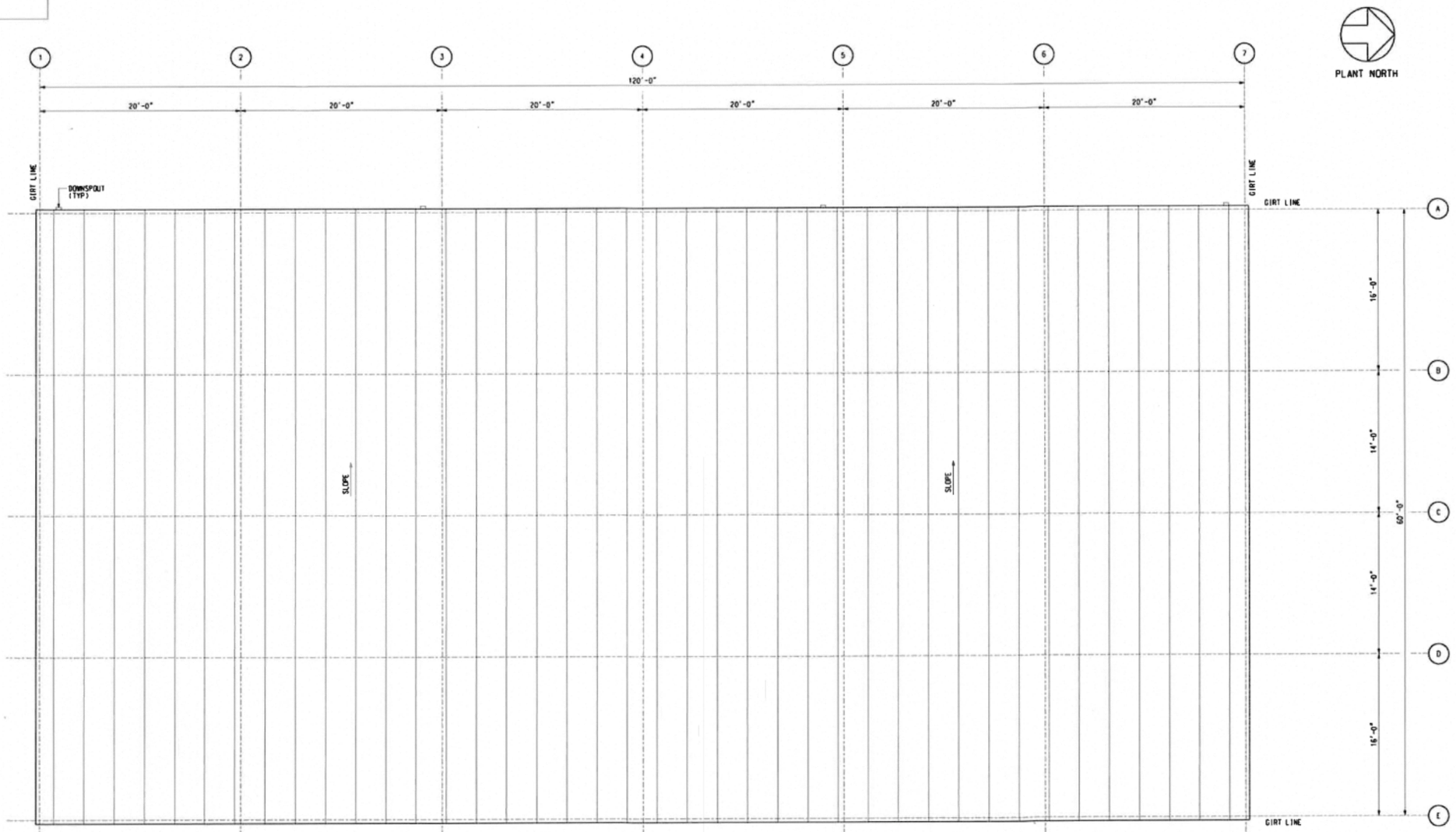
SIMPLE CYCLE TURBINE FACILITY
GAS COMPRESSOR BUILDING
ROOF PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-010
APPROVED		SHEET: 2 OF 3
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
4-15-16

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



ROOF PLAN
SCALE: 3/32" = 1'-0"

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41762
REGISTERED
PROFESSIONAL ENGINEER
9-22-16

NO.	DATE	REVISION	JGM	DGJ	CHK.	APP.
A	9/15/16	ISSUED FOR CCC PERMIT				

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

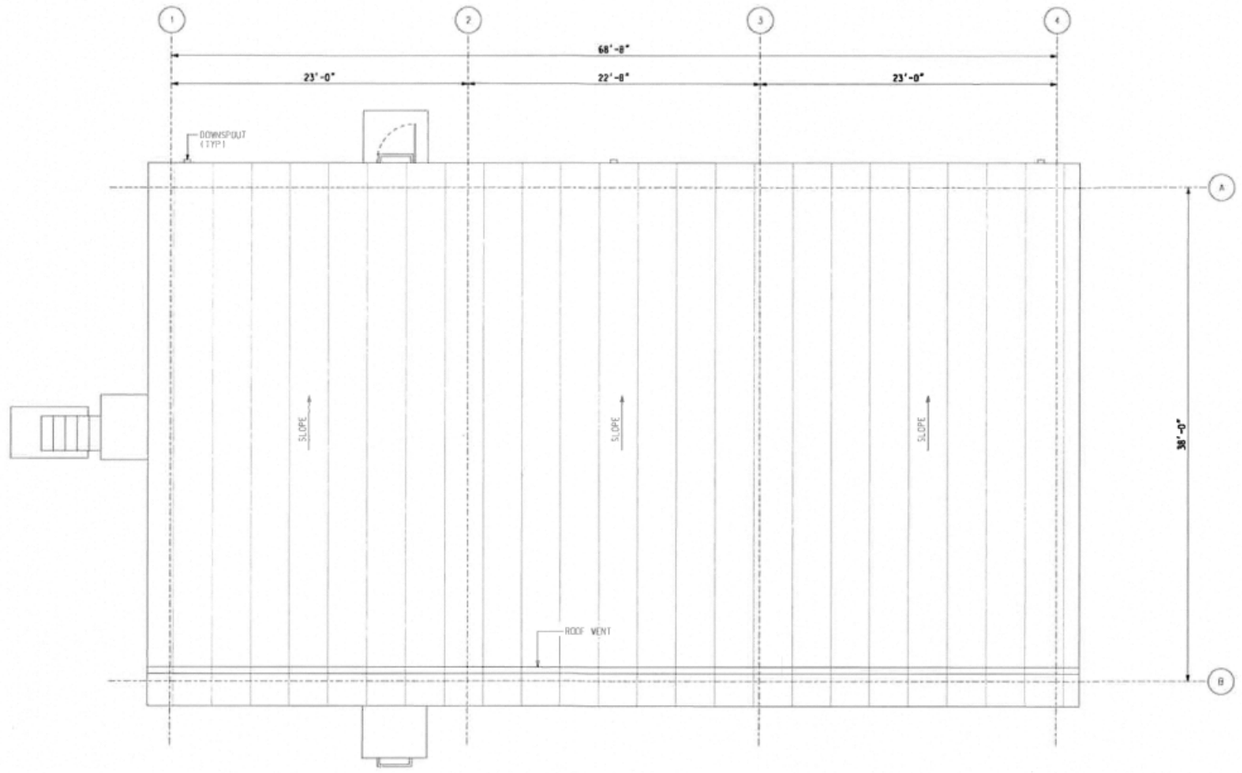
SIMPLE CYCLE TURBINE FACILITY
DEMIN WATER TREATMENT BUILDING
ROOF PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	146125-CA-011
APPROVED		SHEET: 4
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 3/32"=1'-0"	FILE:

NOTE:

1. AMMONIA TANKS, FOUNDATION AND CONTAINMENT ARE EXISTING STRUCTURES TO BE MODIFIED WITH AN ENCLOSURE AND VENTILATION SYSTEM.

PLANT NORTH



ROOF PLAN
SCALE: 1/16" = 1'-0"

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
9-22-16

nrg.

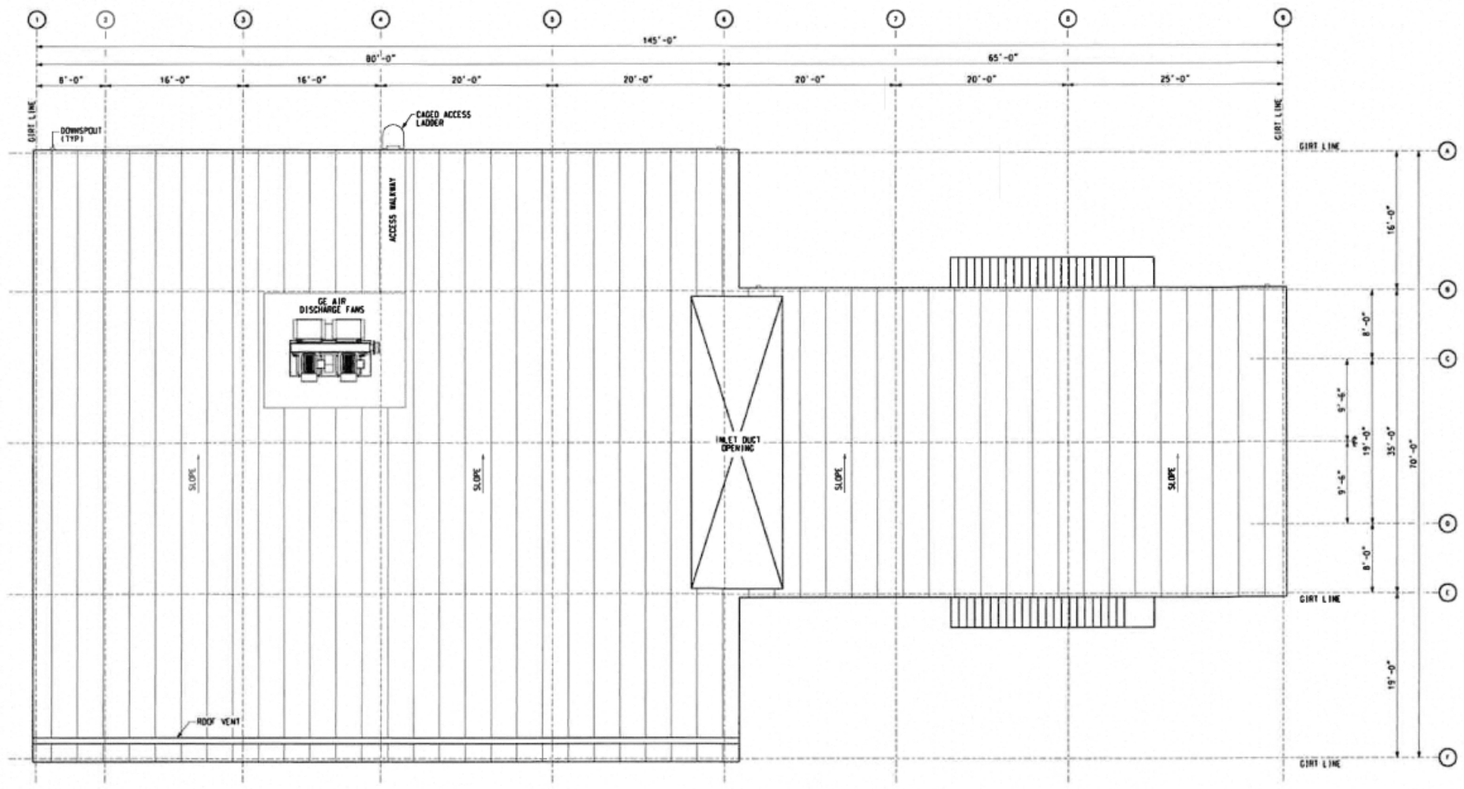
CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
AQUEOUS AMMONIA STORAGE
ROOF PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-012
APPROVED		SHEET: 4
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1/16"=1'-0"	FILE:

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CDC PERMIT	JGM	DGJ	BTM

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



ROOF PLAN
SCALE: 1/4" = 1'-0"

PLANT NORTH

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/23/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

COMMONWEALTH OF MASSACHUSETTS
CHRISTOPHER J. CLEUM
No. 44982
REGISTERED PROFESSIONAL ENGINEER
9-22-16

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

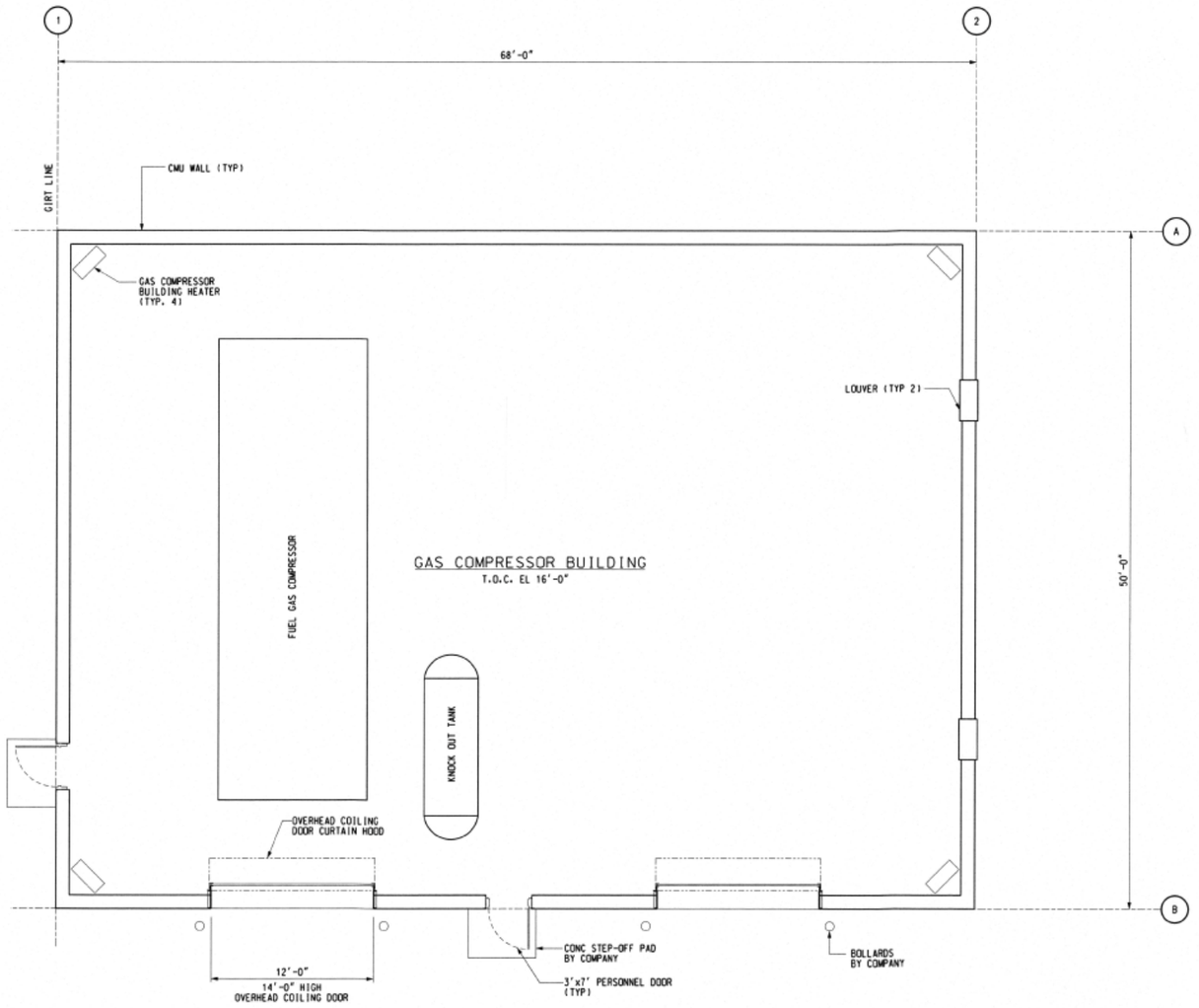
nrg.

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
GAS TURBINE & GENERATOR ENCLOSURE
ROOF PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-013
APPROVED		SHEET: 4
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1/4"=1'-0"	FILE:

PLANT NORTH



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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41762
REGISTERED PROFESSIONAL ENGINEER
4-15-16

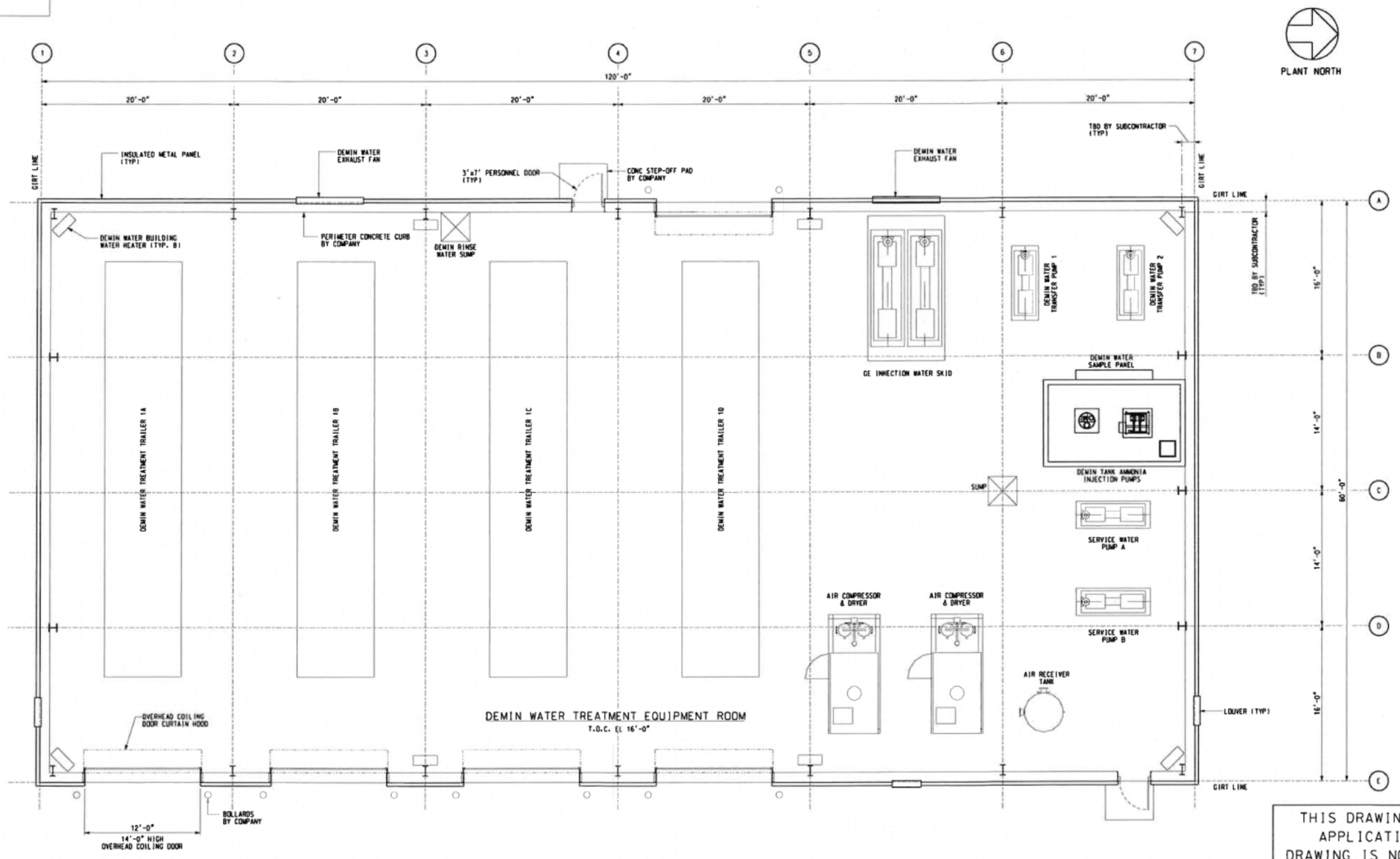
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
GAS COMPRESSOR BUILDING
FLOOR PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-010
APPROVED		SHEET: 1 OF 3
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:



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

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
DEMIN WATER TREATMENT BUILDING
FLOOR PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-011
APPROVED		SHEET: 1
SIZE: D 22X34		REV: B
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:

COMMONWEALTH OF MASSACHUSETTS
GLENN PELRINE
STRUCTURAL
No. 41752
REGISTERED PROFESSIONAL ENGINEER
9-22-16

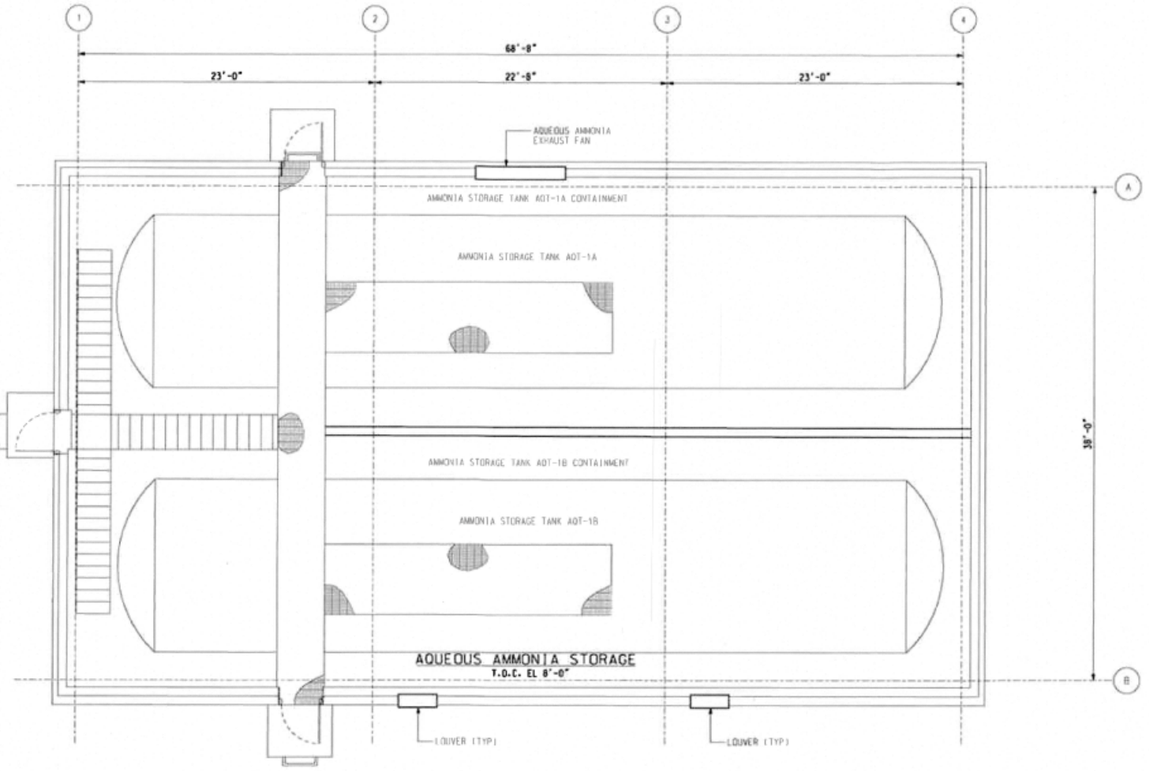
NO.	DATE	REVISION	BY	CHK.	APP.
B	9/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ	
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NOTE:

1) AMMONIA TANKS, FOUNDATION AND CONTAINMENT ARE EXISTING STRUCTURES TO BE MODIFIED WITH AN ENCLOSURE AND VENTILATION SYSTEM.

PLANT NORTH



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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

COMMONWEALTH OF MASSACHUSETTS
GLENN PELPINE
STRUCTURAL
No. 41782
REGISTERED PROFESSIONAL ENGINEER
9-22-16

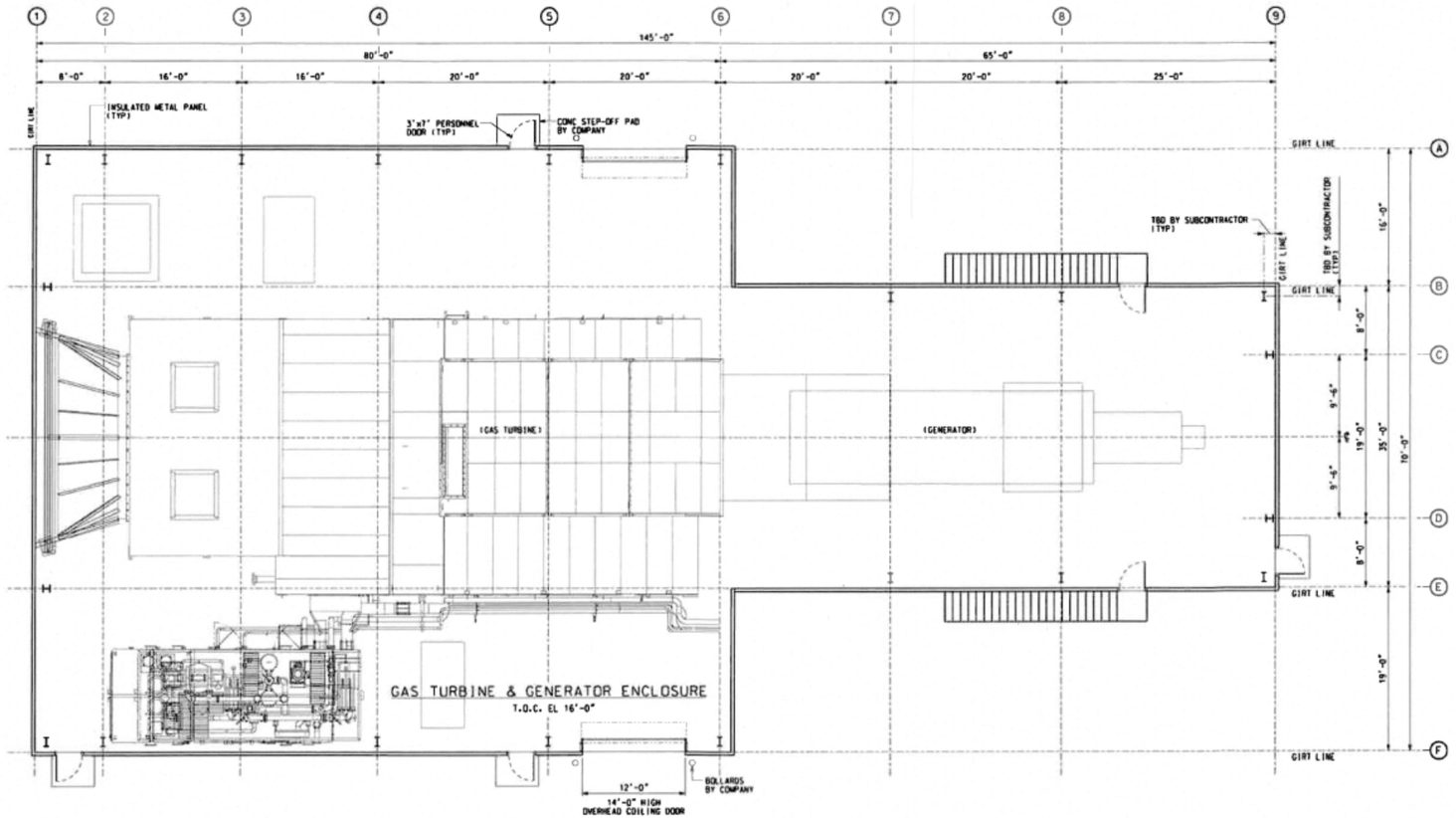
NO.	DATE	REVISION	BY	CHK.	APP.
B	9/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ	
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg. | CANAL #3

SIMPLE CYCLE TURBINE FACILITY
AQUEOUS AMMONIA STORAGE
FLOOR PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	149125-CA-012
APPROVED		SHEET: 1
SIZE: D 22X34		REV: B
DISCIPLINE:	SCALE: 3/16"=1'-0"	FILE:



FLOOR PLAN
SCALE: 1/4" = 1'-0"

PLANT NORTH

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

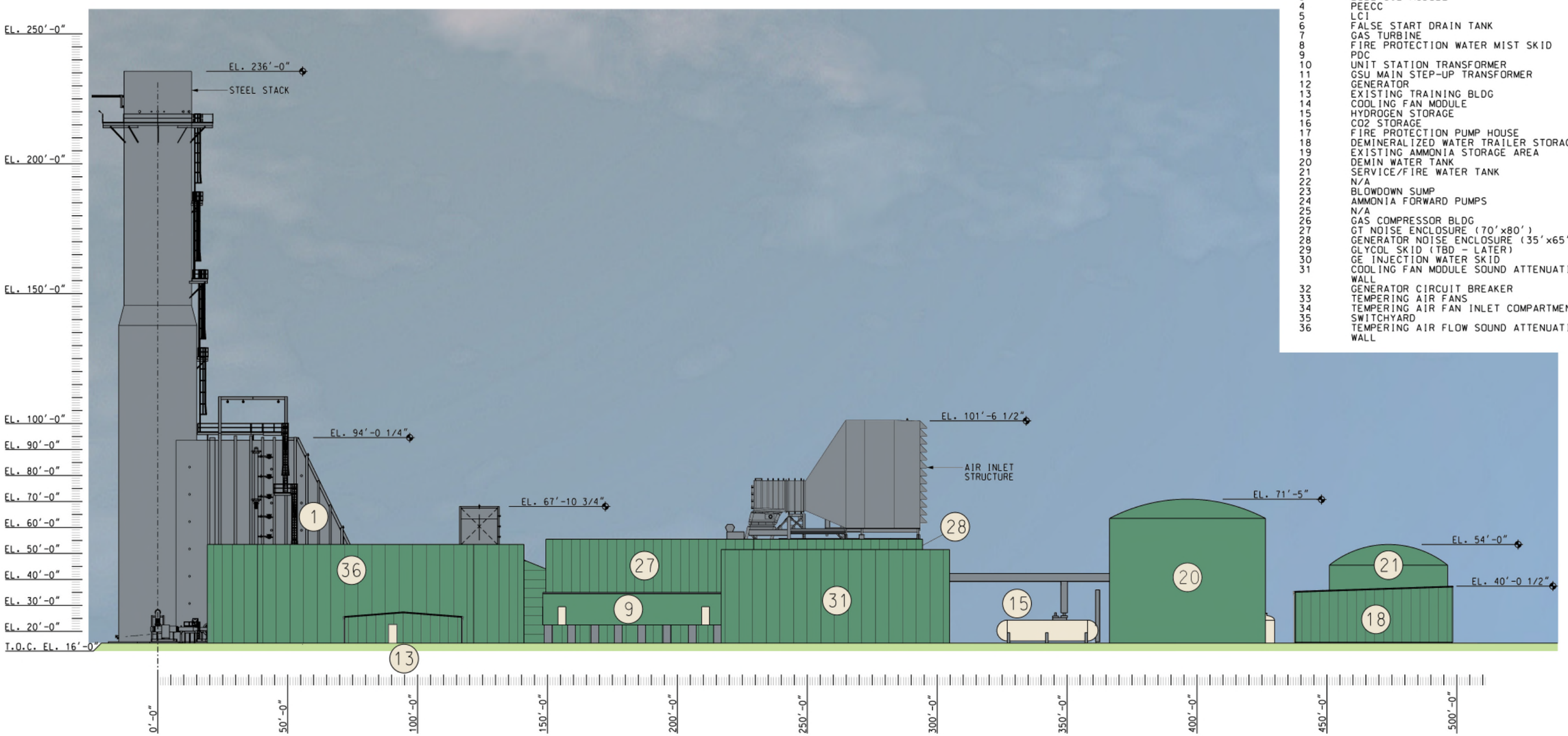
SIMPLE CYCLE TURBINE FACILITY
GAS TURBINE & GENERATOR ENCLOSURE
FLOOR PLAN

DRAWN:	J.G. MARTIN	DRAWING NUMBER	
CHECKED	D.G. JOHNSON	149125-CA-013	
APPROVED		SHEET: 1	
SIZE: D 22X34		REV: A	
DISCIPLINE:	SCALE: 1/4"=1'-0"	FILE:	

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ	PM

COMMONWEALTH OF MASSACHUSETTS
GLENN PELPINE
STRUCTURAL
No. 41760
REGISTERED
PROFESSIONAL ENGINEER
9-22-16

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



PROJECT SOUTH ELEVATION (LOOKING NORTH)
SCALE: 1"=20'

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg. | CANAL #3

SIMPLE CYCLE TURBINE FACILITY
PROJECT SOUTH ELEVATION
(LOOKING NORTH)

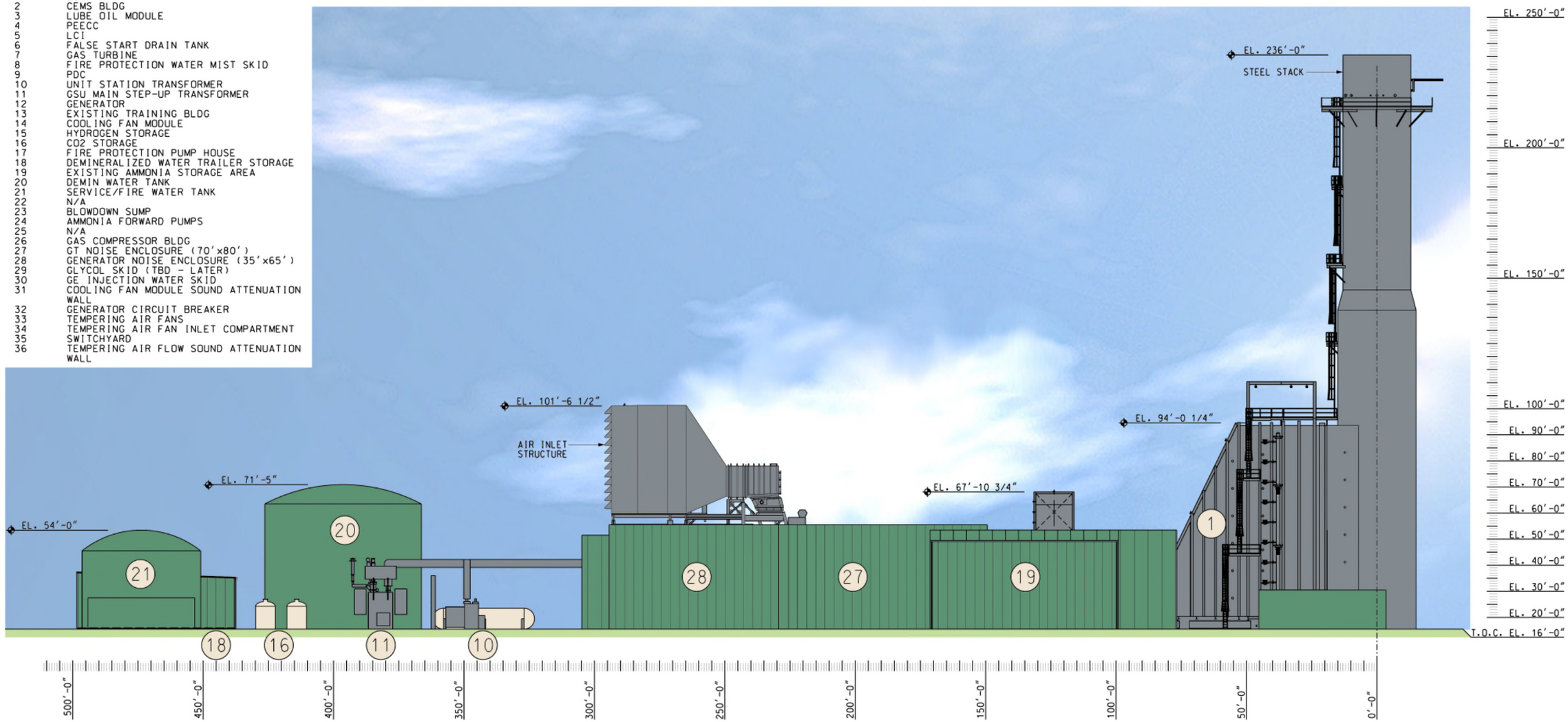
DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	FIGURE A
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL



PROJECT NORTH ELEVATION (LOOKING SOUTH)
SCALE: 1"=20'

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

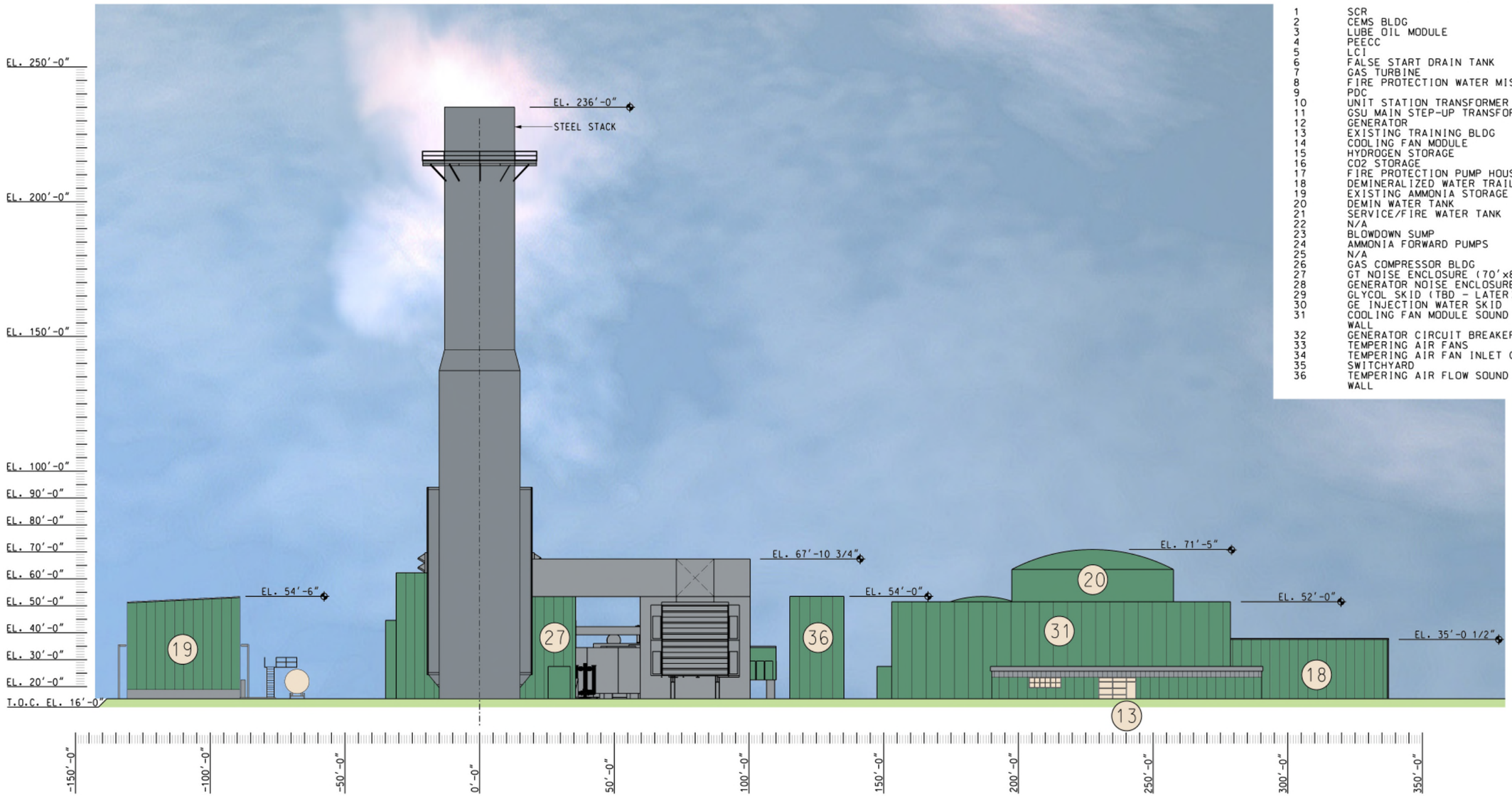
CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
PROJECT NORTH ELEVATION
(LOOKING SOUTH)

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	FIGURE B
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



PROJECT WEST ELEVATION (LOOKING EAST)
SCALE: 1"=20'

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

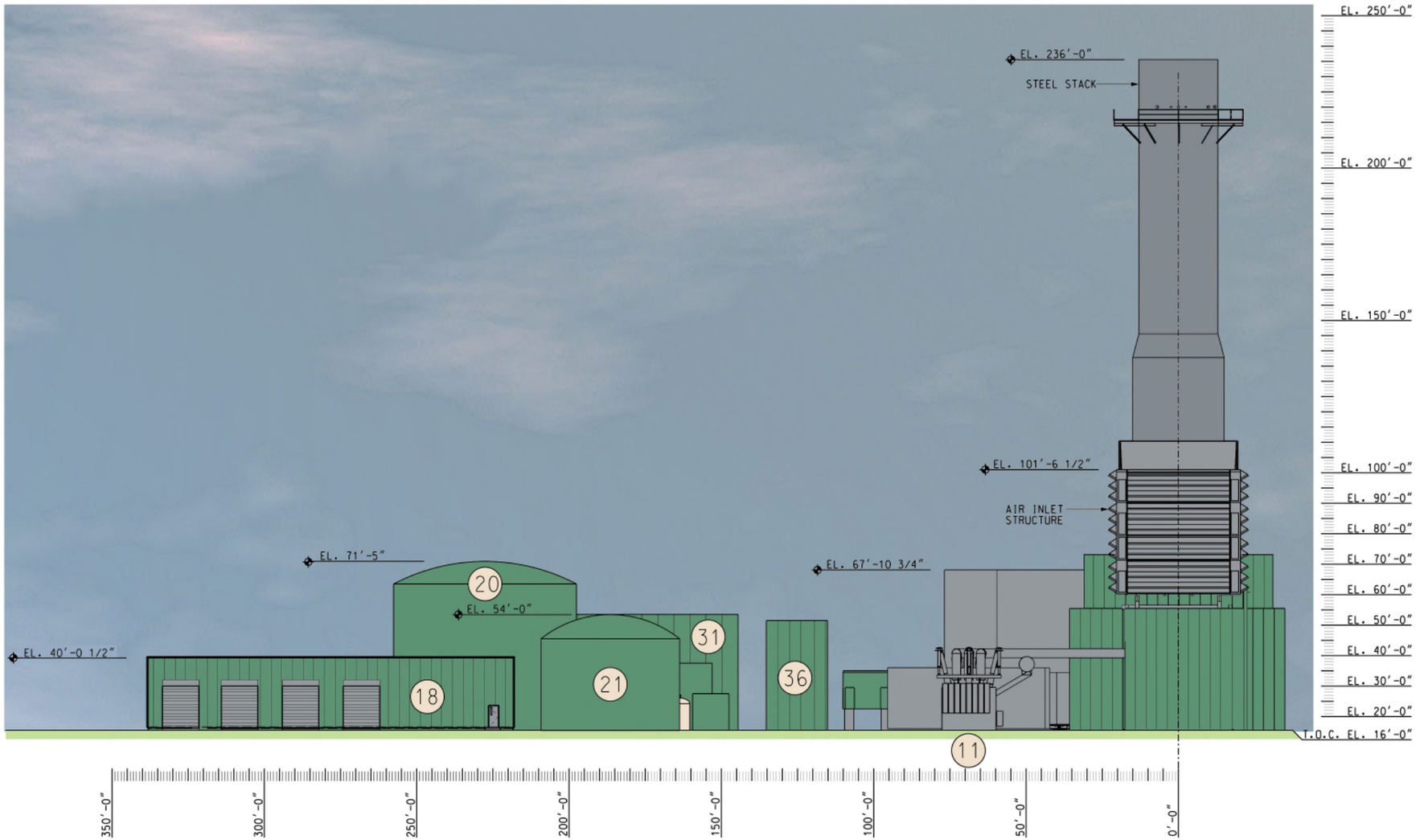
CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
PROJECT WEST ELEVATION
(LOOKING EAST)

DRAWN:	J.G. MARTIN	DRAWING NUMBER	
CHECKED	D.G. JOHNSON	FIGURE C	
APPROVED		SHEET: 1 OF 1	
SIZE: D 22X34		REV: A	
DISCIPLINE:	SCALE: 1"=20'	FILE:	

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



PROJECT EAST ELEVATION (LOOKING WEST)
SCALE: 1"=20'

LEGEND

ITEM	DESCRIPTION
1	SCR
2	CEMS BLDG
3	LUBE OIL MODULE
4	PEECC
5	LCI
6	FALSE START DRAIN TANK
7	GAS TURBINE
8	FIRE PROTECTION WATER MIST SKID
9	PDC
10	UNIT STATION TRANSFORMER
11	GSU MAIN STEP-UP TRANSFORMER
12	GENERATOR
13	EXISTING TRAINING BLDG
14	COOLING FAN MODULE
15	HYDROGEN STORAGE
16	CO2 STORAGE
17	FIRE PROTECTION PUMP HOUSE
18	DEMINERALIZED WATER TRAILER STORAGE
19	EXISTING AMMONIA STORAGE AREA
20	DEMIN WATER TANK
21	SERVICE/FIRE WATER TANK
22	N/A
23	BLOWDOWN SUMP
24	AMMONIA FORWARD PUMPS
25	N/A
26	GAS COMPRESSOR BLDG
27	GT NOISE ENCLOSURE (70'x80')
28	GENERATOR NOISE ENCLOSURE (35'x65')
29	GLYCOL SKID (TBD - LATER)
30	GE INJECTION WATER SKID
31	COOLING FAN MODULE SOUND ATTENUATION WALL
32	GENERATOR CIRCUIT BREAKER
33	TEMPERING AIR FANS
34	TEMPERING AIR FAN INLET COMPARTMENT
35	SWITCHYARD
36	TEMPERING AIR FLOW SOUND ATTENUATION WALL

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

CANAL
#3

SIMPLE CYCLE TURBINE FACILITY
PROJECT EAST ELEVATION
(LOOKING WEST)

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	FIGURE D
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"=20'	FILE:

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/16/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

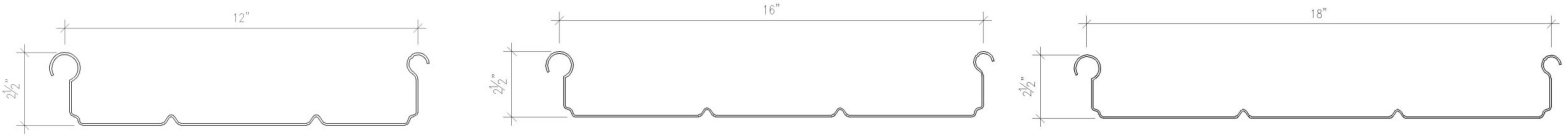
MorZip®
MZ12, MZ16, MZ18

Morin
A Kingspan Group Company

www.morincorp.com
800.640.9501

Technical Specification Sheet

Available as MorZip Naturals and MorZip Painted Metals



MZ12*† **MZ16*†** **MZ18*†**

PRODUCT SUMMARY:

Morin MorZip®Series, a dual purpose roof and wall system that provides a seamless transition from roof to wall and back again. Available as MorZip® Naturals in copper, zinc, stainless steel and mill finish aluminum or as MorZip® Painted Metals in both aluminum or Galvalume/Zincalume.

PRODUCTION REFERENCES:

- Lengths 5’ (1.52m) to 30’ (9.14m) standard
- **Jobsite roll forming** of panels in continuous lengths so as to eliminate panel end laps

STORAGE AND INSTALLATION NOTES:

- Deliver panel materials and components in the original, unopened, undamaged packaging with identification labels intact.
- Store panel materials on dry, firm, and clean surface. **Note**: special packaging and storage instructions for copper and zinc panels.
- Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.
- Remove protective film immediately as per standard directions.
- Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.
- Cutting and fitting of panels shall be neat, square and true. Torch or abrasive cutting is prohibited.

PRODUCT OFFERINGS:

Panel Type - Structural concealed fastener standing seam roof or wall
Application - Weather-resistant or Rainscreen
Panel Depth - 2 1/2” (mm)
Cover Width - 12”(305mm) or 16”(406 mm) or 18”(457 mm)

Material Options

Painted Metals:
Painted Steel - Galvalume/Zincalume 20 and 22 GA
Painted Aluminum - 0.050 GA and 0.040 GA

Naturals:
Stainless Steel - 20 GA, and 22 GA
Zinc - 1.0mm and Natural Copper- 20 oz.

Color and Finish Options for Aluminum and Steel
Standard (Fluropon®PVDF-Kynar500®)
Premium Colors MICA (Fluropon Classic®II PVDF)
Premium Colors METALLIC (Fluropon Classic®PVDF)
Morin Custom Color Matching Services
Other Finishes Available

Surfaces Options -Smooth surface standard, stucco embossed texture *optional*
Sealant- Optional factory caulking available
Clip- Morin MorZip® Series Clip
Substrate- Open framing or “built up” similar
Perforations- Refer to TSS on Morin Perforated Panels

- **MANUFACTURING FACILITIES:**
  Bristol, CT • Fontana, CA • DeLand, FL

***Rendering on reverse**
†Sold previously as SRR12, SRR16, SRR18

MorZip®
MZ12, MZ16, MZ18

Morin
A Kingspan Group Company

www.morincorp.com
800.640.9501

Technical Specification Sheet

Available as MorZip Naturals and MorZip Painted Metals

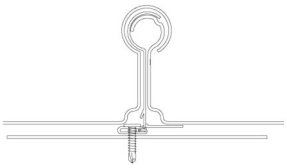
TESTING

ASTM

FM

UL

Florida approvals



Assembly Detail

LOAD SPANS

DOWNLOAD AT WWW.MORINCORP.COM OR CONTACT YOUR MORIN REGIONAL SALES MANAGER OR INDEPENDENT AGENT

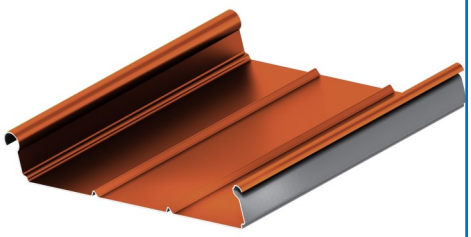
Sustainability

All MorZip products contain various recycled contents and are 100% recyclable at the end of their useful life cycle.

- *Aluminum* - Average Total Recycled Content 15-69% with an estimated life span of 70+ years
- *Stainless Steel* – Average Total Recycled Content up to 60% with an estimated life span of 80+ years.
- *Alloy Zinc* - Average Total Recycled Content 40-50% with an estimated life span of 80+ years.
- *Copper* - Average Total Recycled Content 75-90% with an estimated life span of 90+ years.
- *Galvalume/Zincalume* - 17% post-consumer and 14% pre-consumer content

Design Features

- Mechanically seamed side lap provides unsurpassed weather tightness at slopes as low as 1/2:12.
- Hidden clip fastening eliminates need for through fasteners.
- Curving capabilities include convex lay-down/mechanical curve and concave mechanical curve.
- Tapered options are either a curved convex tapered or a straight tapered MorZip panel.
- Contact MORIN Technical Service Department with your unique project requirements.



Exposed Fastener Series

Y-36*

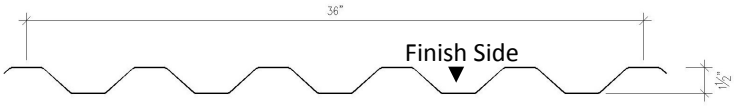
Morin

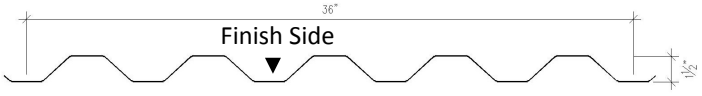
A Kingspan Group Company

www.morincorp.com

800.640.9501

Technical Specification Sheet





Y-36A

Y-36B

PRODUCT SUMMARY:

Morin Y-36 Exposed Fastener Series wall and roof panel is designed into every type of building today from industrial/manufacturing plants to Class A office buildings.

PRODUCTION REFERENCES:

- Lengths 5’ (1.52m) to 30’ (9.14m) standard Shorter and longer lengths available.

STORAGE AND INSTALLATION NOTES:

- Deliver panel materials and components in the original, unopened, undamaged packaging with identification labels intact.
- Store wall panel materials on dry, firm, and clean surface.
- Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.
- Remove protective film immediately as per standard directions.
- Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.
- Cutting and fitting of panels shall be neat, square and true. Torch or abrasive cutting is prohibited.
- **MANUFACTURING FACILITIES:**
  Bristol, CT • Fontana, CA • DeLand, FL

PRODUCT OFFERINGS:

Panel Type - Exposed fastener roof or wall

Application - Weather tight or rainscreen rear ventilated application

Panel Installation - Horizontal, vertical or diagonal

Finish Side: Noted Above On Profile

Panel Depth - 1 1/2” (38 mm)

Cover Width - 36” (914 mm)

Material Options

Galvalume/Zincalume Painted Steel Options:
18, 20, 22 and 24 GA
Aluminum - 0.050 and 0.040 GA
Stainless Steel - 20, 22 and 24 GA
Zinc - 0.8mm, 1.0 mm and 1.2 mm
Natural Copper- 20 and 16 oz.

Color and Finish Options for Aluminum and Steel

Standard (Fluropon®PVDF-Kynar500®)
Premium Colors MICA (Fluropon Classic®II PVDF)
Premium Colors METALLIC (Fluropon Classic®PVDF)
Morin Custom Color Matching Services
Other Finishes Available

Surfaces Options -Smooth surface standard, stucco embossed texture *optional*

Perforations- Refer to TSS on Morin Perforated Panels

DESIGN OPTIONS:

Overlapping side joint design
May be insulated to meet required thermal values
Ideal for new or retrofit projects
All weather installation

***Rendering on reverse**

Morin
A Kingspan Group Company

www.morincorp.com
800.640.9501

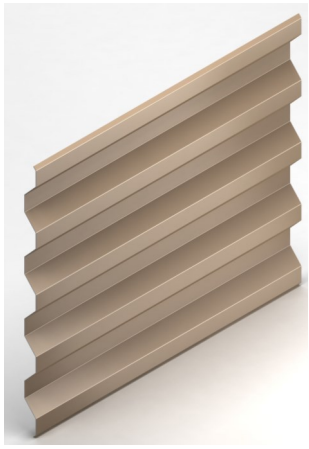
Technical Specification Sheet

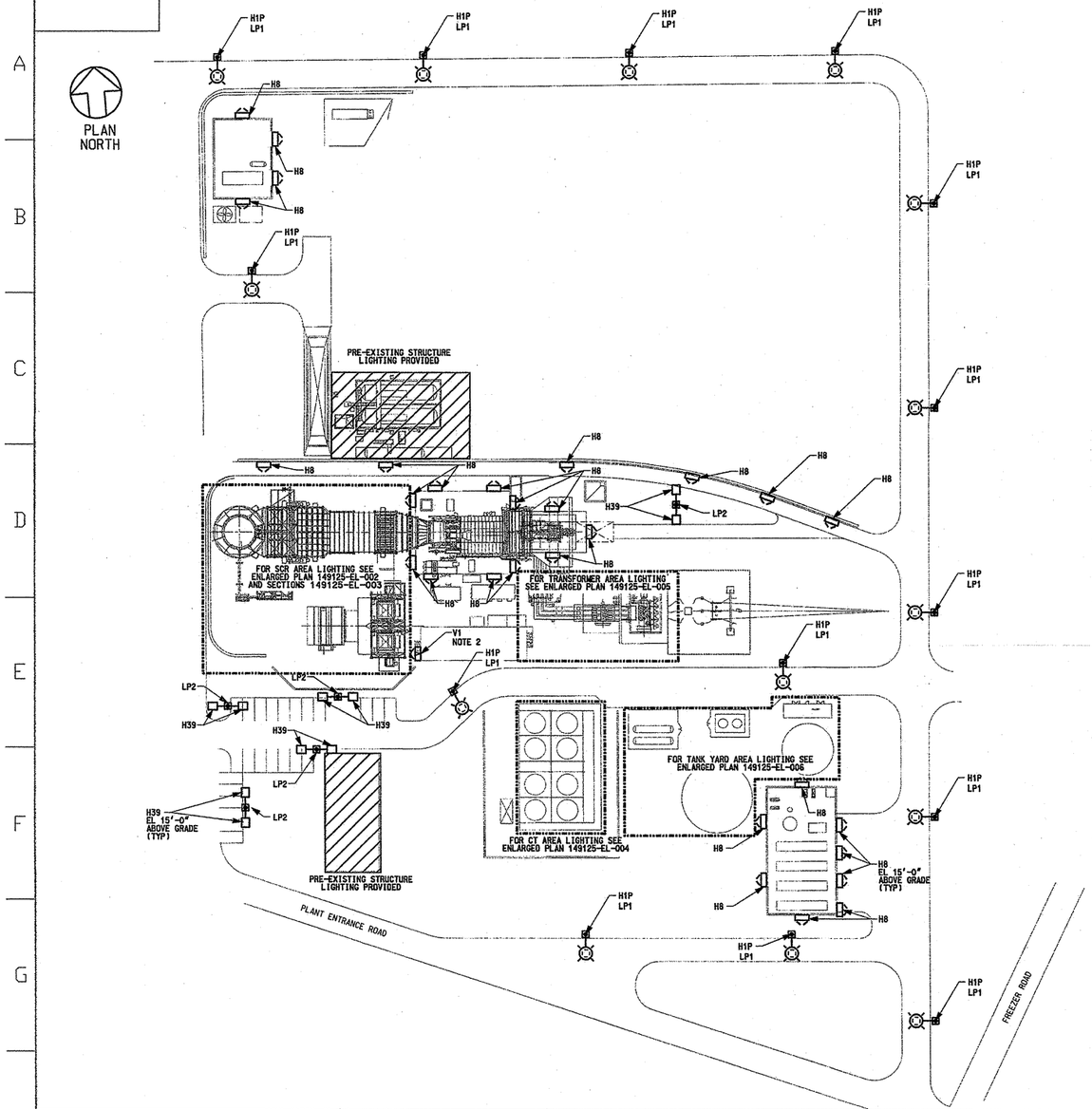
TESTING

Air Infiltration: ASTM E283
Water Penetration: ASTM E331
Structural Performance: ASTM E330 and E1592
Impact Testing:
TAS201 - Large and Small Missile Test Standards
TAS202 - Static Air Pressure Tests
TAS203 - Cyclic Wind Pressure Loading

LOAD SPANS

DOWNLOAD AT WWW.MORINCORP.COM OR CONTACT YOUR MORIN REGIONAL SALES MANAGER OR INDEPENDENT AGENT





NOTES:

1. ALL LIGHTING FIXTURES AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST STANDARDS OF THE NATIONAL ELECTRIC CODE AS ADOPTED BY THE NATIONAL FIRE PROTECTION ASSOCIATION AND/OR STATE AND LOCAL ORDINANCES.
2. TYPICAL VENDOR SUPPLIED FIXTURE. SEE FIXTURE SPECIFICATION (RAB CAT # WP1H70/PC). DIFFERENT FIXTURE CAN BE USED AT CLIENT REQUEST.

REFERENCES:

CMS-830-07-SD-56014	WALL MOUNTED AREA FIXTURE (WALLPACK)
CMS-830-07-SD-56015	WALL MOUNTED FIXTURE (CONCRETE/MASONRY SURFACE
CMS-830-07-SD-56018	WALL FIXTURE MOUNTED TO STEEL OR ALUMINUM SDG
CMS-830-07-SD-56033	25 FOOT POLE MOUNTED CUTOFF FIXTURE
CMS-830-07-SD-56038	FOUNDATION DETAIL POLE MOUNTED FIXTURE WITH CONDUIT FEED

BILL OF MATERIALS - LIGHTING

ITEM	DESCRIPTION
H1P	MONGOOSE FULL CUTOFF 250W HPS FIXTURE, 120 VOLT, WIDE FLAT GLASS OPTICS, LOW TILT, GRAY, HORIZONTAL MOUNTING, PROTECTED STARTER, TWIST LOCK PHOTOCONTROL RECEPTACLE, WITH LAMP, HOLOPHANE CAT.# 250HP12LWFHGPR LAMP
H8	TWAC SERIES 100W HPS CUTOFF FIXTURE, 120 VOLT, CUTOFF OPTICS, BLACK, PROTECTIVE STARTER, PHOTOCELL, WITH LAMP, LITHONIA CAT # TWAC100S120CM1 PEDBL LP1
H39	SOMERSET HPS CUTOFF FIXTURE, 120 VOLT, PRISMATIC FORWARD THROW, GRAY, PROTECTIVE STARTER, PHOTOCONTROL, GRAY POLE ARM MOUNT, WITH LAMP, HOLOPHANE CAT # SMST15AHP12GRPF PS SMSTARM GR LAMP
LP1	POLE: 1 LUMINAIRE MOUNT, SQUARE STRAIGHT ALUMINUM, 25 FT POLE NOMINAL LENGTH, 110 MPH WINDLOAD, GRAY PAINT FINISH, MONGOOSE SQURE POSTOP ARM, VIBRATION DAMPENER HOLOPHANE CAT. # SSA256GG D1K8 GR4 WITH ANCHOR BOLT SET AB-27-4 AND TEMPLATE TMP-48
LP2	POLE: 2 LUMINAIRE 180° MOUNT, SQUARE STRAIGHT ALUMINUM, 15 FT POLE NOMINAL LENGTH, 110 MPH WINDLOAD, GRAY PAINT FINISH, SOMERSET DRILL PATTERN, VIBRATION DAMPENER HOLOPHANE CAT. # SSA1544C D2R2 GR4 WITH ANCHOR BOLT SET AB-26-4 AND TEMPLATE TMP-41

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

0 25' 50' 100' 150'
SCALE: 1"= 50'

CB&I, Inc.
LA Eng. Firm Reg.-REF.-0003725

COMMONWEALTH OF MASSACHUSETTS
JOSE C. LOPES
ELECTRICAL
No. 47344
REGISTERED
PROFESSIONAL ENGINEER
9-12-2016

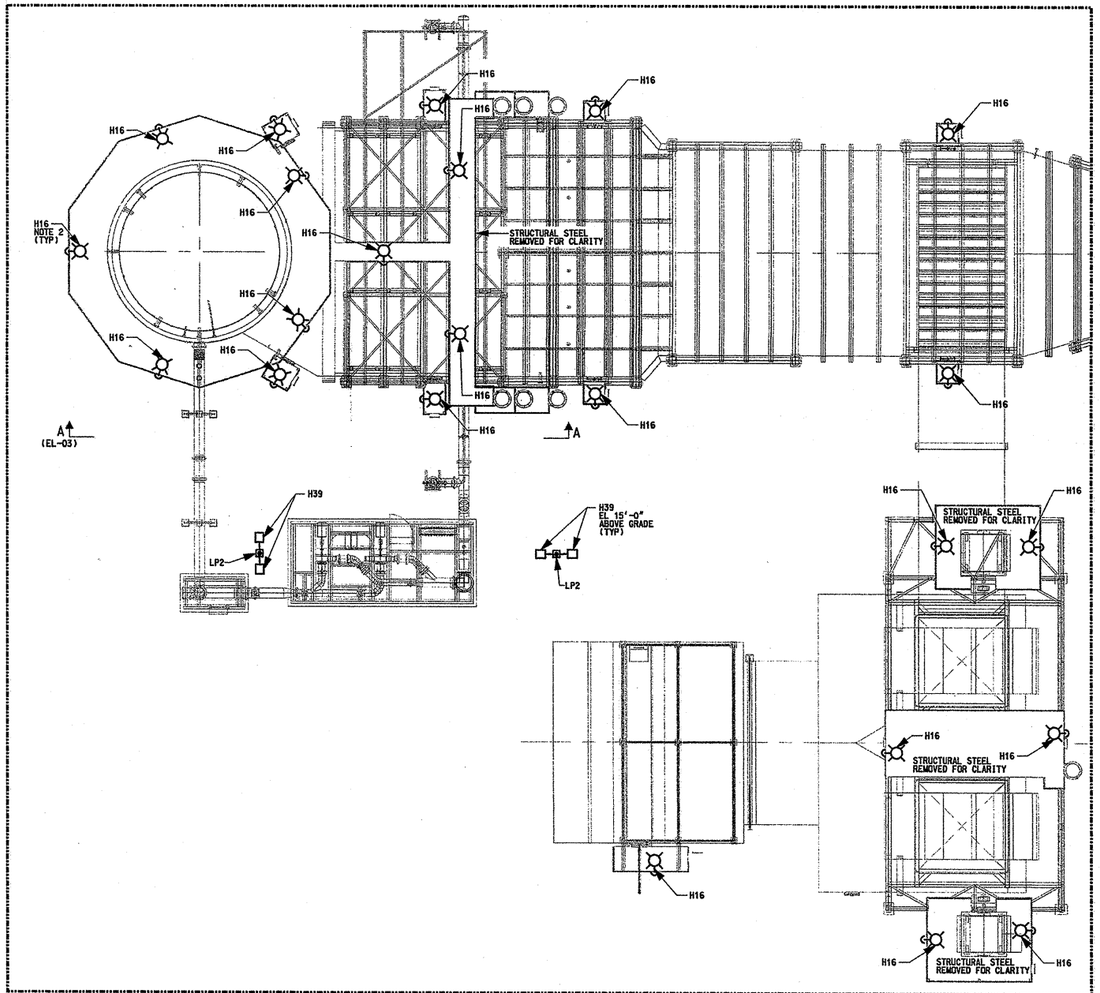
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

ELECTRICAL LIGHTING PLAN
ROADWAY AND
AREA LIGHTING

NO.	DATE	REVISION	BY	CHK.	APP.
A		ISSUED FOR PERMITTING			

DRAWN:		DRAWING NUMBER
CHECKED		149125-EL-001
APPROVED		SHEET:
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1"= 50'-0"	FILE:



PLAN NORTH

NOTES:
1. ALL LIGHTING FIXTURES AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST STANDARDS OF THE NATIONAL ELECTRIC CODE AS ADOPTED BY THE NATIONAL FIRE PROTECTION ASSOCIATION AND/OR STATE AND LOCAL ORDINANCES.
2. ALL STANCHION MOUNTED FIXTURE POLES ARE TO BE SIZED SO THAT THE BOTTOM OF THE FIXTURE IS 8'-0" ABOVE GRATING.

REFERENCES:

CMS-830-07-SD-56017	WALL MOUNTED AREA FIXTURE TO STRUCTURAL STEEL FLANGE
CMS-830-07-SD-56043	STANCHION MOUNTED FIXTURE- METAL RAILING
CMS-830-07-SD-56044	HANDRAIL BRACKET FOR STANCHION MOUNTED FIXTURE (METAL RAILING)

BILL OF MATERIALS - LIGHTING

ITEM	DESCRIPTION
H16	PETROLUX III 50W HPS FIXTURE, 120 VOLT, ENCLOSED POLYMERIC REFLECTOR, GRAY, UNIVERSAL MOUNT, WITH LAMP HOLOPHANE CAT # PWM050HPCG312FDZ UN NA GO P3US LAMP
H39	SOMERSET HPS CUTOFF FIXTURE, 120 VOLT, PRISMATIC FORWARD THROW, GRAY, PROTECTIVE STARTER, PHOTOCONTROL, GRAY POLE ARM MOUNT, WITH LAMP, HOLOPHANE CAT # SMST15AHP12GRPF PS SMSTARM GR LAMP
LP2	POLE: 2 LUMINAIRE 180° MOUNT, SQUARE STRAIGHT ALUMINUM, 15 FT POLE NOMINAL LENGTH, 110 MPH WINDLOAD, GRAY PAINT FINISH, SOMERSET DRILL PATTERN, VIBRATION DAMPENER HOLOPHANE CAT. # SSA1544C D2R2 GR4 WITH ANCHOR BOLT SET AB-26-4 AND TEMPLATE TMP-41

0 5' 10' 20' 30'
SCALE: 1"= 10'

C&I, Inc.
LA Eng. Firm Reg.#EF.0003725

JOSE C. LOPES ELECTRICAL No. 47344 REGISTERED PROFESSIONAL ENGINEER
COMMONWEALTH OF MASSACHUSETTS
9-12-2016

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

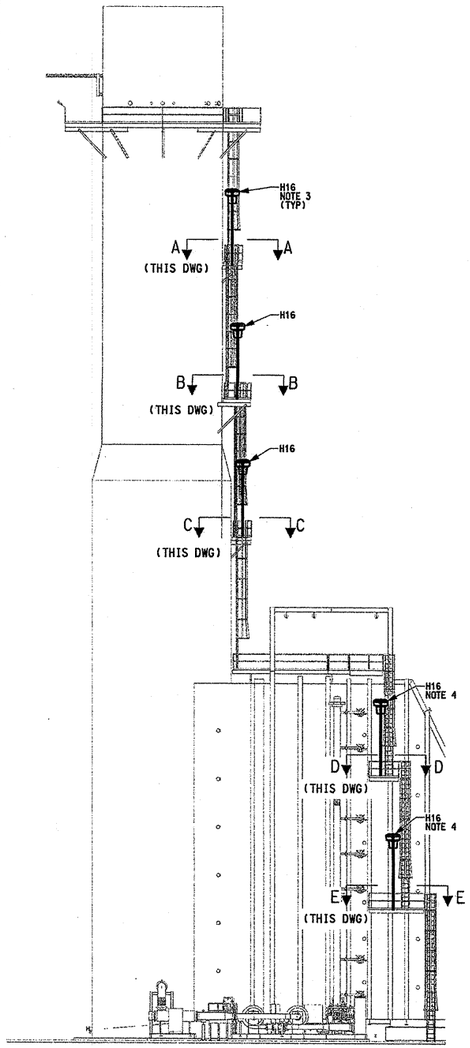
nrg.

ELECTRICAL LIGHTING
ENLARGED PLAN
SCR AREA AND PLATFORMS

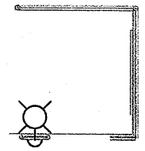
DRAWN:			DRAWING NUMBER
CHECKED			149125-EL-002
APPROVED			SHEET:
SIZE: D 22X34			REV: A
DISCIPLINE:	SCALE: 1"= 10'-0"		FILE:

NO.	DATE	REVISION	BY	CHK.	APP.
A		ISSUED FOR PERMITTING	AKZ	9/13	RMM

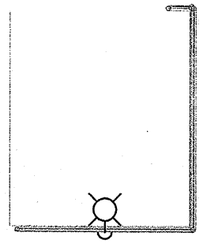
OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL



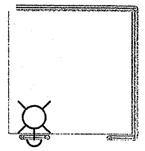
SECTION A-A
LADDER PLATFORMS SCR
(EL-02)
(NOT TO SCALE)



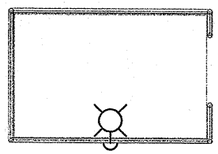
SECTION A-A
THIS DWG
(NOT TO SCALE)



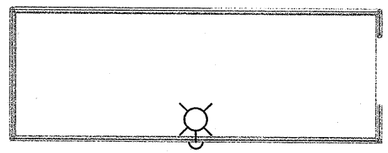
SECTION B-B
THIS DWG
(NOT TO SCALE)



SECTION C-C
THIS DWG
(NOT TO SCALE)



SECTION D-D
THIS DWG
(NOT TO SCALE)



SECTION E-E
THIS DWG
(NOT TO SCALE)

NOTES:

1. ALL LIGHTING FIXTURES AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST STANDARDS OF THE NATIONAL ELECTRIC CODE AS ADOPTED BY THE NATIONAL FIRE PROTECTION ASSOCIATION AND/OR STATE AND LOCAL ORDINANCES.
2. FIXTURES SHOWN ON SCR PLAN DRAWING ARE NOT SHOWN FOR CLARITY.
3. ALL STANCHION MOUNTED FIXTURE POLES ARE TO BE SIZED SO THAT THE BOTTOM OF THE FIXTURE IS 8'-0" ABOVE GRATING.
4. FIXTURE LOCATION IS TYPICAL ON NORTH AND SOUTH SIDE PLATFORMS OF SCR.

REFERENCES:

CMS-830-07-SD-56043	STANCHION MOUNTED FIXTURE- METAL RAILING
CMS-830-07-SD-56044	HANDRAIL BRACKET FOR STANCHION MOUNTED FIXTURE (METAL RAILING)

BILL OF MATERIALS - LIGHTING

ITEM	DESCRIPTION
H16	PETROLUX III 50W HPS FIXTURE, 120 VOLT, ENCLOSED POLYMERIC REFLECTOR, GRAY, UNIVERSAL MOUNT, WITH LAMP HOLOPHANE CAT # PWM050HPCGB12FDZ UN NA GD P3US LAMP

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

CB&I, Inc.
LA Eng. Firm Reg.-REF.-0003725

COMMONWEALTH OF MASSACHUSETTS
JOSE C. LOPES
ELECTRICAL
No. 47344
REGISTERED
PROFESSIONAL ENGINEER

9-12-2016

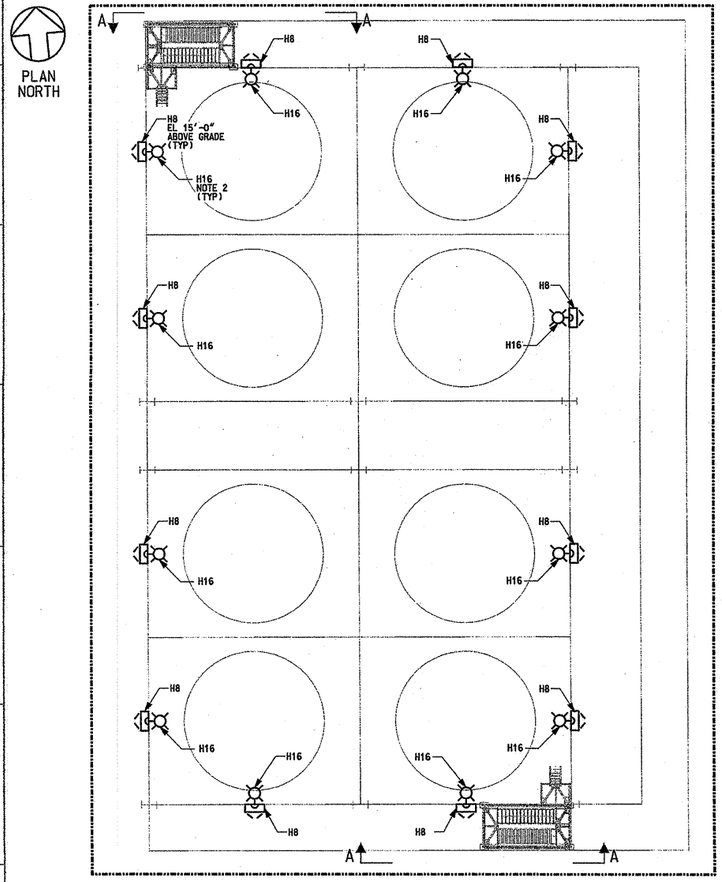
NO.	DATE	REVISION	BY	CHK.	APP.
A		ISSUED FOR PERMITTING			

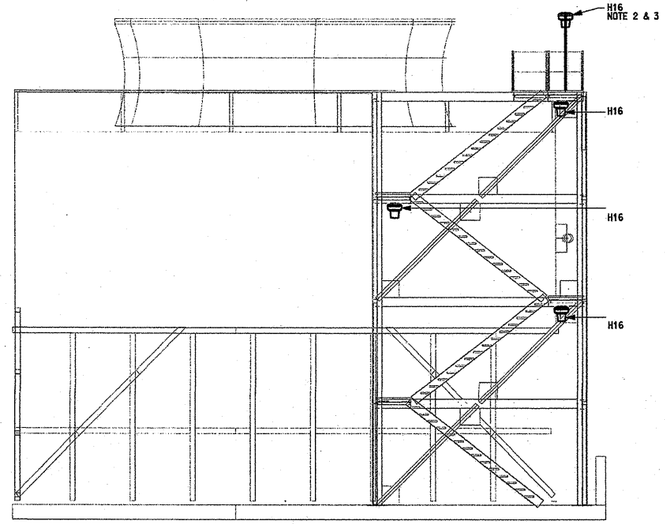
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

ELECTRICAL LIGHTING
SECTIONS
SCR PLATFORMS

DRAWN:		DRAWING NUMBER
CHECKED		149125-EL-003
APPROVED		SHEET:
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: NTS	FILE:





SECTION A-A
COOLING TOWER STAIR TOWER
(NOT TO SCALE)

NOTES:

1. ALL LIGHTING FIXTURES AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST STANDARDS OF THE NATIONAL ELECTRIC CODE AS ADOPTED BY THE NATIONAL FIRE PROTECTION ASSOCIATION AND/OR STATE AND LOCAL ORDINANCES.
2. ALL STANCHION MOUNTED FIXTURE POLES ARE TO BE SIZED SO THAT THE BOTTOM OF THE FIXTURE IS 8'-0" ABOVE GRATING.
3. FIXTURE LOCATION IS TYPICAL ON NORTH AND SOUTH STAIR TOWERS OF COOLING TOWER.

REFERENCES:

CMS-830-07-SD-56018	WALL MOUNTED AREA FIXTURE TO STEEL OR ALUMINUM SIDING
CMS-830-07-SD-56028	CEILING FIXTURE MOUNTING TO STRUCTURAL STEEL
CMS-830-07-SD-56043	STANCHION MOUNTED FIXTURE- METAL RAILING
CMS-830-07-SD-56044	HANDRAIL BRACKET FOR STANCHION MOUNTED FIXTURE (METAL RAILING)
CMS-830-07-SD-56047	EXTERIOR STAIRWELL LIGHTING MULTIPLE LANDINGS

	BILL OF MATERIALS - LIGHTING
ITEM	DESCRIPTION
H8	TWAC SERIES 100W HPS CUTOFF FIXTURE, 120 VOLT, CUTOFF OPTICS, BLACK, PROTECTIVE STARTER, PHOTOCELL, WITH LAMP, LITHONIA CAT # TWAC1OOS120CWI PEDBL LPI
H16	RETROLUX III 50W HPS FIXTURE, 120 VOLT, ENCLOSED POLYMERIC REFLECTOR, GRAY, UNIVERSAL MOUNT, WITH LAMP HOLOPHANE CAT # PWM050HPCGB12FDZ UN NA GD P3US LAMP

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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

NO.	DATE	REVISION	BY	CHK.	APP.
A		ISSUED FOR PERMITTING			

CB&I, Inc.
LA Eng. Firm Reg.REF.0003725

COMMONWEALTH OF MASSACHUSETTS
JOSE C. LOPES
ELECTRICAL
No. 47344
REGISTERED
PROFESSIONAL ENGINEER

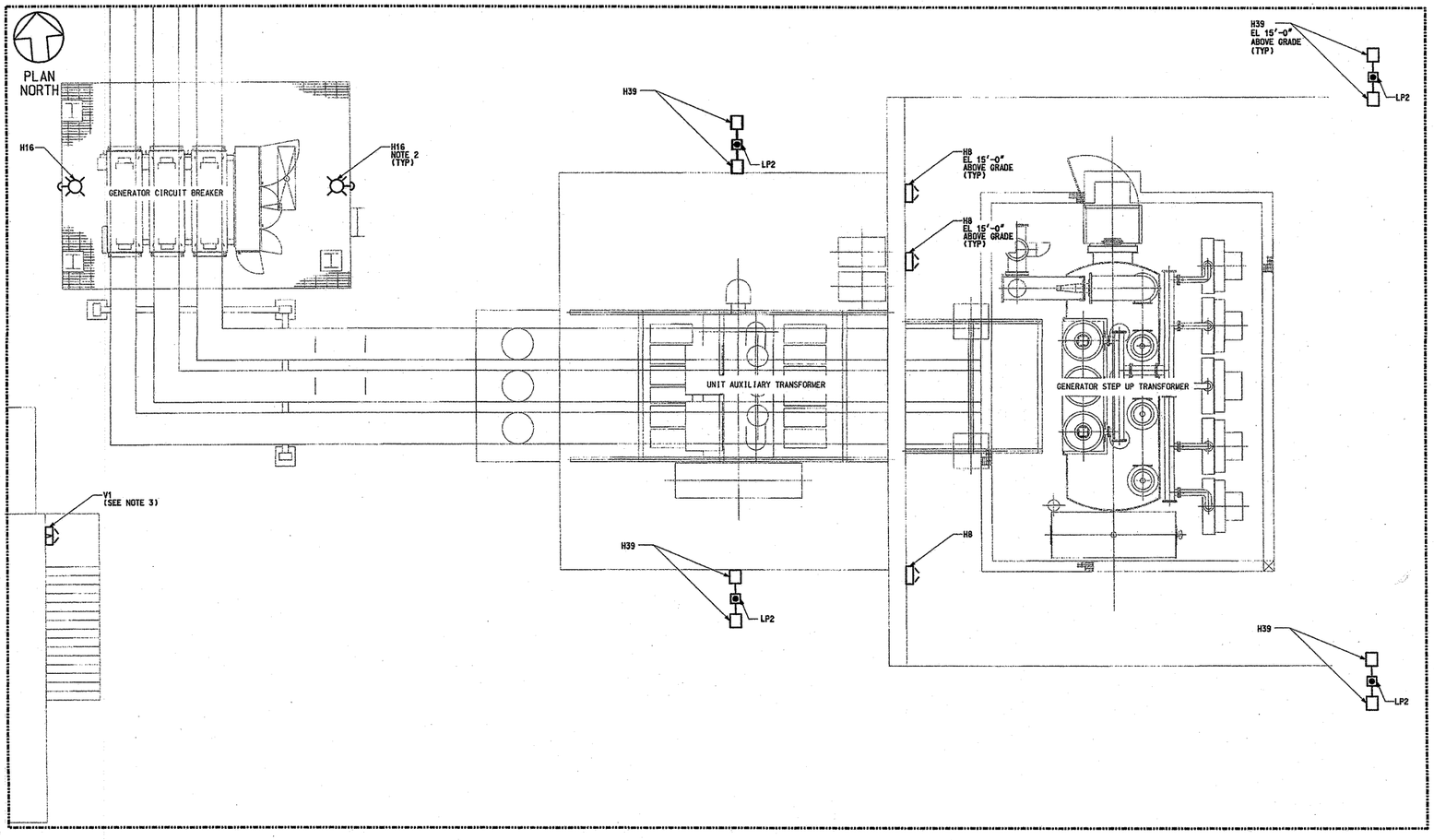
9-12-2016

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

ELECTRICAL LIGHTING
ENLARGED PLAN
COOLING TOWER OUTDOOR LIGHTING

DRAWN:		DRAWING NUMBER
CHECKED		149125-EL-004
APPROVED		SHEET:
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 1/8" = 1'-0"	FILE:



NOTES:

1. ALL LIGHTING FIXTURES AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST STANDARDS OF THE NATIONAL ELECTRIC CODE AS ADOPTED BY THE NATIONAL FIRE PROTECTION ASSOCIATION AND/OR STATE AND LOCAL ORDINANCES.
2. ALL STANCHION MOUNTED FIXTURE POLES ARE TO BE SIZED SO THAT THE BOTTOM OF THE FIXTURE IS 8'-0" ABOVE GRATING.
3. TYPICAL VENDOR SUPPLIED FIXTURE. SEE FIXTURE SPECIFICATION (RAB CAT # WP1H70/PC). DIFFERENT FIXTURE CAN BE USED AT CLIENT REQUEST.

REFERENCES:

CMS-830-07-SD-56016	WALL MOUNTED FIXTURE (CONCRETE/MASONRY SURFACE)
CMS-830-07-SD-56028	CEILING FIXTURE MOUNTING TO STRUCTURAL STEEL
CMS-830-07-SD-56043	STANCHION MOUNTED FIXTURE- METAL RAILING
CMS-830-07-SD-56044	HANDRAIL BRACKET FOR STANCHION MOUNTED FIXTURE

	BILL OF MATERIALS - LIGHTING
ITEM	DESCRIPTION
H8	TWAC SERIES 100W HPS CUTOFF FIXTURE, 120 VOLT, CUTOFF OPTICS, BLACK, PROTECTIVE STARTER, PHOTOCELL, WITH LAMP, LITHONIA CAT # TWAC100S120CWI PEDBL LPI
H16	PETROLUX III 50W HPS FIXTURE, 120 VOLT, ENCLOSED POLYMERIC REFLECTOR, GRAY, UNIVERSAL MOUNT, WITH LAMP HOLOPHANE CAT # PWM050HPCCB12FDZ UN NA GD P3US LAMP
H39	SOMERSET HPS CUTOFF FIXTURE, 120 VOLT, PRISMATIC FORWARD THROW, GRAY, PROTECTIVE STARTER, PHOTOCONTROL, GRAY POLE ARM MOUNT, WITH LAMP, HOLOPHANE CAT # SMST15AHP12GRPF PS SWSTARM GR LAMP
LP2	POLE: 2 LUMINAIRE 180° MOUNT, SQUARE STRAIGHT ALUMINUM, 15 FT POLE NOMINAL LENGTH, 110 MPH WINDLOAD, GRAY PAINT FINISH, SOMERSET DRILL PATTERN, VIBRATION DAMPENER HOLOPHANE CAT. # SSA1544C D2R2 GR4 WITH ANCHOR BOLT SET AB-26-4 AND TEMPLATE TMP-41

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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

CB&I, Inc. LA Eng. Firm Reg.#EF.0003725

COMMONWEALTH OF MASSACHUSETTS JOSE C. LOPES ELECTRICAL No. 47944 REGISTERED PROFESSIONAL ENGINEER

9-12-2016

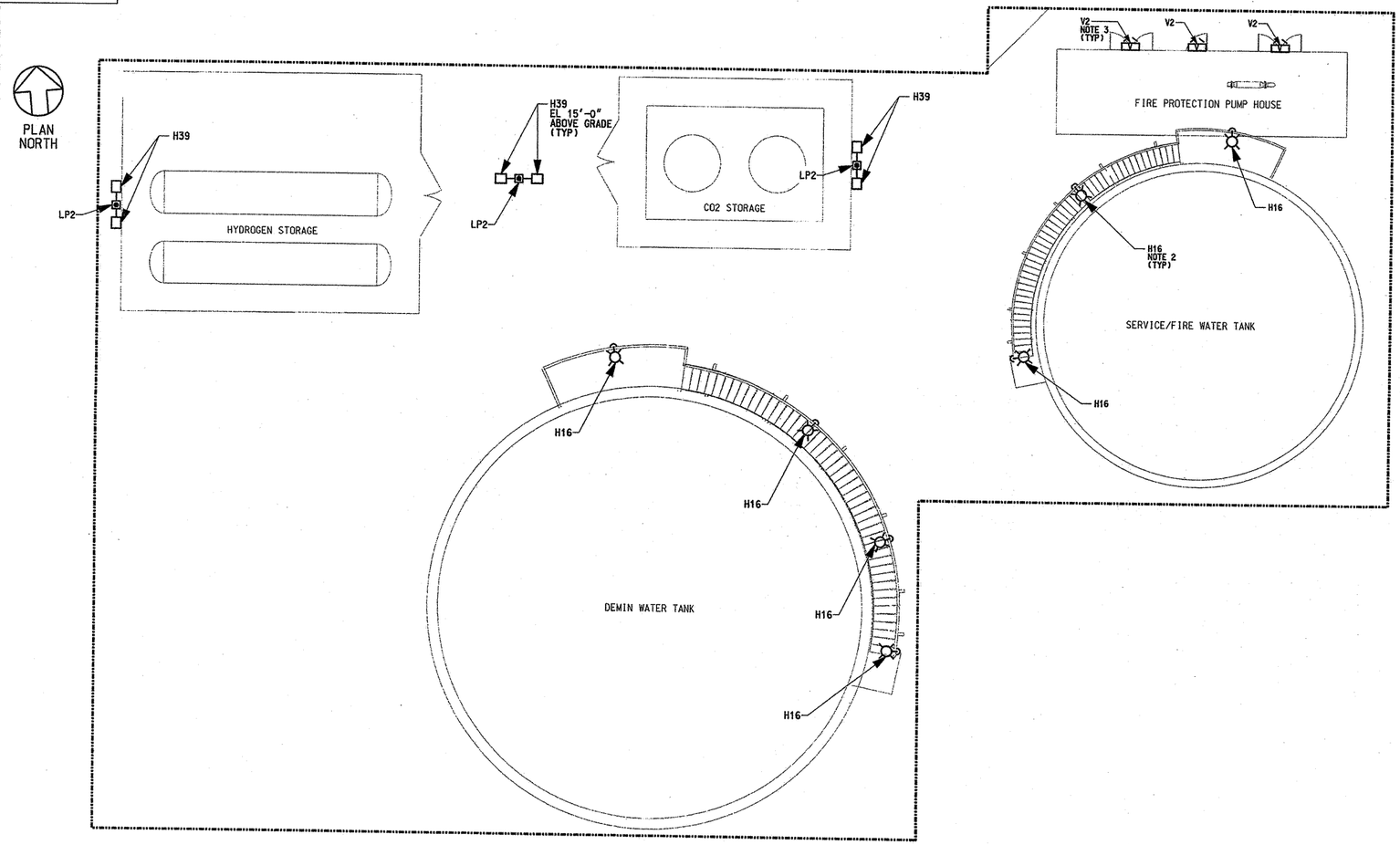
THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

ELECTRICAL LIGHTING
ENLARGED PLAN
TRANSFORMER YARD AREA LIGHTING

NO.	DATE	REVISION	BY	CHK.	APP.
A		ISSUED FOR PERMITTING			

DRAWN:		DRAWING NUMBER
CHECKED		149125-EL-005
APPROVED		SHEET:
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: 3/16" = 1'-0"	FILE:



NOTES:

1. ALL LIGHTING FIXTURES AND MATERIALS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST STANDARDS OF THE NATIONAL ELECTRIC CODE AS ADOPTED BY THE NATIONAL FIRE PROTECTION ASSOCIATION AND/OR STATE AND LOCAL ORDINANCES.
2. ALL STANCHION MOUNTED FIXTURE POLES ARE TO BE SIZED SO THAT THE BOTTOM OF THE FIXTURE IS 8'-0" ABOVE GRATING.
3. TYPICAL VENDOR SUPPLIED FIXTURE. SEE FIXTURE SPECIFICATION (RAB CAT # SLIM18). DIFFERENT FIXTURE CAN BE USED AT CLIENT REQUEST.

REFERENCES:

CMS-830-07-SD-56043 STANCHION MOUNTED FIXTURE- METAL RAILING
CMS-830-07-SD-56044 HANDRAIL BRACKET FOR STANCHION MOUNTED FIXTURE (METAL RAILING)

	BILL OF MATERIALS - LIGHTING
ITEM	DESCRIPTION
H16	PETROLUX III 50W HPS FIXTURE, 120 VOLT, ENCLOSED POLYMERIC REFLECTOR, GRAY, UNIVERSAL MOUNT, WITH LAMP HOLOPHANE CAT # PWM050HPCGB12FDZ UN NA GD P3US LAMP
H39	SOMERSET HPS CUTOFF FIXTURE, 120 VOLT, PRISMATIC FORWARD THROW, GRAY, PROTECTIVE STARTER, PHOTOCONTROL, GRAY POLE ARM MOUNT, WITH LAMP, HOLOPHANE CAT # SNST15AMP12GRPF PS SWSTARM OR LAMP
LP2	POLE: 2 LUMINAIRE 180° MOUNT, SQUARE STRAIGHT ALUMINUM, 15 FT POLE NOMINAL LENGTH, 110 MPH WINDLOAD, GRAY PAINT FINISH, SOMERSET DRILL PATTERN, VIBRATION DAMPENER HOLOPHANE CAT. # SSA1544C D2R2 GR4 WITH ANCHOR BOLT SET AB-26-4 AND TEMPLATE TMP-41

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

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

CB&I, Inc.
LA Eng. Firm Reg.-AEF-0003725

COMMONWEALTH OF MASSACHUSETTS
JOSE C. LOPES
ELECTRICAL
No. 47344
REGISTERED
PROFESSIONAL ENGINEER
9-12-2016

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

nrg.

ELECTRICAL LIGHTING
ENLARGED PLAN
TANK AREA

NO.	DATE	REVISION	BY	CHK	APP.
A		ISSUED FOR PERMITTING			

DRAWN:
CHECKED
APPROVED
SIZE: D 22X34
DISCIPLINE:
SCALE: 1/8" = 1'-0"

DRAWING NUMBER 149125-EL-006
SHEET:
REV: A
FILE:

5.0 SUPPORTING STUDIES, REPORTS OR INFORMATION

5.A DETAILED PROJECT DESCRIPTION

5.A.1 Project Overview

5.A.1.1 Equipment Layout

The proposed Project will occupy approximately 12 acres east of the existing Station. The CTG and associated equipment will be placed on concrete foundations and pads. A site plan and general arrangement, and elevation drawings of the Project are provided in Section 4.0. A computer-generated rendering of the Project's major components is provided as Figure 5.A-1.

The yard area of the Project Site will be finished with crushed stone and native vegetation, as shown on the Project's landscaping plan provided in Section 4.0. A paved perimeter access road will provide routine and emergency access to the Project. The new perimeter road will connect to the internal driveway that currently provides access to the Station. This internal roadway connects, in turn, to Freezer Road. Access to the Project will be controlled via the existing staffed security gate, located off the Property's main access driveway, as shown in Section 4.0.

Ancillary facilities include: an approximately 1,850-foot, three-phase 345-kV overhead transmission line connecting the Project to the adjacent Eversource switchyard; an approximately 3,590-foot on-site natural gas pipeline extending from the existing on-site natural gas meter station to the new gas compressor building; and an approximately 4,000-foot on-site ULSD pipeline connecting the fuel unloading dock, ULSD storage tank, day tank, and the CTG.

5.A.1.2 Process Description

A process flow diagram is provided as Figure 5.A-2. The CTG will have the capability to generate approximately 350 MW[3] using natural gas or ULSD. Thermal energy is produced in the CTG through the combustion of natural gas or ULSD that is introduced into the combustion section of the turbine along with combustion air. Evaporative cooling will be used under certain conditions to cool the ambient air, increasing its density and, in turn, the CTG efficiency and output. The ambient air will then be compressed prior to introduction into the combustion section of the CTG, where the air is mixed with fuel. The combustion results in high-temperature exhaust gases, which are expanded through the turbine, causing the turbine blades and shaft to rotate, converting the thermal energy into mechanical energy, which drives the turbine generator compressor section. A generator is also coupled to the turbine shaft, converting rotational mechanical energy into electrical energy.

The exhaust temperature of the combustion turbine (flue gas) is in excess of 1,100 degrees Fahrenheit (°F). Tempering air will be injected into the flue gas stream to reduce the temperature of the flue gas to approximately 850°F, which is the optimum operating temperature for the SCR and oxidation catalyst to control emissions. During ULSD firing, demineralized water will also be introduced into the combustor to reduce nitrogen oxides (NO_X) emissions. Emissions from the combustion process will be discharged through a 220-foot exhaust stack.

The output of the Project will vary depending on ambient temperature. The lower the ambient temperature, the greater the electrical output. The Project's electrical output will be connected to the electrical grid via the adjacent Eversource 345-kV switchyard.

[3] The gross electrical output of the CTG will vary from approximately 330 MW at higher ambient temperatures to approximately 365 MW at very low temperatures.

The two existing non-potable water supply wells that currently serve the Station (Well Nos. 2 and 3) will supply raw water to the Project and the demineralization system. Demineralized water will be used for control of NO_X emissions during ULSD firing and as combustion turbine wash water. The wash water equipment is used occasionally to keep the compressor section of the CTG clean, which maintains the overall efficiency of the system. Raw water will be used for fire protection as well as makeup to the evaporative inlet air cooling system and general Project service water use.

No new sanitary or process wastewater connection is required for the Project. Demineralizer reject water, plant drains, and other service wastewater discharges will be recycled in a near-zero liquid discharge design. Turbine wash-water will be collected in a 4,000-gallon holding tank before being trucked offsite for disposal. The evaporative cooler blowdown stream that cannot be recycled will be collected in a 20,000-gallon sump and transported offsite for disposal. Floor drains from the Project will go through an oil-water separator; water will be recycled and any oily component will be collected and disposed offsite. No new sanitary wastewater discharges are proposed; all operational staff will use the existing sanitary facilities.

5.A.1.3 Description of Generating Project Systems and Components

The Project will include:

- one GE 7HA.02 CTG, or a comparable turbine;
- an evaporative inlet air cooler;
- tempering air fans;
- SCR system, complete with NH_3 injection skid;
- an oxidation catalyst system;
- a continuous emissions monitoring system (CEMS);
- a 220-foot exhaust stack;
- a three-winding main generator step-up (GSU) transformer;
- an auxiliary transformer; and
- a power distribution center (PDC) and distributed control system (DCS) enclosure.

The Project also will include a number of new ancillary systems and components, including:

- a trailer-mounted demineralized water system;
- an enclosed natural gas compressor station with an associated natural gas pre-heater;
- a 360,000-gallon aboveground fire/service water tank;
- a 1,000,000-gallon aboveground demineralized water storage tank;
- a 20,000-gallon underground wastewater holding sump;
- a 4,000-gallon turbine wash-water holding tank;
- hydrogen (H_2) and carbon dioxide (CO_2) storage cylinders and associated piping;
- a 500-kilowatt (kW) emergency diesel generator;
- two emergency fire pumps; and
- a perimeter access road.

The Project will include a new stormwater management system and stormwater will be collected and routed to three infiltration basins on the Project Site; the basin outlets will connect to the existing pipe network and discharge via existing outfalls. The north basin will tie into an existing drain line that will continue to convey flows to the Station's cooling water discharge flume and eventually to the Cape Cod Canal via an existing outfall. The central basin and the south basin will outlet to an existing drain line in the western access road where flows will continue to be conveyed to the wetland system south of the railroad ROW. No new point sources are proposed, as all three basins will tie into the existing stormwater infrastructure.

Natural gas will be supplied from a new connection to the existing on-site meter station for the AGT natural gas pipeline. ULSD will be stored in an existing 5,700,000-gallon aboveground storage tank and associated

1,800,000-gallon day tank; both tanks currently hold No. 6 fuel oil and will be converted to hold ULSD prior to Project operation. Two existing fully diked aqueous NH_3 storage tanks with a combined capacity of 120,000 gallons will provide NH_3, the reagent for the SCR system. A new structure will be constructed to enclose the NH_3 tanks.

5.A.1.4 Combustion Turbine Generator

The Project will include a GE 7HA.02 CTG, or comparable unit. The two main components of the CTG are the combustion turbine and the generator. Other key components include: the vent fan maintenance platform; the fuel gas scrubber package; the water wash skid; the lube oil module; the inlet filter housing and ducting; and the combustion turbine control system.

The CTG is composed of the compressor, the combustor, and the power turbine, which are described below.

- In the compressor section, ambient air is drawn through a filter (and under certain meteorological conditions, an evaporative cooler) to clean (and cool) the air. The air is then compressed and directed to the combustor section.
- In the combustor section, fuel is introduced and combusted. Hot gases from the combustion are diluted with additional air from the compressor section and directed to the power turbine section at high temperature. When the Project is firing ULSD, water is also injected for NO_X control.
- In the power turbine section, the hot exhaust gases expand and rotate the turbine blades, which are coupled to a shaft. The rotating shaft drives the compressor and the generator, which generates electricity.

The electrical output of the CTG varies with temperature. The lower the temperature (and thus, density) of the combustion air, the higher the electrical output. In warm weather, an evaporative cooler is utilized to cool the combustion air in order to achieve greater efficiency and electrical output.

The gross electrical output of the CTG will vary from approximately 330 MW at higher ambient temperatures to approximately 365 MW at very low ambient temperatures. The net electrical output of the CTG will be slightly less due to use by auxiliary equipment associated with the Project.

Evaporative Air Cooling

Under warm conditions, cooling the inlet air can increase the efficiency and output of the CTG. Evaporation of water is one of the simplest and most proven methods of cooling air. Evaporative coolers consist of recirculated water sprayed over an extended surface media mounted downstream from the inlet air filters. As inlet air passes through the media, evaporation occurs, cooling takes place, and the water vapor content of the air approaches saturation. Cooling increases the density of the air, which in turn increases the mass flow and electrical output of the CTG.

Exhaust Stack

The exhaust stack releases the products of combustion to the atmosphere after passing through the SCR for NO_X control and the oxidation catalyst for control of carbon monoxide (CO) and volatile organic compounds (VOC). The temperature of the exhaust from the stack will be approximately 750°F. The exhaust stack will be constructed of steel and is proposed to be 220 feet tall, with a 25-foot diameter. With the base of the exhaust stack proposed at 16 feet North American Vertical Datum of 1988 (NAVD88), the top of stack is proposed at elevation of 236 feet NAVD88.

A galvanized ladder and platforms will be included for stack testing and maintenance of the CEMS. The exhaust stack will be equipped with medium-intensity flashing white aviation obstruction lighting, as required by the Federal Aviation Administration (FAA). An employee-protection screen will be installed at the base of the exhaust stack to prevent any accidental contact with the hot stack surface. An elevation view of the

exhaust stack in relation to the adjacent existing power plant equipment and the Project's other equipment is shown in the Site Development Plan provided in Section 4.0.

Additional Equipment and Systems

The following sections describe the major additional equipment and systems associated with the Project, which are shown on Figure 5.A-1.

Natural Gas Compressor

The CTG requires natural gas to be at a pressure between 535 pounds per square inch gauge (psig) and 605 psig. There are times when the pipeline natural gas pressure falls below this range, requiring the natural gas compressor to be used to maintain the required pressure.

The natural gas compressor consists of a positive displacement compressor with associated auxiliary equipment and systems. The compressor is run by a fixed-speed motor and associated gearbox.

Natural Gas Pre-Heater

An electrically powered natural gas (dew point) heater will be used to maintain natural gas above its dew point temperature prior to introduction to the CTG. Heating the natural gas above its dew point temperature prevents the natural gas from condensing into a liquid due to a change in temperature or pressure.

Emergency Diesel Generator

The purpose of the emergency diesel generator is to provide power to critical services of the Project in the event of a power failure, including the distributed control system, combustion turbine turning gear, combustion turbine lube oil pumps, lighting, and communication systems. The emergency diesel generator will have an output of approximately 500 kW.

Compressed Air System

The compressed air system will provide compressed air to various equipment proposed as part of the Project, primarily instrumentation and controls. The compressed air system includes two air compressors, an air receiver tank and two air dryers. The air receiver tank serves as a reservoir of compressed air, while the air dryers are used to keep the air above the dew point temperature, avoiding moisture condensation.

Cooling Fan Module

The cooling fan module discharges heat generated from the operation of auxiliary equipment. The cooling fan module is similar to an automobile radiator and utilizes air-cooled heat exchange technology. Heat from the auxiliary equipment is transferred to a mixture of water and propylene glycol. This liquid is then pumped to the cooling fan module where fans blow air over a series of tubes that contain the hot liquid, transferring the heat to the atmosphere. The cooled liquid is then returned to the equipment, creating a continuous process of transferring heat.

Service/Fire Water Storage Tank

The 360,000-gallon aboveground service/fire water storage tank will be a welded or bolted tank constructed of carbon steel with an internal protective coating. Raw water from the existing water supply wells (Well Nos. 2 and 3) will be pumped to the tank for storage. The tank provides makeup water to the demineralized water treatment system, evaporative inlet air cooler, and general Project service water uses. A portion of the tank will be reserved for fire protection.

To ensure that fire water is always available, a tap at the lower portion of the tank will be devoted to fire water. A tap at a higher elevation on the tank, above the volume for the fire water, will be devoted to service water. The fire protection portion of the tank capacity will be sufficient to supply simultaneously the largest

fire extinguishing system plus 500 gallons per minute (gpm) for hose stream demand for a duration of two hours.

Fire Protection and Detection System

A complete and integrated fire protection and detection system will be provided for the Project for effective detection, warning (alarm), and extinguishing of fires. This system will consist of: fire hydrants served by an underground yard distribution system; water-based fire suppression systems; portable fire extinguishers; fire pumps; and a water mist-based dedicated combustion turbine fire protection package. The fire protection system will be engineered and designed in accordance with the requirements of the National Fire Protection Association (NFPA) codes and all applicable local codes and regulations.

Fire Pumps

Two fire pumps will be provided to ensure 100 percent (%) backup of the fire protection system water supply. Each pump will be capable of delivering total system requirements at design pressure and flow rate with any one pump out of service. One fire pump will be driven by a 100-horsepower (hp) electric motor and the other will be driven by a 135-hp ULSD-fired engine.

Both fire pumps will be housed in the service/fire water pump house, shown on Figure 5.A-1. Power for the electric motor-driven fire pump will be supplied through the normal plant power supply. ULSD for the diesel engine-driven fire pump will be stored in a dedicated tank adjacent to the pump. The fire pumps, fire pump controllers, and auxiliary equipment will conform to NFPA Standard No. 20.

Underground Fire Water Distribution System

The underground fire protection water distribution system will be provided and installed in conformance with the requirements of NFPA Standard No. 24 and will extend to all operating areas with a looped configuration to provide multi-directional supply to maintain high reliability. Each fire pump will have an independent connection to the loop. Post-indicating valves will be provided in the distribution system for adequate isolation of branch lines. Dry barrel-type fire hydrants will be provided along the distribution system at approximately 250-foot intervals.

Fire Suppression Systems

The gas compressor building will be protected by a sprinkler system that will comply with the requirements of NFPA Standard No.13. The system will be designed for automatic actuation utilizing heat detectors or through manual actuation by a local push-button station, and will initiate local alarms and remote alarms at the main fire control panel in the main control room.

The service water/fire water pump house will be protected by automatic wet pipe sprinkler systems that will comply with the requirements of NFPA Standard No. 13. Upon sprinkler activation, water will immediately flow through the alarm check valve and initiate local alarms and remote alarms at the main fire control panel in the main control room.

Combustion Turbine Fire Extinguishing Systems

The CTG enclosures will be provided with pre-engineered self-contained fire suppression systems furnished by the CTG supplier. Fire suppression systems will be initiated by heat detectors. In addition, gas detectors will monitor the natural gas concentration within the enclosures. Fire suppression and gas detection systems will be monitored in the control room on the main fire control panel.

Oil-Insulated Transformers

Oil-insulated transformers will be separated from each other and from adjacent structures by two-hour fire walls. All oil-containing transformers will be located within concrete secondary containment areas, sized for greater than the full capacity of the transformer oil.

Fire Detection and Alarm Systems

Fire detection, alarm, actuation, and signaling systems will be designed in accordance with NFPA Standard Nos. 70 and 72. A main fire control panel will be provided in the main control room, which will monitor the condition of all fire alarm and detection circuits, local panels, status of fire pump, and suppression system operation and readiness. The main fire control panel and all local fire control panels will be provided with emergency power upon loss of normal power.

Portable Fire Extinguishers

Portable fire extinguishers of dry chemical and CO_2 type will be provided throughout the Project Site and will be UL-listed and/or FM-approved and will be labeled accordingly. Extinguishers will be provided in readily accessible locations in conformance with NFPA Standard No. 10.

H_2 and CO_2 Tanks

H_2 is used to cool the generator. H_2 gas is circulated in a closed loop within the generator to remove heat from its active parts; then it is cooled by heat exchangers. CO_2 is utilized to purge the H_2 from the generator cooling system safely when access is required for maintenance.

H_2 and CO_2 will be stored in cylinders at protected locations on the Project Site, as shown on Figure 5.A-1.

Project Water Supply

Water will be supplied from the two on-site non-potable production wells currently serving the Station. These wells are adjacent to each other and located west of the proposed Project Site. Withdrawals from Well Nos. 2 and 3 are authorized under the Station's existing Water Management Act (WMA) Registration, and the total cumulative water withdrawal will remain within the currently authorized limits.

Well No. 2 was installed in 1966 and advanced to 117 feet below ground surface (bgs) (RE Chapman, 1966) using 8-inch steel casings. An 8-inch telescoped stainless steel screen was set between approximately 96 and 117 feet bgs, with a variable screen slot size. Well No. 3 was installed in October of 1974. Well No. 3 was advanced to 110 feet bgs and is set in the same water-bearing unit as Well No. 2 (RE Chapman, 1974). The Well No. 3 boring log indicates the well was advanced using 12-inch steel casings through approximately 50 feet of hard-packed material (hardpan) with boulders; below this depth was a unit of gravel, sand, and boulders. The construction records for Well No. 3 indicate the 8-inch well is screened from 90 to 110 feet bgs with a Johnson stainless steel screen using a variable slot size. This screen is welded to the casing and the screen is packed with Cape May #2 gravel. Well construction logs are provided in Attachment 5.A-1.

Well Nos. 2 and 3 are each equipped with high-capacity submersible turbine pumps. Well No. 2 pump is a two-stage, 10-hp vertical turbine bowl, with a capacity of 281 gpm. Well No. 2 pump is set 80 to 86 feet bgs. Well No. 3 pump is a three-stage, 15-hp vertical turbine bowl, with capacity of 380 gpm. Well No. 3 pump is set 63 to 68 feet bgs. A 1974 pump test documented the combined capacity of Well Nos. 2 and 3 at 535 gpm.

Water from Well Nos. 2 and 3 will be pumped and stored in the 360,000-gallon service/fire water storage tank. The tank has been sized to meet the fire water requirements for the Project and to provide water to the demineralized water treatment system, evaporative cooler makeup, and for general Project service water use.

Service water will be conveyed from the service/fire water storage tank to the demineralization system. The demineralization system will be a portable, trailer-mounted system. The water treatment system will include a strong acid cation exchanger, strong base anion exchanger, and mixed bed polisher. When exhausted, the demineralization trailers will be removed from service and replaced with recharged trailers. The exhausted trailer systems will be recharged off-site, which results in no liquid or solid waste being generated

onsite from either the operation or the recharging of the demineralization system. The effluent from the demineralized water system will discharge from the mixed bed polisher to the 1,000,000-gallon demineralized water storage tank. Demineralized water is conveyed from the demineralized water storage tank to the combustion turbine for NO_X control during ULSD-firing, evaporative cooling for efficiency during natural gas-firing, and occasional CTG washing.

Project Wastewater

The Project will employ a near-zero liquid discharge design and have no direct discharge of liquid waste streams to the environment. Liquid process waste streams not treated and recycled on-site will be collected and trucked off-site for treatment and/or disposal.

The turbine and compressor will require periodic cleaning with demineralized water and detergent to remove deposits from the compressor and turbine blades. This wastewater, along with turbine startup drains, will be collected in the 4,000-gallon underground wash-water holding tank and periodically trucked off-site for disposal.

Evaporative cooler blowdown will be minimized by optimizing the operating cycles of concentration, while following the turbine vendor guidelines for circulating water quality. This high total dissolved solids waste stream will be collected in the 20,000-gallon underground wastewater holding sump and trucked off-site for disposal.

Process drains and wash-down water within the power block area will be collected and conveyed to an oil/water separator. The accumulated oil will be trucked off-site for disposal. The treated effluent will be chemically conditioned with a coagulant (alum) and filtered using cartridge type filters to remove any residual oil and grease. The filtered effluent will discharge to the service/fire water storage tank for re-processing.

The Project will use existing sanitary facilities located in the existing Training Building, as shown on Figure 5.A-1. No additional sanitary facilities are proposed for the Project. The existing domestic waste system collects discharge from sinks, toilets, and other sanitary facilities, and discharges to the existing sanitary sewer collection system, which consists of septic tanks and a leach field. The amount of domestic water used and sanitary wastewater generated by the proposed Project will be minimal compared to the volume consumed and generated by existing operations. Therefore, no modifications to the existing septic system are anticipated.

Air Pollution Control Systems

The Project will incorporate state-of-the-art control technology, resulting in extremely low emissions. A summary of the emissions controls incorporated in the Project is provided below.

The Project's NO_X emissions will be controlled through the use of dry-low-NO_X (DLN) burners and an SCR system. NO_X is formed in any combustion process from the oxidation of elemental nitrogen (N_2) in either the fuel or in the combustion air (the Earth's atmosphere is approximately 78% N_2). Both natural gas and ULSD have very low concentrations of N_2 in the fuel. Therefore, most of the NO_X from CTGs is "thermal NO_X," formed from the oxidation of N_2 in the combustion air.

The DLN burners will utilize a lean-burn technology with fuel-to-air ratios below stoichiometric values. This process will limit the formation of thermal NO_X by lowering the flame temperature. During ULSD firing, demineralized water will be injected into the combustion chamber to lower the flame temperature and associated thermal NO_X formation.

After leaving the CTG, the exhaust temperature will be in excess of 1,100°F. Tempering air fans will blow ambient air into the exhaust gas stream downstream of the CTG to reduce the temperature of the flue gas

to approximately 850°F to achieve the optimum operating temperature for the SCR and oxidation catalyst system to control emissions.

The exhaust will next pass through the oxidation catalyst system, which will control emissions of CO and VOC. Oxidation catalysts work very similarly to the catalytic converter on an automobile, by oxidizing any products of incomplete combustion. The oxidation catalyst will consist of a platinum coating on a ceramic base. The exhaust gases will flow through the catalyst bed where excess air will oxidize CO to CO_2 and VOC to water vapor (H_2O) and CO_2.

After passing through the oxidation catalyst, and before passing through the SCR, an NH_3 injection grid will be utilized to inject NH_3, the chemical reagent used by the SCR, to control NO_X. The Project will use aqueous NH_3 (19%) from the existing storage tanks, which have a combined capacity of 120,000 gallons. The existing tanks are located within secondary containment on the Project Site and are equipped with other safety features.

The exhaust gas and NH_3 mixture will then pass through the SCR system. SCR catalysts are made from various ceramic materials, such as titanium oxide, coated with active catalysts, usually either oxides of base metals (such as vanadium, molybdenum, and tungsten), zeolites, or various precious metals. The SCR catalyst will facilitate a chemical reduction (opposite of oxidation) reaction between the NO_X in the exhaust stream and the NH_3 to form elemental N_2 and H_2O.

After passing through the SCR system, the exhaust gases will be directed to the stack. The exhaust stack will be equipped with a CEMS. In the CEMS, a small sample of flue gas will be extracted by a pump into the CEMS via a sample probe. The sample will be transported through a sample line to a manifold, which will distribute the sample to individual analyzers to monitor concentrations of NO_X, CO, oxygen (O_2), and opacity. A data acquisition and handling system will receive the signal output from each analyzer in order to collect and record emissions data. The measured concentrations are continuously monitored in the control room, and an alarm will be triggered if concentrations approach or exceed permit levels.

Proposed Fuel Use

The Project will be designed to generate electricity using natural gas as the primary fuel; ULSD will be used as a back-up fuel. To ensure system reliability the Project is requesting approval to operate up to a total of 4,380 hours per year, with no more than 720 hours per year of ULSD firing.

5.A.1.5 Interconnections

The proposed utility interconnections for the Project are described in this section.

Electric Interconnection

The Project will interconnect with the electrical grid via the existing Eversource 345-kV switchyard, located south of the Property, across the Cape Cod Central Railroad ROW. An approximately 1,850-foot, three-phase 345-kV overhead circuit will be connected from a circuit breaker at the GSU transformer to the Eversource switchyard, as shown on Figure 5.A-3.

Figure 5.A-4 provides a cross-sectional view of the conductor arrangement. The proposed phase conductor is Drake 795 thousand circular mils (kcmil), 1.107-inch diameter, 345-kV, 907-ampere (A) conductor. An optical ground wire (OPGW) shield wire with a diameter of 0.5 inches will be installed on top of the transmission line pole.

The generator will produce approximately 425 mega-volt amperes at 25 kV. This power will then proceed to the GSU transformer where the voltage will be stepped up to 345 kV. The 345-kV power will then be routed to the Eversource switchyard. New equipment to be added within the Eversource substation includes:

- a 3,000-A disconnect switch (with ground switch);
- an overhead rigid bus from the existing bus to the disconnect switch;
- three capacity voltage transformers for metering purposes;
- bus support insulators;
- gateway bridge structures;
- terminal structure string insulators; and
- a riser cable from the disconnect switches to the bridge structure.

A simplified one-line diagram of the transmission line and substations with breaker configuration is shown on Figure 5.A-5. The design of the transmission line will comply with all applicable electrical codes.

Natural Gas Pipeline Interconnection

Natural gas for the proposed Project will be delivered via the existing AGT pipeline that currently serves the existing Station. A new 3,590-foot on-site natural gas pipeline will be constructed from the existing natural gas meter station on the Property to the new gas compressor building, as shown on Figure 5.A-3.

ULSD Interconnection

There are several existing aboveground No. 6 fuel oil tanks located on the Property that are used to support the existing Station. One of the storage tanks and one of the day tanks will be refurbished and converted to store ULSD for the proposed Project. The existing storage tank has a diameter of 125 feet, a height of 64 feet, and an approximate storage capacity of 5.7 million gallons. The existing day tank has a diameter of 80 feet, a height of 48 feet, and an approximate storage capacity of 1.8 million gallons. Both tanks are equipped with secondary containment.

ULSD will be transported to the Project by barge, using the same delivery practices as used for the existing Station. An additional unloading pipe will be constructed parallel to the existing refueling pipes to deliver ULSD for the proposed Project. As shown on Figure 5.A-3, ULSD will be transferred from the storage tank to the day tank to the combustion turbine via a new approximately 4,000-foot pipeline.

Water Supply and Wastewater Interconnections

The cumulative process water demand for the Project and the existing Station will be met using two existing groundwater wells on the Property (Well Nos. 2 and 3), located adjacent to the Project Site. Potable water will continue to be supplied by the Sandwich Water District. No significant increase in potable water demand will result from the Project. Therefore, no new offsite water interconnections will be required.

Direct discharge of wastewater has been avoided by employing a near-zero liquid discharge design. Any liquid process streams that cannot be treated and recycled on-site (e.g., turbine wash water, evaporative cooler blowdown) will be collected and trucked off-site for treatment and disposal. As a result, there will be no new offsite wastewater interconnections.

The Project will use existing sanitary facilities located in the Training Building. No additional sanitary facilities are proposed for the Project.

5.A.2 Summary of Permitting Requirements and Compliance with Local Bylaws and Regulations

The federal, state, and local permits and approvals, notifications and consultations necessary for the development, construction, and operation of the Project are listed in Table 5.A-1.

Table 5.A-1: Required Environmental Permits and Approvals

Issuing Agency	Permit	Status
Federal Approvals		
FAA	Notice of Construction or Alteration	Submitted on December 9, 2015; FAA determination of no hazard received on January 27, 2016
United States Environmental Protection Agency (USEPA)	National Pollutant Discharge Elimination System Stormwater Permits (construction and operation)	To be filed
State Approvals		
Energy Facilities Siting Board (EFSB)	Approval of Petition to Construct Generating Facility	Petition submitted on December 3, 2015
Department of Public Utilities (DPU)	Petition for a Zoning Exemption	Petition submitted on December 15, 2015
Executive Office of Environmental Affairs	Massachusetts Environmental Protection Act (MEPA) Approval	An EENF was filed on July 31, 2015; the Secretary's Certificate was issued on September 18, 2015 A DEIR was filed on March 11, 2016; the Secretary's Certificate was issued on April 29, 2016 A FEIR was filed on July 15, 2016; the Secretary's Certificate was issued on August 26, 2016.
Massachusetts Department of Environmental Protection's (MassDEP)/Bureau of Waste Prevention – Air Quality	New Source Review/Major Comprehensive Plan Approval (MCPA)	Application filed on February 17, 2016
	Federal Prevention of Significant Deterioration (PSD) Permit	Application filed on February 17, 2016
MassDEP/Division of Water Quality	Water Quality Certification (integrated in other approvals)	To be filed
MassDEP/Division of Waterways	Chapter 91 License modification	To be filed
MHC	Cultural resources consultation	Project Notification Form submitted on July 29, 2015; MHC Response received October 2, 2015
Massachusetts Division of Fisheries and Wildlife (MassDFW) Natural Heritage and Endangered Species Program	Protected species consultation	Massachusetts Endangered Species Act Request Form filed July 27, 2015; MassDFW response received August 28, 2015
Regional/Local Approvals		
Cape Cod Commission (CCC)	Development of Regional Impact Review	Filed on September 23, 2016.

Issuing Agency	Permit	Status
Town of Sandwich Old King's Highway Historic District Committee	Certificate of Appropriateness	To be filed
Sandwich Conservation Commission	Order of Conditions under Massachusetts Wetlands Protection Act (WPA) and Sandwich Wetlands Protection Bylaw	To be filed

The Project has been designed to comply with local regulations, and will meet applicable Sandwich bylaws, as described below.

5.A.2.1 Town of Sandwich Wetlands Bylaw

The only Sandwich Wetlands Bylaw jurisdictional wetland on the Project Site is Land Subject to Coastal Storm Flowage (LSCSF). The portions of the three wetlands (Wetlands A, B and C) subject to protection under the Massachusetts Wetlands Protection Act located on the Station Property are also jurisdictional under the Sandwich Wetlands Bylaw. South of the Station Property, Wetland F, which will be crossed by the electric transmission interconnection line, is also jurisdictional under the Massachusetts Wetland Protection Act and the Sandwich Wetlands Bylaw.

The Massachusetts Wetlands Regulations do not specify performance standards for LSCSF. Because the Project Site is located in a coastal environment and drains to the ocean, fill within the 100-year flood zone is not subject to a requirement to provide compensatory flood storage as would be the case in inland areas. In order to minimize potential impacts from coastal storms, the Project has been designed so that buildings and ancillary structures will be elevated 2.3 feet above the existing 100-year flood zone, to a minimum elevation of 16 feet NAVD88.

No long-term permanent impacts to resource areas that require mitigation will result from construction of the Project. Temporary impacts during construction will be mitigated through the implementation of the Project's Storm Water Pollution Prevention Plan (SWPPP).

5.A.2.2 Town of Sandwich Stormwater Management Bylaw

Per Section 7.20 Part 2 of the Town of Sandwich Stormwater Management Bylaw: "The Commission may, at its discretion, accept as the application and plans under this bylaw the Notice of Intent and plans filed under the Wetlands Protection Act, Massachusetts General Laws, Chapter 131, Section 40." The submitted Notice of Intent must meet the Commission's Burden of Proof requirement (Section 7.60) and demonstrate that the proposed Project, including stormwater discharges, will not have an unacceptable significant and cumulative effect upon the values of wetlands, related water resources, and adjoining land areas resources.

The submitted Notice of Intent will meet the Commission's Burden of Proof requirement (Section 7.60), demonstrating that the proposed Project, including stormwater discharges, will not have an unacceptable effect on any of the following: wetlands; public or private water supply; groundwater; flood control; erosion and sedimentation control; storm damage prevention; water pollution; fisheries; shellfish; wildlife habitat; recreation; agriculture; and aquaculture resources (Section 7.00).

5.A.2.3 Town of Sandwich Noise Bylaw

The Town of Sandwich Bylaws (Section 3.55 Noise) include a noise nuisance clause and an accompanying complaint resolution procedure, but do not stipulate numerical decibel (dB) limits. Construction activity is separately regulated through restrictions on construction hours, which are limited to 7 a.m. to 8 p.m., except as allowed by permit.

To comply with the noise nuisance clause, construction will occur between 7 a.m. and 7 p.m., except as other hours are allowed by permit. A noise complaint hotline will be made available to address any noise-related issues during Project construction.

5.A.2.4 Town of Sandwich Zoning Bylaw Noise Ordinance

The Town of Sandwich Zoning Bylaw (Section 3420 Noise) limits construction hours to between 7 a.m. and 7 p.m., except as allowed by permit. No numerical dB limits apply to construction activity.

Construction equipment used on the Project Site will comply with the construction-hour limits specified in the Town of Sandwich Zoning Bylaws. Per the Bylaw, construction will occur between 7 a.m. and 7 p.m., except as other hours are allowed by permit from the Town.

5.A.3 Project Impacts

5.A.3.1 Land Alteration

The Project has minimized the creation of impervious area and will reduce the amount of impervious area on the Project Site from existing conditions. Portions of the Project Site will be raised to an elevation above the 100-year floodplain (plus consideration of future sea level rise), which will require importing approximately 43,000 cubic yards of fill either stockpiled on the current Property or from off-site sources.

5.A.3.2 Air Quality and Greenhouse Gases

The Project will use advanced emissions control equipment and a high-efficiency combustion turbine to minimize emissions and air quality impacts. The Project will be dual fueled, firing primarily natural gas with ULSD as a backup. The Project will employ stringent emission controls that fully meet New Source Performance Standards (NSPS), Best Available Control Technology (BACT), and Lowest Achievable Emissions Rate (LAER) requirements.

Since the proposed Project is a modification of the existing Station, an air quality modeling analysis was conducted to ensure that the combined emissions from the existing Station and the proposed new Project will not cause or contribute to a violation of National Ambient Air Quality Standards (NAAQS) or Massachusetts Ambient Air Quality Standards (MAAQS). The predicted total ambient criteria pollutant concentrations (modeled contributions from the existing Station, plus the proposed Project, plus existing ambient background levels) are below the NAAQS and MAAQS for all pollutants. As such, no significant adverse impact to air quality would be expected to occur. Further, by complying with Prevention of Significant Deterioration (PSD) Increments, no appreciable degradation in existing air quality would be expected to occur.

The Project will also comply with all applicable greenhouse gas (GHG) regulations and policies, and be consistent with the Global Warming Solutions Act (GWSA).

5.A.3.3 Noise

The Project has been designed to minimize noise impacts to the surrounding community and comply with MassDEP's Noise Regulations and Policy and Town of Sandwich Noise Bylaws.

The predicted maximum sound-level impacts at the closest noise-sensitive locations were added to the measured nighttime residual noise (L_{90}) levels to determine the net increase and to assess conformance with the MassDEP Noise Policy. The Project is expected to increase the lowest nighttime background sound levels by 1 to 7 decibels (dBA) at the nearest residences and marina area.

Although the simultaneous operation of existing Units 1 and 2 and the proposed Project would be expected to occur very infrequently as none of the units are expected to provide baseload power to the grid, an analysis was completed to assess the cumulative sound impacts from the operation of the existing Units 1

and 2 combined with the proposed Project, and the cumulative noise analysis demonstrated compliance with the MassDEP Noise Policy.

5.A.3.4 Wetlands and Waterways

There will be no direct impacts to bordering vegetated wetlands or wetlands buffer zone on the Project Site. The Project Site lies within the Federal Emergency Management Agency (FEMA) 100-year flood zone, which is regulated under the Massachusetts Wetlands Protection Act (WPA) as LSCSF. Construction of the Project will result in the permanent alteration of approximately 10.6 acres of LSCSF on the Project Site, mainly due to the fact that the site grades must be raised to ensure that key Project components will be elevated above the 100-year flood zone with adequate additional allowance for future sea level rise. The Project Site will be raised by placing approximately 43,000 cubic yards of fill. The minimum elevation of critical Project components will be set to an elevation of 16 feet NAVD88.

Ancillary components of the Project include an electric interconnection and fuel lines. A new natural gas line to the current onsite connection to the AGT pipeline and a new ULSD line from an existing oil tank to an existing day tank (both of which will be repurposed to store ULSD) will be located within the 100-foot buffer to coastal bank and will also cross LSCSF; however, erosion and sediment controls will be implemented to mitigate potential construction impacts.

As discussed in more detail in Sections 5.A.4.41 and 5.A.4.42, limited impacts to the buffer zone of an offsite bordering vegetated wetland will occur in conjunction with the electric interconnection to the adjacent Eversource switchyard.

The Project is also proposing to construct a 12-inch fuel line to accommodate barge deliveries of ULSD; the new fuel line will be constructed immediately adjacent to the existing fuel delivery line within the footprint of the existing bridge located within the Cape Cod Canal between the shoreline and unloading dock.

A Notice of Intent will be filed with the Sandwich Conservation Commission and MassDEP for the Project, including the electric interconnect, ULSD, and natural gas lines. A request for Minor Modification of an existing Chapter 91 License will be filed with MassDEP to seek approval for installation of the new fuel delivery line on the existing dock.

5.A.3.5 Stormwater

Stormwater during construction will be managed following USEPA, MassDEP, CCC, and Town of Sandwich design and performance guidelines. The proposed stormwater management system during operation will incorporate low-impact development techniques and Best Management Practices (BMPs), and will improve existing stormwater runoff conditions on the Project Site through the installation of new vegetated infiltration basins.

The proposed stormwater management system was designed in accordance with MassDEP Stormwater Management Standards. As discussed in Sections 5.A.6.7 through 5.A.6.25, the Project will result in a decrease in the amount of impervious area from existing conditions. During Project operation, the stormwater management system will improve the quality of runoff discharging from the Project Site. Stormwater will be collected in vegetated infiltration basins rather than discharging directly into the Cape Cod Canal or any wetland resource area.

Sections 5.A.6.7 through 5.A.6.25 discuss the Project's consistency with applicable CCC Regional Policy Plan's standards and practices regarding water resources.

5.A.3.6 Climate Change Adaptation and Resiliency

The Project Site is located within the coastal flood zone. It is expected that the Project Site will be affected by sea level rise in the future; therefore, the design of the Project addresses not only the impacts resulting

from a potential 100-year storm event, but must also include flood adaptation strategies to mitigate future risk associated with sea level rise.

Major risks associated with coastal flooding include storm surges and potential wave damage. The addition of sea level rise causes higher than average tidal ranges and storm surges that pass "normal" heights coupled with correspondingly higher flood waters. Various federal, state, and regional sea level rise studies were consulted to ascertain a reasonable range of potential sea level rise projections. Based on an extensive review of the available information, it was determined that a 2.3-foot rise in sea level would be expected over the 40-year life of the Project.

Within the footprint of the proposed Project, the existing grade is approximately 10 feet NAVD88. With a building design life of 40 years, consideration of the 2060 projected sea level rise for the Project Site was incorporated into the design such that the floor elevations of critical components will be at an elevation of 16 feet NAVD88 or 6 feet above the existing grade and 2.3 feet above the existing 100-year flood zone elevation.

5.A.3.7 Water and Wastewater

The Project has been designed to have insignificant impacts on water resources by utilizing a technology (simple-cycle combustion turbine) with inherently low water demand. The Project's water demand is for: NO_X emissions control during ULSD firing; evaporative inlet air cooling; periodic turbine washing; and general process use. The maximum average volume of water needed for the Project is approximately 18,000 gallons per day (gpd).

The cumulative process water demand for the Project and the existing Station will be met using two existing groundwater wells on the Property (Well Nos. 2 and 3), within current registered volumes, reflecting pumping levels that historically occurred for nearly 30 years without any observed adverse impact. The Town of Sandwich Water District provides potable water to the Station and will also provide potable water to the Project. No significant increase in potable water demand will result from the Project.

Given the depth of the wells plus the clay-rich layer that acts as a barrier to vertical hydraulic connection to the well screens, infiltration of salt water from the Cape Cod Canal due to future sea level rise would not be expected to materially impact the wells. Nevertheless, water quality from the existing wells is routinely monitored and any change in water quality would be noted and addressed, as appropriate.

Direct discharge of wastewater has been avoided by employing a near-zero liquid discharge design. Any liquid process streams that cannot be treated and recycled on-site (e.g., turbine wash water, evaporative cooler blowdown) will be collected and trucked off-site for treatment and disposal. As a result, there will be no additional wastewater discharged from the operation of the Project.

The Project will use existing sanitary facilities located in the Training Building. No additional sanitary facilities are proposed for the Project. The existing domestic waste system collects discharge from sinks, toilets, and other sanitary facilities, and discharges to the Station's sanitary sewer collection system, which consists of septic tanks and a leach field. The amount of domestic water used and sanitary wastewater generated by the proposed Project will be minimal compared to the volume consumed and generated by existing operations. Therefore, no modifications to the existing septic system are anticipated.

5.A.3.8 Hazardous Materials

As discussed in Section 5.L, a variety of chemical reagents and materials will be stored and used in conjunction with operation and maintenance of the Project. The type and character of these materials will be the same as or comparable to those currently used in the operation of the existing Station. A Spill Prevention Control and Countermeasure (SPCC) Plan is currently being maintained for the existing Station, which will be modified to reflect the Project's proposed chemical storage, as required.

Most routine chemical deliveries will be by truck, as is the current practice at the Station; aqueous NH_3 will continue to be delivered by rail. Secondary containment in the form of curbs, berms, and concrete pits will be used where hazardous chemicals are stored, including unloading areas. Two 60,000-gallon welded-steel tanks already existing on the Project Site will continue to be used for storage of aqueous NH_3. The existing tanks are not currently enclosed in a building, but a new structure will be installed to enclose these tanks.

ULSD will be transported to the Project by barge, following the same delivery practices used by the existing Station. ULSD will be stored in a 5.7-million-gallon storage tank and a 1.8-million-gallon day tank; both of which already exist on the Property and are located within secondary containment. These two tanks will be converted from their current No. 6 fuel oil storage to ULSD storage. Oil will also be present in miscellaneous equipment throughout the Project, such as transformers, lubrication oil reservoirs, 55-gallon drums, and the emergency generator fuel tanks. Cylinders of compressed gases, acetylene, and propane will also be stored on-site as required for routine operation.

As discussed in Section 5.G, No Notices of Activity and Use Limitation (AULs) exist on the Property. Although there are on-going remediation efforts on the Property, no construction or operation activity associated with the proposed Project, including site grading and stormwater management system installation and operation, is anticipated to impact these efforts. There are no open MassDEP Release Tracking Numbers (RTNs) associated with the Project Site and no contamination remaining from closed RTNs is present on the Project Site.

5.A.3.9 Historic Resources

The Project Site, located entirely within the Property, was previously disturbed in association with construction of the existing Station. A 1998 investigation of the Project Site for a prior proposed development determined that the presence of any intact below-ground archaeological resources was highly unlikely due to the extent of the prior site disturbance. The MHC reviewed the 1998 archaeological investigation and determined that the proposed activities were “unlikely to affect significant historic or archaeological resources.”

The Project has been designed to be as close to and as aesthetically compatible as possible with existing Station elements. The proposed exhaust stack will be 220 feet in height, well below the height of the existing exhaust stack and only slightly taller than the existing boiler room building directly west of the Project Site. All other proposed modifications are lower than the heights of existing structures and, with the exception of an overhead transmission line that will transmit the power produced by the Project to the existing adjacent Eversource switchyard, will be contained within previously disturbed portions of the Property. As such, no significant impact to nearby historical resources would be expected.

The Project is consistent with the policies of the Town of Sandwich regarding historic preservation and community character, as contained in the Local Comprehensive Plan (LCP). Further, the Project is particularly consistent with the objectives of the Town of Sandwich and the Old King's Highway Act regarding the preservation of the economic contributions of historic sites, in this case, the existing Station itself. A Certificate of Appropriateness will be sought from the Sandwich Old King’s Highway Historic District Commission.

5.A.3.10 Transportation

One active and two inactive NRG-owned rail spurs are located on the Project Site. The two inactive rail spurs will be removed as part of Project construction, while the active rail spur will remain in operation, primarily for delivery of aqueous NH_3 to the Project Site.

Since the private railroad spurs are owned and operated by NRG and were never owned or operated by any railroad company or by the Commonwealth, Project-related activities, including removal of the inactive rail spurs, will not impact the transportation system.

5.A.4 Consistency with Town of Sandwich Local Comprehensive Plan

The town of Sandwich has experienced enormous growth over the past several decades. The year-round population increased by 867 percent from 1960 to 2000, fundamentally changing the nature of the town. To address on-going growth and development, the Town of Sandwich developed a Local Comprehensive Plan in May 2009. The goal of this local comprehensive plan was to preserve and enhance the community's historic character and cultural heritage, protect natural resources, and expand economic opportunity.

Development of the Local Comprehensive Plan included a land use analysis in which the town of Sandwich was divided into 15 Strategic Planning Areas. The designation of these areas was based on zoning, land use patterns, parcel lines, topographic and natural attributes, common development patterns, public facilities and existing regulations. With input from the public, the Local Planning Committee sought to determine the most appropriate forms of growth management.

According to the LCP, the Station Property is located in the Town Marina/Tupper Road/Route 6A Strategic Planning Area. The LCP identifies this area as providing good opportunities for mixed-use and infill development. As a location within a designated industrial district, the Project Site is designated as an appropriate location to service industrial and commercial needs of the town.

5.A.5 Consistency with Regional Policy Plan's Minimum Performance Standards and Best Development Practices

The Cape Cod Regional Policy Plan (RPP) establishes growth management goals, organized by resource and issue area, to direct future development within Barnstable County. To provide guidance in meeting these goals, the RPP establishes Minimum Performance Standards (MPS) and Best Development Practices (BDP), consisting of specific actions or procedures projects that qualify as a Development of Regional Impact (DRI) must utilize to be consistent with RPP goals. The proposed Project was assessed to determine its consistency with each applicable MPS and BDP. Table 5.A-2 lists all MPS and BDP and the Project's applicability to each, as assessed by the Applicant. Standards that are applicable to the Project are discussed further in Section 5.A.6.

To determine the RPP MPS and BDP applicable to the proposed Project, the Project is considered in the context of the RPP. As defined by the RPP, the proposed Project is considered a redevelopment project. The RPP defines redevelopment as "the reconstruction, reuse, intensification, or change in use of any developed property within the Developed Area," or "any area that currently contains buildings, paved parking, and other development-related infrastructure." The Project Site is highly developed and a previously disturbed area, occupied by concrete-slab, aluminum-sided warehouses; two 60,000-gallon NH_3 storage tanks, several temporary trailers, and hard-packed gravel area used for temporary parking; the Project Site contains sparse vegetation. The Project is proposed to be a simple-cycle electric generating facility that will manufacture electricity from natural gas and ULSD fuels; therefore, the Project is considered an industrial use and RPP policies addressing commercial DRIs are not applicable. To support energy generation activities, the Project is proposing to construct interconnection infrastructure including a natural gas pipeline, ULSD delivery line, and electrical transmission line. This infrastructure will be for private use of the Project and, therefore, do not meet the RPP's definition of capital facilities, defined in the Cape Cod Commission Act as "public facilities and services necessary to support development."

Table 5.A-2: Project's Applicability with RPP's MPS and BDP

#	Title	Applicability
Land Use (LU)		
LU1	Compact Growth and Resource Protection	
LU1.1	Development Location	See Section 5.A.6.1.
LU1.2	Compact Development	See Section 5.A.6.2.
LU1.3	Redevelopment/Reuse	See Section 5.A.6.3.
LU1.4	Reuse of Historic Buildings	See Section 5.A.6.4.
LU1.5	Location of Municipal Offices	The Applicant believes this standard is not applicable.
LU2	Capital Facilities and Infrastructure	
LU2.1	Connections to Existing Infrastructure	The Applicant believes this standard is not applicable.
LU2.2	Co-location of Telecommunication Facilities	The Applicant believes this standard is not applicable.
LU2.3	Co-locate Public Infrastructure	The Applicant believes this standard is not applicable.
LU2.4	Access to Emergency Responders	The Applicant believes this standard is not applicable.
LU3	Rural Lands	
LU3.1	Buffers to Agricultural Uses	The Applicant believes this standard is not applicable.
LU3.2	Impacts to Agricultural Lands	The Applicant believes this standard is not applicable.
LU3.3	Best Management Practices	The Applicant believes this standard is not applicable.
Economic Development (ED)		
ED1	Low-impact and Compatible Development	
ED1.1	Location in Economic Centers	See Section 5.A.6.5.
ED1.2	Industrial and Service Trade Areas	The Applicant believes this standard is not applicable.
ED1.3	Waiver	The Applicant believes this standard is not applicable.
ED1.4	Resource-based Economic Areas	The Applicant believes this standard is not applicable.
ED2	A Balanced Economy	

#	Title	Applicability
ED2.1	Gaming	The Applicant believes this standard is not applicable.
ED2.2	Quality Employment Opportunities	See Section 5.A.6.6.
ED2.3	Employee Housing	The Applicant believes this standard is not applicable.
ED3	Regional Income Growth	
ED3.1	Local Labor and Service Providers	The Applicant believes this standard is not applicable.
ED3.2	Local Ownership	The Applicant believes this standard is not applicable.
ED3.3	Diverse Employment Opportunities	The Applicant believes this standard is not applicable.
ED3.4	Regional Export Growth	The Applicant believes this standard is not applicable.
ED3.5	Regional Import Substitution	The Applicant believes this standard is not applicable.
ED3.6	Value-added Manufacturing	The Applicant believes this standard is not applicable.
ED3.7	Local Fiscal Impact	The Applicant believes this standard is not applicable.
ED4	Infrastructure Capacity	
ED4.1	Demonstrated Need and Public Benefit	The Applicant believes this standard is not applicable.
ED4.2	Telecommunications Access	The Applicant believes this standard is not applicable.
ED4.3	Reliable Emergency Access	The Applicant believes this standard is not applicable.
ED4.4	Quality of Service	The Applicant believes this standard is not applicable.
Water Resources (WR)		
WR1	General Aquifer Protection	
WR1.1	Five-ppm Nitrogen Loading Standard	See Section 5.A.6.7.
WR1.2	Identification of Drinking Water Wells	See Section 5.A.6.8.
WR1.3	Groundwater Study Requirement	See Section 5.A.6.9.
WR1.4	Cluster Development	Applicant believes this standard is not applicable.
WR1.5	Turf and Landscape Management Plan	See Section 5.A.6.10.
WR1.6	Management of Water Withdrawals/Wastewater Discharges	See Section 5.A.6.11.

#	Title	Applicability
WR1.7	Use of Water-conservation Technologies	See Section 5.A.6.12.
WR1.8	Alternatives to Chemical Fertilizers and Pesticides	See Section 5.A.6.13.
WR1.9	Greater Protection of Groundwater/Surface Water	See Section 5.A.6.14.
WR1.10	Wastewater and Stormwater Reuse	See Section 5.A.6.15.
WR2	Drinking Water Quality and Quantity	
WR2.1	Five-ppm Nitrogen Loading Standard	The Applicant believes this standard is not applicable.
WR2.2	Prohibition on Hazardous Materials/Waste	The Applicant believes this standard is not applicable.
WR2.3	Restrictions on Public and Private Wastewater Treatment Facilities	The Applicant believes this standard is not applicable.
WR2.4	Prohibited Uses under State Regulations	The Applicant believes this standard is not applicable.
WR2.5	Future Well Site Restrictions	The Applicant believes this standard is not applicable.
WR2.6	One-ppm Nitrogen Loading Standard	The Applicant believes this standard is not applicable.
WR3	Marine Water Embayments and Estuaries	
WR3.1	Critical Nitrogen Load Standard for Development	The Applicant believes this standard is not applicable.
WR3.2	Maintenance or Improvement of Nitrogen Loading	The Applicant believes this standard is not applicable.
WR3.3	Local Management Plans	The Applicant believes this standard is not applicable.
WR3.4	Nitrogen Offset Contribution	The Applicant believes this standard is not applicable.
WR3.5	Monetary Contribution	The Applicant believes this standard is not applicable.
WR3.6	Public and Private Wastewater Treatment Facilities	The Applicant believes this standard is not applicable.
WR4	Freshwater Ponds and Lakes	
WR4.1	Limits on Subsurface Disposal Systems	The Applicant believes this standard is not applicable.
WR4.2	Monetary Contribution	The Applicant believes this standard is not applicable.
WR4.3	Public and Private Wastewater Treatment Facilities	The Applicant believes this standard is not applicable.
WR5	Water Quality Improvement Areas	
WR5.1	Nitrogen Loading Standard	The Applicant believes this standard is not applicable.

#	Title	Applicability
WR5.2	Public and Private Wastewater Treatment Facilities	The Applicant believes this standard is not applicable.
WR5.3	Monetary Contribution in Designated Mapped Areas	The Applicant believes this standard is not applicable.
WR5.4	Nitrogen Loading Standard in Impaired Areas	The Applicant believes this standard is not applicable.
WR5.5	Alternative Water Supply in Designated Mapped Areas	The Applicant believes this standard is not applicable.
WR5.6	Chapter 21E Site Assessments	The Applicant believes this standard is not applicable.
WR5.7	Reduction of Nitrogen Loading in Water Quality Improvement Areas	The Applicant believes this standard is not applicable.
WR6	Public and Private Wastewater Treatment Facilities	
WR6.1	Private Wastewater Treatment Facilities	The Applicant believes this standard is not applicable.
WR6.2	Tertiary Treatment	The Applicant believes this standard is not applicable.
WR6.3	Hydrologic Balance	The Applicant believes this standard is not applicable.
WR6.4	Development Density Limitations	The Applicant believes this standard is not applicable.
WR6.5	Ownership and Maintenance of Treatment Facilities	The Applicant believes this standard is not applicable.
WR6.6	Restrictions in FEMA Flood Zones/Other Sensitive Areas	The Applicant believes this standard is not applicable.
WR6.7	Long-term Ownership of Treatment Facilities	The Applicant believes this standard is not applicable.
WR6.8	Sludge Disposal	The Applicant believes this standard is not applicable.
WR6.9	Operation, Monitoring, and Compliance Agreement	The Applicant believes this standard is not applicable.
WR6.10	Improvement of Existing Wastewater Treatment	The Applicant believes this standard is not applicable.
WR6.11	Water Quality Remediation	The Applicant believes this standard is not applicable.
WR7	Stormwater Quality	
WR7.1	No New Direct Discharges of Untreated Stormwater	See Section 5.A.6.16.
WR7.2	On-Site Infiltration	See Section 5.A.6.17.
WR7.3	Roof Runoff	See Section 5.A.6.18.
WR7.4	Biofiltration Practices	See Section 5.A.6.19.
WR7.5	Structured Infiltration Devices	See Section 5.A.6.20.

#	Title	Applicability
WR7.6	Impervious Surfaces	See Section 5.A.6.21
WR7.7	Structured Infiltration Devices in Designated Mapped Areas	See Section 5.A.6.22.
WR7.8	Minimum Two-foot Separation to Groundwater	See Section 5.A.6.23.
WR7.9	Best Management Practices during Construction	See Section 5.A.6.24.
WR7.10	Stormwater Maintenance and Operation Plan	See Section 5.A.6.25.
WR7.11	Shut-off Valve in Wellhead Protection Areas	The Applicant believes this standard is not applicable.
WR7.12	Road Widths	The Applicant believes this standard is not applicable.
Coastal Resources (CR)		
CR1	Maritime Industry, Character, and Public Access	
CR1.1	Public Access	See Section 5.A.6.26.
CR1.2	Public Access to Beach Nourishment Sites	The Applicant believes this standard is not applicable.
CR1.3	Maritime Industry	The Applicant believes this standard is not applicable.
CR1.4	Maritime Aesthetics	See Section 5.A.6.27.
CR1.5	Walkways	The Applicant believes this standard is not applicable.
CR1.6	Coastal Structures	The Applicant believes this standard is not applicable.
CR1.7	Water-dependent Facilities	The Applicant believes this standard is not applicable.
CR2	Coastal Hazard Mitigation	
CR2.1	Prohibiting Development in V-Zones	See Section 5.A.6.28.
CR2.2	Accommodating Relative Sea-level Rise	See Section 5.A.6.29.
CR2.3	Migration of Coastal Resources	The Applicant believes this standard is not applicable.
CR2.4	Damage Prevention and Flood Mitigation	See Section 5.A.6.30.
CR2.5	Barrier Beaches, Coastal Dunes and Their Buffers	See Section 5.A.6.31.
CR2.6	Coastal Banks and Their Buffers	See Section 5.A.6.32.
CR2.7	Disasters within A-and V-Zones	The Applicant believes this standard is not applicable.

#	Title	Applicability
CR2.8	Public Infrastructure in Land Subject to Coastal Storm Flowage	The Applicant believes this standard is not applicable.
CR2.9	Dredged Material	The Applicant believes this standard is not applicable.
CR2.10	General Exceptions	The Applicant believes this standard is not applicable.
CR2.11	Beach Nourishment Site Conditions	The Applicant believes this standard is not applicable.
CR2.12	Beach Nourishment – Site Monitoring	The Applicant believes this standard is not applicable.
CR2.13	Remove Development from Coastal Floodplains	See Section 5.A.6.33.
CR2.14	Use Mean Sea Level Data	See Section 5.A.6.34.
CR2.15	Calculation of Setback from Top of Coastal Bank	See Section 5.A.6.35.
CR3	Coastal Water Quality and Habitat	
CR3.1	Buffers to Coastal Wetland	See Section 5.A.6.36.
CR3.2	Septic Systems in V-Zones	The Applicant believes this standard is not applicable.
CR3.3	Stormwater Discharges	See Section 5.A.6.37.
CR3.4	Stormwater Management Designed to Accommodate Relative Sea-level Rise	The Applicant believes this standard is not applicable
CR3.5	Docks and Piers	The Applicant believes this standard is not applicable.
CR3.6	New Marinas	The Applicant believes this standard is not applicable.
CR3.7	Prohibition on Improvement Dredging	The Applicant believes this standard is not applicable.
CR3.8	Maintenance Dredging	The Applicant believes this standard is not applicable.
CR3.9	Beneficial Reuse of Dredged Material	The Applicant believes this standard is not applicable.
CR3.10	Eelgrass	The Applicant believes this standard is not applicable.
CR3.11	Fish, Shellfish, Crustaceans	The Applicant believes this standard is not applicable.
CR3.12	Aquaculture	The Applicant believes this standard is not applicable.
CR3.13	Waterfront-fueling Facilities	See Section 5.A.6.38.
Marine Resources (MR)		
MR1	Marine Resources	

#	Title	Applicability
MR1.1	Prohibited Areas, Sand Mining	The Applicant believes this standard is not applicable.
MR1.2	Prohibited Areas, Cables/Pipelines	The Applicant believes this standard is not applicable.
MR1.3	Buffers to Navigation	The Applicant believes this standard is not applicable.
MR1.4	Operations and Maintenance Plan	The Applicant believes this standard is not applicable.
MR1.5	Emergency Response Plan	The Applicant believes this standard is not applicable.
MR1.6	North Atlantic Right Whale	The Applicant believes this standard is not applicable.
MR1.7	North Atlantic Right Whale, TOY Restrictions	The Applicant believes this standard is not applicable.
MR1.8	Whales	The Applicant believes this standard is not applicable.
MR1.9	Sea Turtles	The Applicant believes this standard is not applicable.
MR1.10	Fish Resources and Habitat	The Applicant believes this standard is not applicable.
MR1.11	Benthic Habitats, Direct Impacts	The Applicant believes this standard is not applicable.
MR1.12	Benthic Habitats, Indirect Impacts	The Applicant believes this standard is not applicable.
MR1.13	Benthic Habitats, TOY Restrictions	The Applicant believes this standard is not applicable.
MR1.14	Monitoring of Benthic Habitats during Construction	The Applicant believes this standard is not applicable.
MR1.15	Rare Species Habitat	The Applicant believes this standard is not applicable.
MR1.16	Construction Noise	The Applicant believes this standard is not applicable.
MR1.17	Cumulative Impacts	The Applicant believes this standard is not applicable.
MR1.18	Coordinated Conduit Crossings	The Applicant believes this standard is not applicable.
MR1.19	Archaeological Resources	The Applicant believes this standard is not applicable.
MR1.20	Coastal Landforms	The Applicant believes this standard is not applicable.
MR1.21	Minimizing Impacts to Benthic Resources	The Applicant believes this standard is not applicable.
MR1.22	Post-Construction Monitoring of Benthic Habitats	The Applicant believes this standard is not applicable.
MR1.23	Coastal Waterbirds	The Applicant believes this standard is not applicable.
MR1.24	Sea Ducks	The Applicant believes this standard is not applicable.

#	Title	Applicability
MR1.25	Project Benefit	The Applicant believes this standard is not applicable.
MR1.26	Scenic Resources	The Applicant believes this standard is not applicable.
MR1.27	Benthic Communities	The Applicant believes this standard is not applicable.
MR1.28	Coastal Waterbirds	The Applicant believes this standard is not applicable.
MR1.29	Multi-Hazard Mitigation Plan	The Applicant believes this standard is not applicable.
Wetlands (WET)		
WET1	Wetland Protection	
WET1.1	Wetlands	See Section 5.A.6.39.
WET1.2	Wetland Buffers	See Section 5.A.6.40.
WET1.3	Wetlands, Buffers, and Utility Line Installation	See Section 5.A.6.41.
WET1.4	Stormwater	See Section 5.A.6.42.
WET1.5	Wetland Restoration	See Section 5.A.6.43.
WET1.6	Artificial Wetlands	The Applicant believes this standard is not applicable.
WET1.7	Agricultural Areas	The Applicant believes this standard is not applicable.
Wildlife and Plant Habitat (WPH)		
WPH1	Prevent Loss, Minimize Adverse Impact, and Maintain Diversity	
WPH1.1	Natural Resources Inventory	See Section 5.A.6.44.
WHP1.2	Clearing and Grading	See Section 5.A.6.45.
WHP1.3	Wildlife and Plant Habitat	See Section 5.A.6.46.
WHP1.4	Rare Species	The Applicant believes this standard is not applicable.
WHP1.5	Vernal Pools	The Applicant believes this standard is not applicable.
WHP1.6	Invasive Species	See Section 5.A.6.47.
WHP1.7	Habitat Restoration	See Section 5.A.6.48.
WHP1.8	Un-development	The Applicant believes this standard is not applicable.

#	Title	Applicability
Open Space and Recreation (OS)		
OS1	Open Space and Natural Resources	
OS1.1	Clustering of Development	The Applicant believes this standard is not applicable.
OS1.2	Open Space Connections	See Section 5.A.6.49.
OS1.3	Open Space Requirements	See Section 5.A.6.50.
OS1.4	Sensitive Natural Resources	See Section 5.A.6.51.
OS1.5	Residential Cluster	The Applicant believes this standard is not applicable.
OS1.6	Sensitive Open Space Resources	The Applicant believes this standard is not applicable.
OS1.7	Open Space in GIZ/Economic Centers	The Applicant believes this standard is not applicable.
OS1.8	Open Space Requirements and Parking Garages	The Applicant believes this standard is not applicable.
OS1.9	Location of Open Space	The Applicant believes this standard is not applicable.
OS1.10	Open Space Credits	The Applicant believes this standard is not applicable.
OS2	Passive/Active Recreation	
OS2.1	Recreation Needs	See Section 5.A.6.52.
OS2.2	Provision of Recreation Areas	The Applicant believes this standard is not applicable.
Transportation (TR)		
TR	Transportation	
TR0.1	Source(s) of Trip-generation Data	See Section 5.A.6.53.
TR0.2	Traffic Credit for Past Uses	The Applicant believes this standard is not applicable.
TR0.3	Permits for Roadwork prior to Construction	The Applicant believes this standard is not applicable.
TR0.4	Alternative Method for Compliance within Economic Centers	The Applicant believes this standard is not applicable.
TR0.5	Incentive for Mixed Use Development in Economic Centers	The Applicant believes this standard is not applicable.
TR1	Safety	
TR1.1	No Degradation of Safety	See Section 5.A.6.54.

#	Title	Applicability
TR1.2	Crash Frequency at Key Locations	See Section 5.A.6.55.
TR1.3	Identification of Safety Impacts	The Applicant believes this standard is not applicable.
TR1.4	Standards for Driveway Construction	The Applicant believes this standard is not applicable.
TR1.5	Route 6 Access/Egress	The Applicant believes this standard is not applicable.
TR1.6	Sight-distance Obstructions	See Section 5.A.6.56.
TR1.7	Bicyclists and Pedestrians Safety and Access/Egress Requirements	See Section 5.A.6.57.
TR1.8	Sight-distance Requirements	See Section 5.A.6.58.
TR1.9	Mitigation Timing	The Applicant believes this standard is not applicable.
TR1.10	Transportation Safety	The Applicant believes this standard is not applicable.
TR1.11	Curb Cuts	The Applicant believes this standard is not applicable.
TR2	Trip Reduction/Transportation Balance and Efficiency	
TR2.1	Trip Reduction Outside Growth Incentive Zones or Economic Centers	The Applicant believes this standard is not applicable.
TR2.2	Trip Reduction Inside Growth Incentive Zones or Economic Centers	The Applicant believes this standard is not applicable.
TR2.3	Interconnections	The Applicant believes this standard is not applicable.
TR2.4	Incentives for Connections between Adjacent Properties	The Applicant believes this standard is not applicable.
TR2.5	Estimating Trip Reduction	The Applicant believes this standard is not applicable.
TR2.6	Bus Stops, Turn-outs, and Shelters	The Applicant believes this standard is not applicable.
TR2.7	Bicycle and Pedestrian Accommodations	The Applicant believes this standard is not applicable.
TR2.8	Preservation of Frontage	See Section 5.A.6.59.
TR2.9	Parking Spaces	See Section 5.A.6.60.
TR2.10	Acceptable Trip-reduction Strategies	The Applicant believes this standard is not applicable.
TR2.11	Other Trip-reduction Strategies	The Applicant believes this standard is not applicable.
TR2.12	Trip-generation Credit	The Applicant believes this standard is not applicable.

#	Title	Applicability
TR2.13	Inflation Factor	The Applicant believes this standard is not applicable.
TR2.14	Uses of Trip-reduction Funds	The Applicant believes this standard is not applicable.
TR2.15	Bike Racks and/or Storage	See Section 5.A.6.61.
TR2.16	Alternate Modes of Travel	See Section 5.A.6.62.
TR2.17	Buffers around Airports	The Applicant believes this standard is not applicable.
TR2.18	Rail and Marine Freight Shipment	See Section 5.A.6.63.
TR2.19	Preferred Parking Spaces for Car/Van Pools	See Section 5.A.6.64.
TR2.20	Parking Structures	See Section 5.A.6.65.
TR2.21	Shared Parking	See Section 5.A.6.66.
TR3	Level of Service/Congestion Management	
TR3.1	Operational Requirements	See Section 5.A.6.67.
TR3.2	Credit for Trip-reduction Mitigation	The Applicant believes this standard is not applicable.
TR3.3	Traffic Studies	The Applicant believes this standard is not applicable.
TR3.4	Mitigation of Congestion Impacts Required	The Applicant believes this standard is not applicable.
TR3.5	Mitigation Fee	The Applicant believes this standard is not applicable.
TR3.6	"Fair-share" Payments	The Applicant believes this standard is not applicable.
TR3.7	Restrictions on Road Widening or New Signals	The Applicant believes this standard is not applicable.
TR3.8	Year-round Structural Mitigation	The Applicant believes this standard is not applicable.
TR3.9	Bicycle and Pedestrian Accommodation	The Applicant believes this standard is not applicable.
TR3.10	Preserve Existing Rights-of-Way	See Section 5.A.6.68.
TR3.11	No Capacity Increases on Controlled-access Highways	The Applicant believes this standard is not applicable.
TR3.12	Consistency with Other Plans	The Applicant believes this standard is not applicable.
TR3.13	Operation and Maintenance Costs	The Applicant believes this standard is not applicable.
TR3.14	Traffic-monitoring Devices	The Applicant believes this standard is not applicable.

#	Title	Applicability
TR3.15	Inflation Factor	The Applicant believes this standard is not applicable.
TR3.16	Use of Congestion Mitigation Funds	The Applicant believes this standard is not applicable.
TR3.17	Automatic Data Collection	The Applicant believes this standard is not applicable.
TR3.18	Consistency with Federal and State Plans	The Applicant believes this standard is not applicable.
Waste Management (WM)		
WM1	Hazardous Materials and Waste	
WM1.1	Hazardous Materials/Waste Restrictions	The Applicant believes this standard is not applicable.
WM1.2	Credit for Redevelopment	The Applicant believes this standard is not applicable.
WM1.3	Credit for Removal of Development	The Applicant believes this standard is not applicable.
WM1.4	Pollution Prevention and Emergency Response Plan	The Applicant believes this standard is not applicable.
WM1.5	Compliance with Massachusetts Hazardous Waste Regulations	See Section 5.A.6.69.
WM1.6	Elimination of Hazardous Materials/Waste	See Section 5.A.6.70.
WM2	Solid Waste	
WM2.1	Construction Waste	See Section 5.A.6.71.
WM2.2	C&D Waste Plan	See Section 5.A.6.72.
WM2.3	Post-construction Waste	See Section 5.A.6.73.
WM2.4	Food-waste Recycling	The Applicant believes this standard is not applicable.
Energy (E)		
E1	Emissions and Energy Use	
E1.1	Redevelopment Energy Audit	See Section 5.A.6.74.
E1.2	Designed to Earn ENERGY STAR® Certification	See Section 5.A.6.75.
E1.3	ANSI/LEED Standards	See Section 5.A.6.76.
E1.4	Multi-family Projects	The Applicant believes this standard is not applicable.
E1.5	On-site Renewable Energy Generation	See Section 5.A.6.77.

#	Title	Applicability
E1.6	Alternative Method of Meeting MPS E1.1 through E1.5	The Applicant believes this standard is not applicable.
E1.7	Clear Area	The Applicant believes this standard is not applicable.
E1.8	Noise	The Applicant believes this standard is not applicable.
E1.9	Shadow Flicker	The Applicant believes this standard is not applicable.
E1.10	Decommissioning	The Applicant believes this standard is not applicable.
E1.11	Municipal WECF Waiver	The Applicant believes this standard is not applicable.
Affordable Housing (AH)		
AH1	Promotion and Creation of Affordable Housing	
AH1.1	Residential Requirement	The Applicant believes this standard is not applicable.
AH1.2	Ten-percent Requirement for Subdivisions of 10-plus Lots	The Applicant believes this standard is not applicable.
AH1.3	Cash-contribution Option	The Applicant believes this standard is not applicable.
AH1.4	Calculation of Affordable Units	The Applicant believes this standard is not applicable.
AH1.5	Off-site Option Criteria	The Applicant believes this standard is not applicable.
AH1.6	Location of Off-site Option	The Applicant believes this standard is not applicable.
AH1.7	Timing of Off-site Contributions	The Applicant believes this standard is not applicable.
AH1.8	Timing and Mix of Affordable Units	The Applicant believes this standard is not applicable.
AH1.9	Integration and Size of Affordable Units	The Applicant believes this standard is not applicable.
AH1.10	ENERGY STAR® Requirement	The Applicant believes this standard is not applicable.
AH1.11	Pricing and Rents of Affordable Units	The Applicant believes this standard is not applicable.
AH1.12	Permanent Affordability	The Applicant believes this standard is not applicable.
AH1.13	Monitoring of Affordability	The Applicant believes this standard is not applicable.
AH1.14	No Reduction in Number of Existing Units	The Applicant believes this standard is not applicable.
AH1.15	Location of Affordable Housing	The Applicant believes this standard is not applicable.
AH1.16	Priority for Affordable Rental Housing	The Applicant believes this standard is not applicable.

#	Title	Applicability
AH1.17	Moderate-income Homeownership	The Applicant believes this standard is not applicable.
AH2	Fair Housing/Equal Opportunity	
AH2.1	Non-discrimination	The Applicant believes this standard is not applicable.
AH2.2	Visitability and/or Accessibility Requirement	The Applicant believes this standard is not applicable.
AH2.3	Affirmative Marketing and Selection of Buyers/Tenants	The Applicant believes this standard is not applicable.
AH2.4	Relocation Requirement	The Applicant believes this standard is not applicable.
AH3	Community Participation	
AH3.1	Mitigation Standard	The Applicant believes this standard is not applicable.
AH3.2	Alternate Mitigation Calculation Option	The Applicant believes this standard is not applicable.
AH3.3	Annual Adjustment of Mitigation	The Applicant believes this standard is not applicable.
AH3.4	On-site Units Option	The Applicant believes this standard is not applicable.
AH3.5	Redevelopment/Change of Use	The Applicant believes this standard is not applicable.
Heritage Preservation and Community Character (HPCC)		
HPCC1	Historic, Cultural, and Archaeological Resources	
HPCC1.1	Historic Structures	See Section 5.A.6.78.
HPCC1.2	Cultural Landscapes	See Section 5.A.6.79.
HPCC1.3	Archaeological Sites	The Applicant believes this standard is not applicable.
HPCC1.4	Local Preservation Efforts	See Section 5.A.6.80.
HPCC1.5	Preservation Restrictions	See Section 5.A.6.81.
HPCC2	Community Character/Site and Building Design	
HPCC2.1	Strip Development	The Applicant believes this standard is not applicable.
HPCC2.2	Protection of Existing Roadway Character	The Applicant believes this standard is not applicable.
HPCC2.3	Avoid Adverse Visual Impacts	The Applicant believe this standard is not applicable
HPCC2.4	Consistency with Regional Context or Surrounding Distinctive Area	See Section 5.A.6.82.

#	Title	Applicability
HPCC2.5	Footprints over 15,000 Square Feet	See Section 5.A.6.83.
HPCC2.6	Building Forms and Façades	See Section 5.A.6.84.
HPCC2.7	Non-traditional Materials and Designs	See Section 5.A.6.85.
HPCC2.8	Parking to the Side or Rear of Buildings	See Section 5.A.6.86.
HPCC2.9	Landscaping Improvements for Redevelopment	See Section 5.A.6.87.
HPCC2.10	Landscape Plan Requirements	See Section 5.A.6.88.
HPCC2.11	Exterior Lighting	See Section 5.A.6.89.
HPCC2.12	Signage	See Section 5.A.6.90.
HPCC2.13	Underground Utilities	See Section 5.A.6.91.
HPCC2.14	Roadway Appurtenances	The Applicant believes this standard is not applicable.
HPCC2.15	Conservation Restrictions for Landscapes and Viewsheds	See Section 5.A.6.92.
HPCC2.16	Specimen Trees and Original Topography	See Section 5.A.6.93.
HPCC2.17	Impervious Parking Areas	See Section 5.A.6.94.
HPCC2.18	Public Open Spaces, Public Art, and Related Amenities	The Applicant believes this standard is not applicable.
HPCC2.19	Multiple Stories to Reduce Building Footprint	The Applicant believes this standard is not applicable.
HPCC2.20	Underground Utilities	The Applicant believes this standard is not applicable.

5.A.6 Consistency with Applicable Minimum Performance Standards and Best Development Practices

The following sections discuss the Project's consistency with the applicable RPP MPS and BDP as identified in Table 5.A-2.

5.A.6.1 MPS LU1.1: Development Location

Development and redevelopment shall be consistent with the category of desired land use where the project is located as well as the characteristics of that category, both as identified on the Regional Land Use Vision Map. Notwithstanding this requirement, the Commission may find that development and redevelopment has met this requirement, if, in its discretion, it finds each of the following:

1) ***The proposed project is a redevelopment, or the expansion of a previously approved DRI; and,***
2) ***The Commission finds that the proposed development does not present a threat to the resources and/or characteristics intended to be protected and maintained by its land use category.***

This standard does not apply until the town has an endorsed Land Use Vision Map nor shall it apply to developments that are not designated on the Regional Land Use Vision Map.

The Project is located in a designated Economic Center, as identified on the Cape Cod Regional Land Use Vision Map. Economic Centers are areas that could include characteristics such as civic and institutional uses, retail, and mixed use. Economic Centers are appropriate for growth and redevelopment and are defined by parcel data and/or zoning district boundaries. The Property, including the Project Site, is located within the IND zoning district as designated by Town of Sandwich. Per Section 2200 of the Town of Sandwich Protective Zoning Bylaw, "Power Generation, Electrical" use in the Industrial District is "[a]llowed throughout the Industrial Area adjacent to the Cape Cod Canal." Accordingly, the Project is consistent with the category of desired land use and the characteristics of that category.

5.A.6.2 MPS LU1.2: Compact Development

Nonresidential development and redevelopment shall be clustered on the site and with adjacent uses to the maximum extent possible by incorporating features, as applicable, such as multistory buildings, mixed use development, minimal setbacks from the street, limited and/or shared parking, and a pedestrian-friendly design that encourages walking, biking, and transit. All residential subdivisions of five or more lots and all commercial subdivisions of land shall cluster the proposed development unless inconsistent with local bylaws. Cluster plans shall use site designs that maximize contiguous open space, respect the natural topography and character of the site, and employ shared wastewater treatment, community water supply alternatives and Low Impact Development (LID) landscaping to allow more compact development.

The 12-acre Project Site is located directly adjacent to the east of the existing Station on the Property. The Project's layout has been deliberately arranged to locate major equipment as close as possible to the Station's existing structures. This proposed layout serves to cluster structures to minimize impact and facilitate use of shared infrastructure. The 220-foot stack and other major equipment have been situated in an east-west direction to minimize the effects of new visual elements. The clustered development results in the least visual change from off-site vantage points; avoids natural resource encroachment; and maximizes distance to residences and other sensitive off-site land uses. The proposed layout of the Project also allows for shared infrastructure between the Project and existing Station. Shared infrastructure is discussed in Section 5.A.6.3.

5.A.6.3 BDP LU1.3: Redevelopment/Reuse

DRIs are encouraged to incorporate redevelopment and/or reuse of existing buildings or developed sites in appropriate locations.

The Project has been designed to utilize facilities and infrastructure of the existing Station where feasible. The existing Training Building will continue to be used for operations and maintenance services, as well as administrative offices. The Project will also utilize the following shared infrastructure:

- an existing oil storage tank and a day tank will be converted to hold ULSD and a new unloading pipe will be added on the existing fuel dock parallel to the existing unloading pipe;
- the existing natural gas interconnection with AGT will be employed for gas supply;
- the existing NH_3 handling system and the two existing NH_3 storage tanks will be shared;
- the existing onsite wells (Nos. 2 and 3) will supply water to the Project; and
- existing buildings will be used for warehousing, storage, operations, and administration.

5.A.6.4 BDP LU1.4: Reuse of Historic Buildings

DRIs within Economic Centers or Villages as identified on the Regional Land Use Vision Map involving an historic structure are encouraged to include its rehabilitation and reuse in accordance with federal standards for treatment of historic properties.

The Project is located adjacent to the existing Station, which is state-listed on the MHC Massachusetts Cultural Resource Information System (MACRIS) database and is designated by the Town of Sandwich as a historic site within the Old King's Highway Regional Historic District (the District). There will be no modifications to existing Station structures considered historic. The Project proposes to reuse the Station's existing Training Building for operation and maintenance services and administrative offices, and will make energy-saving improvements to the building in compliance with RPP energy policies. Project construction will include demolition of aluminum-sided warehouses that currently exist on the Project Site; however, these structures are not historically significant elements of the existing Station.

5.A.6.5 MPS ED1.1: Location in Economic Centers

Development shall be located in Economic Centers or Industrial and Service Trade Areas, or where appropriate, Villages as designated on the Regional Land Use Vision Map unless waived in accordance with ED1.3. For towns without a Land Use Vision Map or developments not designated on the Regional Land Use Vision Map, all DRIs shall meet the waiver requirements under ED1.3. This standard does not apply to residential subdivisions or wireless communication towers.

The Project is located in an Economic Center as designated on the Cape Cod Regional Land Use Vision Map. As described in Section 5.A.6.1, land use vision categories are defined by local zoning district boundaries. The Town of Sandwich zoning map indicates that the Project is located in an IND zoning district; therefore, the Project is compatible with the land use vision category and intended land use.

5.A.6.6 BDP ED2.2: Quality Employment Opportunities

DRIs are encouraged to provide competitive wages consistent with the state average for that industry, employer-supported medical and retirement benefits packages, training opportunities beyond that need to perform the current job, and opportunities for advancement.

Jobs at the existing Station are provided with: competitive wages; employer-supported medical and retirement benefit packages; and training and advancement opportunities. The positions associated with the Project will offer competitive wages, benefits, and opportunities equal to those of jobs at the existing Station.

5.A.6.7 MPS WR1.1: Five-ppm Nitrogen Loading Standard

All development and redevelopment shall not exceed a 5-parts per million (ppm) nitrogen loading standard for impact on groundwater unless an alternative standard applies in accordance with the water resources classification system as described in the Water Resources planning section... Guidance on methodology to meet this standard can be found in Cape Cod Commission Nitrogen Loading Technical Bulletin 91-001, as amended.

Projected nitrogen loading discharges to groundwater from the Project Site were calculated at 1.3 parts per million (ppm), which is below the 5 ppm target. Nitrogen loading calculations prepared in accordance with Technical Bulletin 91-001, *Nitrogen Loading*, are provided in Attachment 5.D-1.

5.A.6.8 MPS WR1.2: Identification of Drinking Water Wells

Development and redevelopment shall identify their proposed drinking water wells and existing private drinking water wells on abutting properties within 400 feet and assess the impact of the development on the water quality of these wells and all other existing wells that may potentially be affected by the proposed development. Septic systems and other sources of contamination shall be sited to avoid adversely affecting downgradient existing or proposed wells.

The Project is not proposing to install or use drinking water wells, and there are no drinking water wells on the Property. The Town of Sandwich Water District provides potable water for the existing Station and will also supply potable water for the proposed Project. Review of the MassDEP Well Drilling database confirmed that there are no existing public or private drinking water wells on abutting properties within 400 feet.

5.A.6.9 MPS WR1.3: Groundwater Study Requirements

Developments of Regional Impact that withdraw more than 20,000 gallons of water per day shall demonstrate through a groundwater study that the project will not have adverse impacts on groundwater levels or adjacent surface waters and wetlands. The study shall include mapping of surface water morphology and comparison of existing and affected water-table fluctuations.

The Project's water demand will be met using two existing groundwater wells on the Property (Well Nos. 2 and 3), within the current registered volume of 0.45 million-gallons-per-day (MGD). As groundwater wells on the Property have been used to support the existing Station since 1966, groundwater levels and potential groundwater withdrawal impacts have been extensively monitored.

The most recent pumping test which included wetland monitoring was performed for Well No. 4 in April 2001 (while Well No. 3 was in full operation). The results of this monitoring indicated no discernable impacts to the wetlands when pumping a total of 710 gpm from the aquifer, more than twice the Station's normal maximum withdrawal rate. This result is not surprising given the fact that the wells are screened more than 90 feet bgs, and below a well-defined confining layer that significantly limits any conductivity with surficial wetlands. This confining layer that has been shown in numerous on-site geologic borings and demonstrated by the 2001 pumping test. It is further evidenced by the fact that pumping at the WMA-registered volume occurred for nearly 30 years without any observable impact on nearby wetlands or other surface water features.

5.A.6.10 MPS WR1.5: Turf and Landscape Management Plan

Development and redevelopment shall adopt Best Management Practices such as a turf and landscape management plan that incorporates water conservation measures including the use of native and drought resistant plantings and the use of drip irrigation, and minimizes the amount of pesticides and chemical fertilizers.

A landscaping management plan for the Project is provided in the Project's Site Development Plans provided in Section 4.0. As indicated in the landscaping management plan, upon completion of construction, the Project will utilize native, non-invasive flora adapted to Cape Cod's sandy soils.

5.A.6.11 BDP WR1.6: Management of Water Withdrawals/Wastewater Discharges

Water withdrawals and wastewater discharges are encouraged to be managed so that they do not adversely affect surface water resources, wetlands, private wells, or the safe yield of the aquifer.

Water withdrawals for the Project will be managed so they do not adversely impact groundwater or surface water resources. As described in Section 5.A.6.8, Project water needs will be met be met through withdrawals from two existing groundwater wells (Well Nos. 2 and 3) on the Property within current permitted limits. Wells Nos. 2 and 3 have been operating since 1966 and 1974, respectively, and have been monitored since. No impacts to groundwater or surface water resources have been observed throughout the long-term operation of these wells. During a test of inactive Well No. 4 (not proposed to be used), with Well No. 3 in operation, withdrawal rates from the aquifer were increased, while kept below permitted amounts, and no impact to nearby surface water features were observed.

Wastewater generated by the Project will not be discharged to groundwater, but will be collected and trucked offsite for disposal.

5.A.6.12 BDP WR1.7: Use of Water-Conservation Technologies

Development and redevelopment are encouraged to use water-conservation technologies or other strategies to obtain a 40-percent reduction of water use.

The Project has employed water-conservation technologies by selecting a technology with inherently low water demand. The Project will utilize a simple-cycle combustion turbine, which has a low water demand compared to other technologies that use steam for electric generation. Water use at the Project will be further minimized by using air-cooled fin fan coolers for ancillary equipment cooling. The proposed Project's water demand is primarily for NO_X control during ULSD firing, evaporative inlet air cooling, periodic turbine washes, and general process use. Figure 5.A-6 provides water balance diagrams showing how daily water demand may vary based on fuel type, season, and other factors. As shown, the maximum average volume of water needed for the Project is approximately 18,000 gpd, which is equal to 54.2 gpm. Expected actual water use will be considerably less, estimated at 22,000 gpd.

5.A.6.13 BDP WR1.8: Alternatives to Chemical Fertilizers and Pesticides

Development and redevelopment are encouraged to utilize alternatives to synthetic chemical fertilizers and pesticides in favor of organic and biological methods.

Due to the developed, industrial nature of the Project Site and Property, the Project involves limited landscaping, as shown in the plans provided in Section 4.0. However, the Project will utilize organic and biological methods where appropriate for the landscaping to be installed.

5.A.6.14 BDP WR1.9: Greater Protection of Groundwater/Surface Water

Development and redevelopment are encouraged to attain greater groundwater or surface water protection than provided for in the Minimum Performance Standards.

The proposed Project will exceed groundwater and surface water protection provided for in the MPS. As described in Section 5.D, projected nitrogen loading discharges to groundwater from the Project were calculated at 1.3 ppm, well below the 5 ppm standard. Nitrogen loading calculations for the proposed Project are provided in Attachment 5.D-1.

All fuel and chemical storage will be within secondary containment and subject to a comprehensive SPCC Plan. No new surface water discharges are proposed. Stormwater will be collected and conveyed to vegetated infiltration basins with appropriate non-structural BMPs.

5.A.6.15 BDP WR1.10: Wastewater and Stormwater Reuse

Development and redevelopment are encouraged to incorporate reuse of wastewater and stormwater for irrigation.

The Project is a simple-cycle peaking unit utilizing a near-zero liquid discharge system, treating and recycling wastewater, as practicable. As a result, very little wastewater will be generated by the proposed Project. The Project's wastewater streams include evaporative cooler blowdown, process drain and wash-down water, and periodic cleaning of the compressor and turbine blades with demineralized water and detergent. Wastewater from some of these processes may contain high total dissolved solids, oil, and some metals. As such, these wastewaters are not suitable for irrigation purposes, and will be collected in a wastewater holding tank and periodically trucked off-site for disposal. Stormwater from the proposed Project will be routed to vegetated infiltration basins for recharge.

5.A.6.16 MPS WR7.1: No New Direct Discharges of Untreated Stormwater

New direct discharge of untreated stormwater, parking-lot runoff, and/or wastewater into marine and fresh surface water and natural wetlands shall not be permitted.

No new direct point discharges of untreated stormwater associated with the Project are proposed. The proposed Project Site will include a new stormwater management system consisting of a combination of structural and non-structural practices. Structural BMPs will include permeable pavement and deep sump hooded/leaching catch basins. Non-structural practices include vegetated infiltration basins coupled with sediment forebays, water quality swales, and/or vegetated filter strips to pretreat sheet flow from areas such as the access roadways. Therefore, runoff from all redeveloped portions of the Project Site will be filtered prior to discharge. Any overflow from the infiltration basins will be directed to two existing stormwater discharge structures.

5.A.6.17 MPS WR7.2: On-Site Infiltration

Stormwater for all roadways and parking areas shall be managed and infiltrated on site, close to the source, to minimize runoff and maximize water quality treatment. Stormwater water quality treatment shall be provided for the first inch of rainfall (25-year 24-hour storm) consistent with 310 CMR 10 and the Massachusetts Stormwater Management Handbook to attain 80-percent total suspended solids removal and to reduce nutrients. All designs shall provide for at least 44-percent total suspended solids removal shall be designed prior to discharge into structured infiltration systems.

This Standard will be met by proposed stormwater BMPs providing treatment of the first inch of runoff, providing a minimum of 80% Total Suspended Solids (TSS) removal and 44% TSS pretreatment prior to discharge to the infiltration practices.

5.A.6.18 MPS WR7.3: Roof Runoff

Roof runoff shall be managed separately and directly infiltrated unless there is an identified rooftop water quality concern that requires additional treatment or management.

This standard will be met by capturing roof runoff and routing it to the vegetated infiltration basins for recharge. Roof design plans are provided in the Site Development Plans in Section 4.0, which provides details on separating the roof drain from surface runoff.

5.A.6.19 MPS WR7.4: Biofiltration Practices

Stormwater design for the first inch of stormwater flow from development parking and roadways shall use biofiltration practices including, but not limited to, vegetated swales and filter strips, constructed wetlands, tree box filters, bio-retention basins and rain gardens for treatment of stormwater runoff. Bioretention areas shall be constructed in accordance with the Massachusetts Storm Water Management Volume One: Stormwater Policy Handbook, March 1997. Approved biofiltration areas may be counted as open space within Wellhead Protection Areas.

The proposed stormwater management system includes vegetated infiltration basins, with vegetated swales and vegetated filter strips as pretreatment devices. Infiltration basins will be vegetated with native, non-invasive plants.

5.A.6.20 MPS WR7.5: Structured Infiltration Devices

Structured infiltration devices shall be used to accommodate frozen flow conditions and storms that exceed the 25-year 24-hour storm and designed to be consistent with the Massachusetts Stormwater Standards under 310 CMR 10 and the Massachusetts Storm Water Management Handbook.

Detailed structured infiltration control structures are presented in the Project's Site Development Plans in Section 4.0.

5.A.6.21 MPS WR7.6: Impervious Surfaces

Roadway and parking design shall limit impervious surfaces. Parking lots shall be designed for the minimum required by the town in accordance with MPS TR2.9. Overflow peak parking design shall be constructed from pervious materials such as porous pavement, permeable pavers, or biomaterial such as grass pavers unless inconsistent with local bylaws. Bioretention shall be incorporated into parking islands and roadway perimeters. Permeable paving shall be encouraged where appropriate

Impervious surfaces, such as roads and existing parking spaces, are accounted for in the impervious area calculations. The introduction of permeable pavement in select proposed parking areas has minimized the amount of impervious surface. Project design will result in a net reduction of 1,850 square feet of impervious area on the Project Site from existing conditions.

5.A.6.22 MPS WR 7.7: Structured Infiltration Devices in Designated Mapped Areas

Structured detention basins, infiltration basins and galleries may be used for redevelopment in Impaired Areas, Economic Centers, Industrial and Service Trade Areas, Villages, and Growth Incentive Zones. In towns without a Land Use Vision Map, this MPS shall only apply to redevelopment in Impaired Areas.

This standard is met through the construction of on-site vegetated infiltration basins.

5.A.6.23 MPS WR 7.8: Minimum Two-foot Separation to Groundwater

New infiltration basins or other stormwater leaching structures shall maintain a minimum two-foot separation between points of infiltration and maximum high water table except as required under MPS CR3.4. Guidance on the high groundwater adjustment methodology can be found in Estimation of High Groundwater Levels for Construction and Land Use Planning, Technical Bulletin 92-001, as amended.

Surficial aquifer groundwater levels at high tide on the Property were measured on September 20, 2016. The maximum groundwater elevation recorded was 6.5 feet NAVD88 in the area of the proposed stormwater infiltration area. These levels are consistent with readings from taken during the 2001 pumping

test (M&E, 2001). The bottom of the stormwater basin is proposed to be 9 feet NAVD88, providing a minimum of 2.5 feet of separation between the groundwater level and the vegetated infiltration basin.

5.A.6.24 MPS WR 7.9: Best Management Practices during Construction

Construction best management practices for erosion and sedimentation controls shall be specified on project plans to prevent erosion, control sediment movement and stabilize exposed soils.

This standard will be met during construction through the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the USEPA National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit (MSGP) for Discharges from Construction Activities dated February 16, 2012.

5.A.6.25 MPS WR 7.10: Stormwater Maintenance and Operation Plan

Development and redevelopment shall submit a Professional Engineer-certified stormwater maintenance and operation plan demonstrating compliance with the Massachusetts Stormwater Guidelines including a schedule for inspection, monitoring, and maintenance. The plan shall identify the parties responsible for plan implementation, operation and maintenance. The identified responsible party shall keep documentation of the maintenance and inspection records and make these available to the Commission or local board of health upon request. One year from completion of the system, a Professional Engineer shall inspect the system and submit a letter certifying that the system was installed and functions as designed.

This standard will be met through the implementation of the Operation and Maintenance (O&M) Plan of the stormwater management design, which is provided in Attachment 5.A-2. The existing plant operations O&M Plan has been updated to include the new practices along with specific maintenance provisions. The Station's SWPPP under the MSGP will also be updated to include the site improvements and associated provisions. One year from completion of the stormwater system, a Professional Engineer shall certify that the system was installed as designed and is functioning properly.

5.A.6.26 MPS CR1.1: Public Access

Development and redevelopment along the coast shall not interfere with existing legal public access and historic public rights of way to the shore. In addition, public access shall not impair the natural beneficial functions of coastal resources.

Development of the Project will occur within the Property boundaries and public access to the Cape Cod Canal will not be impacted. Although the Property abuts the Cape Cod Canal, a public access walkway maintained by the USACE is located adjacent to the canal, along the northern Property boundary. This public walkway will not be impacted by operation of the Project.

5.A.6.27 MPS CR1.4: Maritime Aesthetics

Development and redevelopment shall reflect the traditional maritime character and/or architecture typical of the area and shall be designed to maintain and enhance views of the ocean and/or shoreline from public ways, waterways, access points, and existing development.

The Project has been designed as close as possible to the existing structures of the Station, with the stack (the tallest element) oriented in order to minimize the effect of new visual elements. The orientation of the equipment, in an east-west direction, is the result of engineering functionality, visual, and air quality considerations. The resulting Project location best avoids natural resource encroachment; maximizes distance to residences and other sensitive off-site land uses; and results in the least visual change from off-site vantage points.

The Project Site is proximate to the Sandwich Marina, Scusset Beach State Reservation, and scattered residences. The existing Station is a more dominant visual element; given its size and presence and vegetative screening, the Project is not anticipated to have a significant visual impact. See Figures 5.A-8 through 17 for visual simulations from selected areas.

5.A.6.28 MPS CR2.1: Prohibiting Development in V-Zones

No development or redevelopment shall be permitted within V-Zones, except as specified in MPS CR2.7. Existing structures may be reconstructed or renovated provided there is no increase in gross floor area, footprint, or intensity of use (including but not limited to increases in wastewater flow, impervious area, or parking spaces, or conversion from seasonal to year-round use). As an exception, where there is no feasible alternative, water-dependent structures and uses and maintenance of marine infrastructure may be permitted provided the activity minimizes impacts to coastal resources and is subject to the approval of all permitting authorities

The Project Site is not located in a FEMA-designated velocity zone (V-Zone). As shown in the Site Development Plans in Section 4.0, the majority of the Project Site is located within Zone AE. Zone AE areas are where a base flood elevation has been established and are subject to inundation by the one-percent-annual-chance flood event (100-year flood). FEMA-designated V-Zones are areas subject to high velocity wave action from storms. The closest V-Zone lies 1,800 feet to the east of the Project Site.

5.A.6.29 MPS CR2.2: Accommodation Relative Sea-level Rise

All new buildings, including replacements, or substantial improvements to existing structures shall be designed as follows to accommodate documented relative sea-level rise rates in Massachusetts:

1) ***Within A-Zones, the lowest horizontal structural member shall be a minimum of one foot above Base Flood Elevation (BFE); or***
2) ***Within V-Zones, due to wave action, the lowest horizontal structural member shall be a minimum of two feet above BFE.***

The Project Site is located within a FEMA-designated Zone AE and has been designed to accommodate relative sea-level rise rates. According to FEMA Flood Insurance Rate Map (FIRM) Panel 319 of 875 #25001C0319J (FEMA, 2014), the BFE (the 100-year flood elevation) on the Project Site is 14 feet NAVD88[4]. Even though not located within a V-zone, critical components of the proposed Project will conservatively be raised 2.3 feet above the 100-year flood zone elevation to an elevation of 16 feet NAVD88 or 6 feet above the existing grade.

5.A.6.30 MPS CR2.4: Damage Prevention and Flood Mitigation

To maintain the storm damage prevention and flood control functions of Land Subject to Coastal Storm Flowage (LSCSF):

1) ***No activity within a V-Zone shall increase the existing site elevations; and***
2) ***No activity within a V- or A-Zone shall increase the velocity of flood waters or increase flows due to a change in drainage or flowage characteristics on the subject site, adjacent properties, or any public or private way; and***
3) ***Placement of fill in hydraulically constricted areas shall not be permitted.***

The Project Site is not located within a V-Zone. Grading to occur in association with the Project has been designed to protect critical infrastructure; to accommodate flood zones and sea level rise; to facilitate drainage; and to direct flows to discrete areas where they could be treated. The proposed changes in elevation associated with the Project will not serve to back-up water from flooding caused by coastal

[4] The Flood Insurance Study identifies the 100-year flood elevation as 13.7 feet NAVD88, which is rounded to 14 feet NAVD88 on the FIRM map.

flooding or rain events. Because the filling is within the coastal floodplain, the volumetric changes related to the Project will not displace flood waters in a manner that will increase flood elevations on or adjacent to the site. The areas to be raised to elevation 16 feet NAVD88 will drain to newly created on-site drainage basins or the Cape Cod Canal, not to adjacent properties. The Project will result in a net decrease of impervious surfaces, and on-site soils drain well, which will further mitigate any flooding impacts.

The Project is not anticipated to be impacted by flooding from Cape Cod Bay. Flood waters from the bay do not include significant wave action. While the Cape Cod Bay entry to the Canal is open to storm-driven waves, their height in Cape Cod Bay is limited by the length of the bay's fetch, or the width of the bay, which limits the distance waves can travel across the bay. The intensity of the sustained winds, and the distance of open-ocean over which those winds can blow, determines the height of the generated wave. Figure 5.A-7 shows that the outer "arm" of Cape Cod restricts unlimited fetch length, preventing high velocity wave action from occurring.

5.A.6.31 MPS CR2.5: Barrier Beaches, Coastal Dunes and Their Buffers

Redevelopment/Reconstruction

Existing structures on barrier beaches or coastal dunes may be reconstructed or renovated, provided there is no increase in the total combined building footprint and existing impervious area, or intensity of use including but not limited to increases in wastewater flow, impervious area, or parking spaces, or conversion from seasonal to year-round use. An applicant shall demonstrate that any allowed redevelopment/reconstruction will not adversely affect the natural beneficial function(s) of coastal resource(s) and that it will not increase the flood hazard. Additionally, if the reconstruction/renovation is greater than 50 percent of the assessed value of a structure it shall be designed as follows:

1) ***Within V-Zone: The lowest horizontal structural member shall be elevated at least two feet above the BFE.***
2) ***Within A-Zone: The lowest horizontal structural member shall be elevated at least one-foot above the BFE or two feet above existing grade, whichever is higher.***
3) ***Outside LSCSF: The structure shall be elevated at least two feet above grade.***
4) ***To allow for storm flowage, wave action, and/or beach and dune migration the structure shall be on open pilings or columns, and if within LSCSF it shall not have breakaway walls.***

The Project Site is located within flood zone AE as designated by FEMA. To accommodate anticipated sea level rise, critical Project structures will be elevated 2.3 feet above the 100-year flood elevation, or 6 feet above the current grade.

5.A.6.32 MPS CR2.6: Coastal Banks and Their Buffers

Redevelopment/Reconstruction

Redevelopment and reconstruction shall be designed to have no adverse effect on the height, stability, or use of the bank as a natural sediment source, as all coastal banks are sediment sources. Every feasible effort shall be made to reduce adverse impacts to the resource, such as to maintain the same footprint or relocate structures landward.

The Project is located adjacent to the Cape Cod Canal, a man-made navigable waterway connecting Cape Cod Bay to Buzzards Bay. The banks of the canal are reinforced with rip rap to stabilize the banks and minimize bank erosion. The proposed Project will have no adverse impact on the banks of the Cape Cod Canal, as there will be no Project structures located within a 100-foot buffer from the bank.

5.A.6.33 BDP CR2.13: Remove Development from Coastal Floodplains

Applicants are encouraged to seek opportunities to remove development from coastal floodplains, either on or off site. The removal of development in V-Zone or of FEMA-designated repetitive-loss properties is particularly encouraged.

The Project is located within the FEMA 100-year floodplain, which is regulated under the Massachusetts WPA as LSCSF. To account for anticipated sea-level rise, critical Project components will be raised 2.3 feet above the 100-year flood elevation to 16 feet NAVD88. As discussed in Section 5.A.6.28, the Project is not located in a V-zone, nor is it a FEMA-designated repetitive loss property.

5.A.6.34 BDP CR2.14: Use Mean Sea Level Data

Use of the most recent Mean Sea Level datum available for a site is encouraged to determine base flood elevation and inform all coastal construction activities. When determining Mean Sea Level, applicants are encouraged to use the 1988 datum of NAVD88, rather than the more commonly used 1929 datum of NGVD29. The difference is generally between 0.8 feet and 1.2 feet and account for relative rise in sea level as well as the increased accuracy of newer measuring devices.

NAVD88 was used to determine base flood elevations and to inform proposed grading activities for the Project.

5.A.6.35 BDP CR2.15: Calculation of Setback from Top of Coastal Bank

Use of calculating a setback from the top of the coastal bank (per standard CR2.6 above) of at least 70 times the average annual erosion rate of the bank (or 100 feet if greater) is encouraged in order to reflect the typical 70-year lifetime of a residential building, as based on a study conducted for the Federal Insurance Administration to establish reliable estimates for the life of residential coastal structures.

The banks of the Cape Cod Canal are reinforced with rip rap to minimize bank erosion along the waterway. As such, erosion within the canal is heavily controlled and monitored. To maintain stability and avoid adverse impacts to the bank of the Cape Cod Canal, Project structures have been concentrated in the southern portion of the Project Site and a 100-foot buffer from the bank will be maintained. Work within the 100-foot buffer will be limited to underground installation of a natural gas interconnection pipeline and a ULSD delivery pipeline; however, no Project structures will be located within 100 feet of the bank of the canal. The closest Project structure to the canal will be the gas compressor building, located approximately 250 feet from the edge of the bank.

5.A.6.36 MPS CR3.1: Buffers to Coastal Wetland

Undisturbed buffer areas of at least 100 feet surrounding coastal wetlands and/or landward of the mean high water mark of coastal water bodies shall be protected in accordance with MPS WET1.2.

By consolidating Project structures primarily in the southern portion of the Project Site, there will be no structures located within 100 feet from the mean high water mark of the adjacent Cape Cod Canal. Construction of the proposed natural gas interconnection pipeline and ULSD delivery pipeline will require disturbance of the ground surface in the northern area of the Property; however, a 100 foot buffer from the Cape Cod Canal bank will be maintained during Project operation. The closest structure to the mean high water mark will be the Project's gas compressor building, located approximately 250 feet from the edge of the bank, as shown on Figure 5.A-1.

5.A.6.37 MPS CR3.3: Stormwater Discharges

No direct untreated stormwater discharges shall be permitted into any coastal waters or wetlands, including discharges above or below the mean high water level. New treated stormwater discharges

shall be located a minimum of 100 feet from wetlands and water bodies, consistent with MPS WET1.4. For redevelopment, treated stormwater discharges shall be located a minimum of 100 feet, or the farthest distance practicable, from wetlands or water bodies. All stormwater discharge shall be consistent with MPS WET1.4.

There will be no new direct point discharges of untreated stormwater associated with the proposed Project. The Project will include a new stormwater management system consisting of a combination of structural and non-structural practices, including permeable pavement and deep sump hooded/leaching catch basins; vegetated infiltration basins coupled with sediment forebays; water quality swales and/or vegetated filter strips to pretreat sheet flow from areas such as the access roadways. Stormwater overflow from these management systems will flow through two existing discharge points utilized by the existing Station. All stormwater discharges shall be consistent with MPS WET1.4.

5.A.6.38 BDP CR3.13: Waterfront-fueling Facilities

Waterfront-fueling facilities are encouraged to be upgraded to ensure that best management practices are used to avoid adverse impacts to water quality.

The Project will receive deliveries of its backup fuel (ULSD) by barge, using the same transportation practices as the existing Station. Unloading facilities will be upgraded through the installation of an additional unloading pipeline parallel to the existing refueling pipeline to deliver ULSD for the Project. During ULSD unloading activities, proper unloading procedures and best management practices will continue to be utilized to avoid impacts to the water quality of the Cape Cod Canal.

5.A.6.39 MPS WET1.1: Wetlands

Wetland alteration shall not be permitted except as provided herein and in Minimum Performance Standard WET1.3. As an exception, where there is no feasible alternative, water-dependent projects involving wetland alteration with appropriate mitigation may be permitted subject to the approval of all permitting authorities. Such permission may be granted subject to a finding that there is no feasible alternative location for the project and that any necessary alteration is the minimum necessary to accomplish the goals of the project. Appropriate mitigation shall not include wetland creation or replication.

The proposed Project will not result in significant alteration of wetland area. Minimal trimming of overstory vegetation within an off-site wetland may be required in association with the placement of a 345-kV overhead electrical transmission line connecting the Project to the existing Eversource switchyard south of the Property. As the minimal vegetation management will support two overhead utility lines, the Applicant believes these activities are permitted under MPS WET1.3. Section 5.A.6.41 discusses Project compliance with MPS WET1.3.

5.A.6.40 MPS WET1.2: Wetland Buffers

Vegetated, undisturbed buffer areas of at least 100 feet in width shall be maintained and/or provided from the edge of coastal and inland wetlands including isolated wetlands, to protect their natural functions. This standard shall not be construed to preclude pedestrian access paths, vista pruning, or construction and maintenance of water-dependent structures within the buffer area, any of which may be permitted at the discretion of permitting authorities where there is no feasible alternative to their location. The Cape Cod Commission and local Conservation Commissions may require a larger buffer area where necessary to protect sensitive areas or where site conditions such as slopes or soils suggest that a larger buffer area is necessary to prevent any adverse impact to wetlands and associated wildlife habitat. Where a buffer area is already altered such that the required buffer cannot be provided without removal of structures and/or pavement, this requirement may be modified by the Cape Cod Commission and other relevant permitting authorities, provided

it makes the following findings: (1) that the proposed alteration will not increase adverse impacts on that specific portion of the buffer area or associated wetland, and (2) that there is no technically demonstrated feasible construction alternative.

There will be minor impacts to a 100-foot buffer of an off-site wetland associated with the 345-kV electrical transmission line connecting the Project to the Eversource switchyard. To support the length of the 1,850-foot long transmission line, two utility poles will be placed inside the existing switchyard on land that is within the 100-foot wetland buffer. Although the utility poles will be within the wetland buffer, they will exist on land previously disturbed during construction of the existing switchyard. The transmission line corridor may also require vegetation management activities to occur within the wetland buffer for safety reasons. As these activities are associated with utility line installation, the Applicant believes that these minor impact are permitted under MPS WET1.3.

5.A.6.41 MPS WET1.3: Wetlands, Buffers, and Utility Line Installation

Disturbance of wetlands and buffer areas for operation and maintenance of underground and overhead utility lines (electrical, communication, sewer, water, and gas lines) may occur as provided below. Installation of new utility lines through these areas may occur where the Cape Cod Commission finds no feasible alternative to the proposed route for such facilities. In all instances, disturbance of wetland and buffer areas shall be minimized and surface vegetation, topography, and water flow shall be restored substantially to the original condition.

To deliver energy to the regional grid, the Project will require the placement of a 345-kV overhead transmission line from the proposed Project to the existing Eversource switchyard located south of the Property. To provide safe separation distances between each of the high voltage lines, a 120-foot wide corridor is required. In order to access the switchyard, the overhead transmission line route must aerially traverse approximately 170 linear feet of forested off-site wetland. The route spanning the wetland was carefully chosen based on field observation in an effort to avoid cutting and/or topping of mature trees to the maximum extent practicable. No structures will be placed within the wetland, nor will any fill be discharged into the wetland, although, two utility poles supporting the span will be located within the 100-foot buffer to the wetland on land previously impacted by the Eversource switchyard. Over time, the crossing location may require maintenance in terms of vegetation management to maintain a clear envelope for safety purposes.

Due to the size and location of the off-site wetland, alternate routes to avoid the proposed potential vegetation management activities within the wetland were considered impracticable. As shown on the Site Development Plans in Section 4.0, the off-site wetland is located to the east of the Eversource switchyard and extends along the northern and southern boundaries of the switchyard. To avoid all wetland impacts a significantly longer electrical transmission line would be necessary, imposing increased clearing requirements and potential visual intrusions.

5.A.6.42 MPS WET1.4: Stormwater

Stormwater management plans for new development shall preclude direct discharge of untreated stormwater into natural wetlands and water bodies. New stormwater discharges shall be located a minimum of 100 feet from wetlands and water bodies.

There will be no discharge of untreated stormwater into natural wetlands or waterbodies associated with the proposed Project. A new stormwater management system consisting of a combination of structural and non-structural practices will be included on the Project Site. Structural BMPs will include permeable pavement and deep sump hooded/leaching catch basins. Non-structural practices include vegetated infiltration basins coupled with sediment forebays, water quality swales and/or vegetated filter strips to pretreat sheet flow from areas such as the access roadways. Runoff from all redeveloped portions of the

Project Site will be pretreated prior to discharge. Following treatment, stormwater from the Project Site will continue to be discharged through two existing discharge points.

5.A.6.43 BDP WET1.5: Wetland Restoration

Measures to restore altered or degraded inland and coastal wetlands, including nonstructural bank stabilization, revegetation, and restoration of tidal flushing are encouraged; however, such areas should not be used as mitigation for wetland alteration projects (mitigation banking).

Placement of a 345-kV overhead transmission line associated with the Project may result in limited trimming of overstory vegetation within an off-site wetland. No other wetland alteration is proposed.

5.A.6.44 MPS WPH1.1: Natural Resources Inventory

Applications for Developments of Regional Impact that propose to alter undeveloped areas shall contain a natural resources inventory. Such inventory shall identify the presence and location of wildlife and plant habitat, including vernal pools, and serve as a guide for the layout of the development. Developments shall be planned to minimize adverse impacts to wildlife and plant habitat. Guidance on preparation of natural resources inventories can be found in Development of Regional Impact Guidelines for Natural Resources Inventory (Plant and Wildlife Habitat Assessment), Technical Bulletin 92-002, as amended.

A Natural Resources Inventory Report for the Project, prepared in accordance with Technical Bulletin 92-002, *DRI Guidelines for Natural Resources Inventory*, is provided in Attachment 5.H-1. The Project Site contains no significant natural resources; including wetlands and vernal pools.

5.A.6.45 MPS WPH1.2: Clearing and Grading

Clearing of vegetation and alteration of natural topography shall be minimized, with native vegetation planted as needed to enhance or restore wildlife habitat. Standing specimen trees shall be protected. The Commission may require designation of building envelopes (for structures, driveways, lawns, etc.), where appropriate, to limit removal of vegetation.

Limited natural vegetation exists on the Project Site, as the entire Property is extensively developed in support of the existing Station. In the sparse undeveloped areas, vegetation consists of grasses and other herbaceous plant species, including dock (*Rumex crispus*), white sweet clover (*Melilotus alba*), rabbit-foot clover (*Trifolium arvense*), and butter-and-eggs (*Linaria vulgaris*), with non-native species predominating. The Project Site contains no specimen trees. Vegetated infiltration basins and Project landscaping will including planting of native, non-invasive species.

The topography of the Project Site was first altered in the 1960s when Units 1 and 2 were constructed and fill material, originating from the construction of the Cape Cod Canal and other undocumented sources, was used to flatten the grade of the Property to approximately 10 feet NAVD88. Alteration of Project Site topography has been limited to critical infrastructure, which will be raised to an elevation of 16 feet NAVD88. Perimeter roadways will also be elevated 1 foot to 11 feet NAVD88, and roadways providing access to the raised critical facilities will also be raised to an elevation of 15 feet NAVD88. Transitional grading will be provided between the roadway elevations. These changes in topography have been designed to accommodate flood zones and anticipated sea level rise.

5.A.6.46 MPS WPH1.3: Wildlife and Plant Habitat

Fragmentation of wildlife and plant habitat shall be minimized by the establishment of greenways and wildlife corridors of sufficient width to protect not only edge species but also species that inhabit the interior forest, as well as by the protection of large unfragmented areas, and the use of open space or cluster development. Wildlife shall be provided with opportunities for passage under or across roads and through developments where such opportunities will maintain the integrity of

wildlife corridors. Fencing shall not be constructed so as to interfere with identified wildlife migration corridors.

The Project Site and Property are highly developed and disturbed, and do not contain significant natural resources. The sparse vegetation present on the Property includes grasses and other herbaceous plant species characterized by non-native species adapted for disturbed conditions. Based on correspondence with the Natural Heritage and Endangered Species Program (NHESP), no state-listed or federally listed rare plant or animal species inhabit the Project Site. A portion of the Property overlaps with Priority Habitat 15 and Estimated Habitat 79. The rare species associated with these habitat areas include two bird species, the least tern (*Sternula antillarum*) and common tern (*Sterna hirundo*), classified as Species of Special Concern. However, only a very small (watersheet) portion of the Property is within the mapped habitats, and the limit and scope of work associated with the Project does not reach these areas. In general, the Project Site and Property are not considered to contain high quality habitat and Project development will not fragment important wildlife and plant habitat.

5.A.6.47 MPS WPH1.6: Invasive Species

Development on sites where a natural resources inventory identifies the presence of invasive plant species shall provide and implement a management and restoration plan detailing the management of, and where possible, the eradication of the invasive species present, and for revegetating the site with native species. A current listing of invasive species can be found on the web at www.massnrc.org/mipag/invasive.htm.

A natural resource inventory of the Project Site (Attachment 5.H-1) determined that five invasive species, as defined by Technical Bulletin 01-001, *DRI Guidelines for Invasive Plant Species Management*, exist on the Property. The five invasive species include Asiatic bittersweet (*Celastrus orbiculatus*), autumn olive (*Elaeagnus umbellata*), glossy-leaved buckthorn (Frangula alnus), common reed (*Phragmites australis*), and multiflora rose (*Rosa multiflora*). Only the multiflora rose was observed on the 12-acre Project Site.

During Project construction, the Project Site and some areas of the Property where invasive species are located will be cleared. As shown on the Site Development Plans in Section 4.0, landscaping to occur as a result of the proposed Project will utilize native, non-invasive plant species. Any invasive plant species to migrate onto the Project Site will chemically treated and exterminated.

5.A.6.48 BDP WPH1.7: Habitat Restoration

Measures to restore altered or degraded upland habitat areas are encouraged where ecologically appropriate (for example, sandplain grasslands, pine barrens, etc.).

The Project Site consists primarily of heavily developed and highly disturbed environments, with no habitats of significant ecological importance. The Project will redevelop this developed and highly disturbed area to support the proposed Project. Remaining undeveloped areas, including the vegetated infiltration basins, will be landscaped with native, non-invasive plant species.

5.A.6.49 MPS OS1.2: Open Space Connections

Preserved open space within proposed developments shall be designed to be contiguous and interconnecting with adjacent open space, and shall be subject to permanent protection under Article 97 of the Massachusetts state constitution, or similar conservation mechanism. Additional guidance on dedication of open space for Developments of Regional Impact can be found in the Guidelines for Calculation and Provision of Open Space in Developments of Regional Impact, Technical Bulletin 94-001, as amended.

The Project Site and Property are primarily comprised of industrially developed and highly disturbed land area with minimal open space. As a simple-cycle energy generating unit, the Project will be secured and

not accessible to the public. For security and safety purposes, interconnecting open space on the Project Site and Property to adjacent open space is impractical. Recreational open space consisting of a USACE-maintained public walkway abuts the Property to the north. A portion of this walkway traverses an area of the Property where the Station dock extends into the Cape Cod Canal. The public walkway recreational open space will not be impacted by operation Project.

5.A.6.50 MPS OS1.3: Open Space Requirements

All development, excepting municipal projects serving municipal purposes, that qualifies as a DRI shall provide permanently restricted upland open space in accordance with the proportional calculation described below:

Total Development Area to Total Open Space Provided

Proportion Required	***Location of Development***
2:1	***Development in Growth Incentive Zones/Economic Centers***
1:2	***Development in Significant Natural Resource Areas***
1:1	***Development in all other areas***

For towns without designated Economic Centers, a DRI shall comply with the open space requirements based on its location relative to SNRA.

Calculation Based on Development Area

A project's open space requirement is calculated in direct proportion to the project's development area. For the purposes of calculating the open space requirement, the development area for new development and redevelopment is any previously undisturbed upland area (including upland areas that are functioning as habitat) affected by —development as defined in the Definitions section of this document. Additional guidance can be found in Guidelines for Calculation and Provision of Open Space in DRIs, Technical Bulletin 94-001, as amended.

Protection of Areas with Highest Natural Resource Values

Open space shall be designed to protect those portions of the site with the highest natural resource values as identified by a natural resources inventory. Within open space areas, the maximum amount of natural vegetation shall be maintained. Where development is located in more than one area as identified in the chart above, open space totals shall be determined for each area and added together. Where new development is proposed within Significant Natural Resource Areas, open space shall be provided within these areas. The requirements for Significant Natural Resource Areas shall apply to projects located in Growth Incentive Zones/Economic Centers that are located within a Significant Natural Resource Area, with exceptions as noted in Minimum Performance Standard OS1.7.

Provision of Off-Site Open Space

Where appropriate and at the Cape Cod Commission's discretion, credit may be obtained for set aside of off-site open space or a contribution of funds may be made to the town, state, land trust, or the Compact of Cape Cod Conservation Trusts' Land Fund for open space acquisition at a rate determined by the calculation specified below and to be updated annually per town in the Guidelines for Calculation and Provision of Open Space in Developments of Regional Impact, Technical

Bulletin 94-001, as amended. The Commission shall give priority to towns when determining the recipient of off-site open space donations or cash contributions. Off-site open space shall be provided in the town where development is proposed, unless the Commission finds, in consultation with the relevant towns, that the provision of off-site open space in an adjacent community on Cape Cod is appropriate.

Calculation of Cash Mitigation Open Space Option

On an annual basis, Commission staff shall calculate the per acre cash equivalent for open space for each town based on the following formula: Select all residentially zoned developable parcels in excess of two acres from town assessor's data. Determine per acre value for each of these properties, sort by value, remove top and bottom 10 percent of properties. The average of the remaining properties is the per acre open space value for that town for current assessor's data.

The per-acre open space value may be adjusted by a reasonable inflation factor for years where current assessor's data is not available.

Credit for Stormwater Low Impact Development

In public water supply Wellhead Protection Areas, stormwater management structures may be counted toward meeting the open space requirement where Low Impact Development (LID) Best Management Practices are used for stormwater infiltration (for example, vegetated swales, rain gardens and bio-retention areas).

Restrictions on Open Space Credit

No credit may be obtained for land that is set aside as open space on a residential lot on which a dwelling exists or may be built, unless the lot is at least three acres in size. No credit may be obtained for areas that have been dedicated as open space prior to the date of a DRI application.

Redevelopment within Growth Incentive Zones/Economic Centers

As an incentive for infill and redevelopment in appropriate locations, redevelopment within Growth Incentive Zones/Economic Centers is not required to provide open space. For the purposes of this exception only, redevelopment shall include projects expanding into greenfields, not to exceed 50 percent of the pre-existing development area on the site. Requirements for the protection of rare species, wetlands and vernal pool buffers shall continue to be met, if relevant. For towns without designated Economic Centers, this provision shall not apply.

Protection of Farmland

In the design of developments, and in the consideration of on-site or off-site open space, agricultural soils and agricultural uses shall be protected. In suitable locations and where conflicts with sensitive habitats and/or state law do not arise, conservation restrictions may reserve the right to farm.

Removal of SNRA Designation for the Calculation of Open Space

Requirement

Notwithstanding the foregoing, where an applicant can provide the following documentation required by subsections 1, 2, or 3 below, and where Commission staff has recommended such removal, the Commission in its discretion may remove the Significant Natural Resources Area designation from all or a portion of the subject property for which the facts in subsections 1, 2, or 3 apply, and open space requirements may be reduced consistent with the chart, Total Development Area to Total Open Space Provided, above, without the SNRA requirements.

1) ***For projects located within a Potential Public Water Supply Area, provide written supporting information from the Town or Water District that demonstrates to the Commission that the area will not be considered as a potential public water supply area.***
2) ***For projects located within an estimated or priority habitat for rare species as mapped by the Natural Heritage and Endangered Species Program, provide written supporting information from the Natural Heritage and Endangered Species Program that demonstrates to the Commission that the area is no longer considered endangered species habitat, and that NHESP will be changing the Natural Heritage Atlas to that effect.***
3) ***For projects located within mapped DEP wetland areas, provide written supporting information from a wetlands specialist that an onsite field evaluation establishes that no wetland resources as defined in the RPP are present on or within 100 feet of the proposed development site.***

The Project qualifies as a redevelopment project under MPS OS1.3 since it is located in a designated Economic Center and Project development will not exceed 50% of the pre-existing development area on the Property. The Property is currently developed to support electricity generating activities, and the Project will serve to expand these activities by redeveloping 12-acres of previously developed and highly disturbed land area within the Property. As such, the Applicant believes the open space requirement is not applicable to the Project. A more detailed discussion of the Project's compliance with MPS OS1.3 is provided in Section 5.M.

5.A.6.51 MPS OS1.4: Sensitive Natural Resources

In the design of developments, significant natural and fragile areas including critical wildlife and plant habitat, significant natural communities, water resources such as ponds and lakes, rivers, aquifers, shore lands, and wetlands; 100-foot buffers to wetlands; historic, cultural, and archaeological areas; significant scenic roads and views; and significant landforms shall be protected. Development should be located outside of 300-foot buffers to ponds and lakes and 200-foot buffers to rivers to the greatest extent feasible, and consistent with state law.

The Project has been designed to avoid and minimize impacts to sensitive natural resources, including wildlife habitat, water resources, historic resources, and viewscapes. The Project Site is highly developed and disturbed, and based on correspondence with the NHESP, no state-listed or federally listed rare plant or animal species inhabit the Project Site.

As discussed in Section 5.A.5.42, minimal impacts to the 100-foot buffer of an off-site wetland will occur associated with the placement of two utility poles to support the Project's electrical interconnection to the Eversource switchyard.

The Project will not impact historic, cultural or archaeological areas. The existing Station, located adjacent to the proposed Project, is a state-listed historic structure on the MHC MACRIS database and is designated by the Town of Sandwich as a historic site. The Project will not alter any structures of the existing Station that are considered historic. The MHC has determined that it is unlikely any intact archaeological resources are present on the Property due to disturbance of the ground surface associated with construction of the Cape Cod Canal and Units 1 and 2.

Project design has been selected to minimize impacts to views of the surrounding area, by location Project structures as close as possible to the structures of the existing Station. There are no distinctive or noteworthy landscapes as identified in the Massachusetts Landscape Inventory that would be impacted by the proposed Project. The Project Site is not bordered by designated scenic roads, and is located within the already developed Property.

5.A.6.52 BDP OS2.1: Recreation Needs

Recreational needs as identified in the 2000 Statewide Comprehensive Outdoor Recreation Plan, Local Comprehensive Plans, and local and regional open space plans should be addressed in the development of projects on Cape Cod. Such needs include opportunities for wildlife study, expansion of trail corridors, protection of scenic roadways, development and expansion of access for the disabled, additional public beaches, and water-based recreational opportunities with associated parking facilities to the extent these minimize alteration of natural shorelines and do not harm wildlife habitat.

No recreational areas will be impacted as a result of the proposed Project. North of the Property, a USACE-maintained public walkway runs along the Cape Cod Canal, with an associated parking area located northeast of the Property. The walkway is used by bicyclists, pedestrians, and recreational fishermen who use the walkway to access the canal. During Project operation, this recreation area will not be impacted and the public walkway will be maintained.

5.A.6.53 MPS TR0.1: Source(s) of Trip-generation Data

For the purpose of DRI review and analysis, trip-generation data from the Institute of Transportation Engineers shall be used as the preferred source. A project-specific trip-generation study may be used at the discretion of the Cape Cod Commission. In the event the applicant elects to complete a project-specific trip-generation study, traffic counts from existing development shall be collected and submitted using the methodology identified in the Cape Cod Commission Guidelines for Transportation Impact Assessment, Technical Bulletin 96-003, Revised January 9, 2003, as amended.

The proposed Project will have negligible traffic impacts on the surrounding roadway system. New positions for the Project will be filled with the existing Station staff. As there will be no change in the Station staff, there will be no additional employees commuting to the Project. Changes to schedule and frequency of routine truck deliveries will also be negligible. As new trip-generation associated with the Project will be nominal, an operational Project traffic impact analysis using trip-generation data is not applicable. A letter stamped by a professional traffic engineer verifying the Project will have no impact on traffic is provided as Attachment 5.C-3.

5.A.6.54 MPS TR1.1: No Degradation of Safety

Regardless of project traffic generation, DRIs shall not degrade safety for pedestrians, bicyclists, or motor vehicle operators or passengers.

The Project is proposed to be located within the Property of the existing Station and will not degrade safety for pedestrians, bicyclists or motor vehicle operators and passengers. The Property is located adjacent and south of a USACE-maintained public walkway, which is utilized by pedestrians, bicycles, and recreational fishermen. The Project will not directly impact the public walkway.

5.A.6.55 MPS TR1.2: Crash Frequency at Key Locations

Review of crash frequency over the most recent three years shall be required on all intersections of regional roads as well as at local road intersections with regional roads that are used by a project for access to the regional road network, where the DRI is expected to increase traffic by 25 vehicle trips or more during the project's peak hour. The most recent three available years of crash data shall be reviewed; the source(s) of the data shall be approved by the Cape Cod Commission staff. The applicant shall collect and submit crash data using the methodology identified in the Cape Cod Commission Guidelines for Transportation Impact Assessment, Technical Bulletin 96-003, Revised January 9, 2003, as amended.

The proposed Project will have negligible traffic impacts on the roadway system in the vicinity of the Project; therefore, there will be no increase in vehicle trips during the Project's peak hour. Nevertheless, crash frequency using crash data was analyzed for three major intersections in the vicinity of the Project to establish existing conditions of the surrounding roadways. All three intersections have crash rates lower than average for the MassDOT District 5, where the town of Sandwich is located, as well as for the state. A table providing a summary of the crash data is provided in Section 5.C.1.5.

5.A.6.56 MPS TR1.6: Sight-distance Obstructions

Human-made objects such as signage, utility poles and boxes, and lighting to service DRIs shall be located to minimize visual obstruction and possible safety conflicts for the traveling public, including glare or other distractions for drivers, bicyclists, and pedestrians. New utility service and relocation of existing utility service shall be placed underground, where deemed feasible and appropriate by the Commission. Further, landscaping and plantings shall be selected and placed in a manner that does not create obstructions to safe sight distances for motorists, bicyclists, and pedestrians.

No visual obstruction or safety conflicts for travelers on public roads will occur as a result of the proposed Project. The Project is to be located within the Property boundaries of the existing Station, and no Project structures will be located directly along a public roadway; Project structures situated on the western area of the Project Site will be located approximately 250 feet from Freezer Road.

5.A.6.57 MPS TR1.7: Bicyclist and Pedestrians Safety and Access/Egress Requirements

Site planning and access/egress for DRIs shall minimize adverse impacts on the adjacent road system and shall adequately and safely accommodate all users including pedestrians, bicyclists, and motorists. DRIs with drive-up windows shall be designed to confine the maximum expected vehicle queue on site to not interfere with traffic on public roadways.

As the Project will be located within the existing Property and will utilize the existing access driveway, there will be no impact to the adjacent roadway system as a result of the proposed Project. All Project structures will be set back from Freezer Road, with the closest Project structure, a service /fire water tank, located approximately 250 feet west of the roadway. The Project is not proposing to modify the existing access driveway; therefore, roadway conditions for pedestrians, bicyclists, and motorists will not change.

5.A.6.58 MPS TR1.8: Sight-distance Requirements

Acceptable sight distances shall be met and maintained at all access and/or egress locations for DRIs regardless of project traffic generation. At a minimum, sight distances shall meet the stricter of the Massachusetts Highway Department and American Association of State Highway Transportation Officials guidelines for safe-stopping sight distances.

For site access, the Project is proposing to utilize an existing driveway that is currently serving the Station. There will be no modifications to the existing driveway as a result of the proposed Project; therefore, existing site distance at the driveway will be unaltered and maintained.

5.A.6.59 MPS TR2.8: Preservation of Frontage

Where deemed appropriate by the Commission, DRIs shall provide appropriate rights-of-way along their street frontage to accommodate expected needs for bicycle and pedestrian accommodation and/or relocation of utilities. DRIs shall also provide for pedestrian and bicyclist connections across their property to allow for possible future connections with adjoining properties, where necessary. Construction of bicycle and pedestrian sidewalks, paths and/or connections may be required by the Commission.

The proposed Project will be located within the Property of the existing Station and all Project structures will be set back from the adjacent roadway. The Project structures closest to Freezer Road will be located approximately 250 feet to the west. As such, street frontage will be maintained and there will be no impact on bicycle and pedestrian accommodations as a result of the proposed Project.

5.A.6.60 MPS TR2.9: Parking Spaces

The maximum parking allowed for DRIs shall be no more than the minimum number of spaces required by the town(s) in which the DRI is located unless, in the Commission's discretion, a greater number of spaces are justified by a parking analysis accepted by the Commission.

To accommodate employees using the Training Building and anticipated visitors, the Project is proposing to replace an existing gravel parking area on the Project Site with a paved parking area. The paved parking area will provide approximately 30 marked parking spaces which are anticipated to meet employee and visitor parking needs. The proposed parking facility is located in an interior area of the Property and, to be consistent with the Project's security and safety requirements, will not be open to the public.

5.A.6.61 BDP TR2.15: Bike Racks and/or Storage

All DRIs proposing industrial or commercial uses are encouraged to provide secure bicycle racks and/or storage within close proximity of a building entrance for five percent or more of all building users (measured at peak periods), and provide shower and changing facilities in the building or within 200 yards of a building entrance for one-half percent of Full-Time Equivalent occupants.

To accommodate employees or visitors biking to the Project, a bicycle rack will be constructed in the proposed parking area to be located adjacent to the existing Training Building in the southwest corner of the Project Site.

5.A.6.62 BDP TR2.16: Alternate Modes of Travel

All DRIs are encouraged to include trip-reduction programs to encourage alternative modes of travel including carpooling, transit, bicycling, walking, and, where appropriate, working at home to reduce congestion, pollution, and energy usage; flexible work hours; and incentives for alternatives to automobile travel.

Canal 3 will inform and encourage its employees to carpool and consider alternate modes of travel when commuting to and from the Project, as appropriate.

5.A.6.63 BDP TR2.18: Rail and Marine Freight Shipment

Rail and marine freight shipment to and from Barnstable County is encouraged as an alternative to truck freight shipments, when appropriate.

The Project is uniquely situated directly south of the Cape Cod Canal and north of an active railroad owned by MassDOT and operated by the Cape Cod Central Railroad. The Project proposes to utilize both alternative delivery methods to reduce potential impact to the roadway system. Similar to the existing Station, the Project will receive shipments of its backup fuel (ULSD) by barge and shipments of aqueous NH_3 by rail through a specialty chemical delivery company. Shipments will follow the same unloading procedures as currently utilized for deliveries supporting the existing Station.

5.A.6.64 BDP TR2.19: Preferred Parking Spaces for Can/Van Pools

DRIs proposing office or industrial uses are encouraged to provide preferred parking spaces for car pools and van pools, marked as such, for five percent of the total parking spaces and be located closer to building entrances than general-use parking spaces.

To accommodate car pool and van pools for employees and visitors, preferred parking spaces will be designated within the parking area for the proposed Project.

5.A.6.65 BDP TR2.20: Parking Structures

Strategically located parking structures that serve several developments are encouraged where appropriate to serve Economic Centers and Growth Incentive Zones, provided such structures also comply with historic, community character, and environmental Minimum Performance Standards.

The parking area for the proposed Project will be located in the southwest corner of the Project Site adjacent to the existing Training Building. The prosed parking area will replace an existing hard-packed gravel parking area on the Project Site. The new parking area is proposed to serve the Project as well as accommodate the existing Station, as the existing parking area does currently. Therefore, the parking area will serve both of the developments on the Property.

5.A.6.66 BDP TR2.21: Shared Parking

DRIs are encouraged to share parking with adjacent uses to the maximum extent feasible.

The proposed Project's parking area will be shared with the existing Station, located directly adjacent to the west of the Project; therefore, the Project is consistent with this BDP.

5.A.6.67 MPS TR3.1: Operational Requirements

Regardless of traffic volumes, Level of Service analysis shall be required at all access and/or egress points onto the road system for DRIs. All new access and/or egress onto the road system for DRIs shall operate at Level of Service C or better during the project's peak hour for a maximum of five years after project occupancy, except that Level of Service D or better shall be allowed for a minimum of five years after project occupancy for projects located within designated Economic Centers or Growth Incentive Zones. For towns without designated Economic Centers, the Level of Service C standard shall apply. For unsignalized driveways, the Level of Service standards shall be met for each turning or non-turning maneuver; for signalized driveways, the Level of Service standards shall apply to the overall intersection Level of Service.

An existing driveway currently serving the Station will be utilized to provide access to the Project from Freezer Road. No modifications to the existing driveway will be made associated with the Project. Freezer Road is a short local road, providing a low level of traffic mobility. To determine the quality of traffic flow in the vicinity of the Project, a Level of Service (LOS) analysis was performed for three primary intersections (one signalized and two unsignalized) to determine peak hour traffic operations on associated roadways. The LOS analysis found that all but one approach to an unsignalized intersection operated at LOS C or better during AM and PM peak hours. Details of the LOS analysis and results are provided in Section 5.C.1.4. The LOS of the existing access/egress onto the road system, as measured at the closest intersection to the access driveway, operates at LOS B or better. Since there will be no material change in operational traffic volumes (see Attachment 5.3-C), no change to the current LOS will occur.

5.A.6.68 MPS TR3.10: Preserve Existing Rights-of-Way

Existing transportation rights-of-way shall be preserved for transportation uses as well as to limit trip generation.

The Project will utilize existing transportation rights-of-way, including an existing driveway that serves the existing Station. Employee commuter traffic and routine truck delivery routes are not anticipated to change as a result of the proposed Project; trip generation for operation of the Project will be nominal.

5.A.6.69 MPS WM1.5: Compliance with Massachusetts Hazardous Waste Regulations

Any development or redevelopment that uses, handles, generates, treats, or stores Hazardous Waste shall be in compliance with Massachusetts Hazardous Waste Regulations, 310 CMR 30.0 for the purposes of Cape Cod Commission review by providing the Commission with evidence of the following:

a) registration with or notification to the Massachusetts Department of Environmental Protection as a generator of Hazardous Waste;
b) a written plan or protocol to manage the Hazardous Waste prior to disposal;
c) a signed contract with a registered, licensed company to dispose of the Hazardous Waste.

As defined under 310 CMR 30.030, the existing Station is registered with MassDEP as a Small Quantity Generator of (non-oil) hazardous waste, with registration ID number MAD071708929. The proposed Project will not change the current generator classification. The existing Station's waste management protocols will be updated to reflect the new unit, as appropriate.

5.A.6.70 BDP WM1.6: Elimination of Hazardous Materials/Waste

Development and redevelopment is encouraged to eliminate Hazardous Materials or Hazardous Waste handled, treated, generated, used, or stored at a pre-existing facility, site, or project.

The Project will store and use a variety of chemical reagents and materials in conjunction with operation and maintenance of an energy generating facility. These materials will be the same as or comparable to those currently used in the operation of the existing station. As is the current practice at the Station, all potentially hazardous materials will be stored in designated containment areas and received and handled in accordance with written control procedures. The SPCC Plan, which is being maintained for the existing Station, will be modified to reflect the Project's proposed chemical storage.

5.A.6.71 MPS WM2.1: Construction Waste

Development and redevelopment projects shall address the disposal of construction waste at both the construction and post-construction phases of development or redevelopment. To do so, a plan shall be provided to demonstrate how the applicant proposes to handle solid wastes, construction and demolition (C&D) wastes, and recyclable materials currently categorized by the Massachusetts Department of Environmental Protection (DEP) as a waste ban material.

Construction waste generated during the construction period will be stored, handled, and managed by the construction contractor. It is anticipated that much of construction waste will be recyclable. Construction solid wastes will generally include scrap wood, excess concrete, empty containers, scrap metal, paper products, and insulation. These materials will be segregated into stockpiles for salvage or on-site reuse where possible or collected by a recycling contractor for off-site processing or recycling. Non-recyclable solid wastes, including trash from construction offices and administrative areas, will be transported to a licensed solid waste disposal facility.

5.A.6.72 MPS WM2.2: C&D Waste Plan

If C&D waste is to be generated as a part of the proposed development or redevelopment, a plan shall be provided that specifies:

- ***a listing of C&D wastes that will be generated during the development or redevelopment;***
- ***the method for separating, storing, transporting, and disposing of gypsum (wall board and sheetrock) from the remainder of the waste stream; and***
- ***the methods that will be used to recycle or dispose of those remaining materials in the C&D waste stream.***

Wastes generated during construction will generally include scrap wood, excess concrete, empty containers, scrap metal, paper products, and insulation. Preparation of the Project Site for construction will include demolition of existing earthen- and concrete-slab, aluminum-sided warehouses and the removal of several temporary trailers. Waste materials from these activities will be segregated and stockpiled to be reused on-site or picked up by a recycling contractor or solid waste disposal contractor for processing and recycling. Non-recyclable solid wastes will be transported to a licensed solid waste disposal facility. As the Project consists primarily of unenclosed structures, waste containing gypsum is not anticipated in significant quantities.

5.A.6.73 MPS WM2.3: Post-construction Waste

A solid waste and recycling management plan shall be provided that identifies how both solid wastes and recyclable materials will be handled in the post-construction phase of the development. In particular, the applicant shall provide a plan detailing how waste ban materials (particularly plastic, glass containers, and cardboard) will be collected, stored on site, and recycled.

Post-construction wastes generated during operation and maintenance include metal and plastic, insulation material, paper, glass, empty containers, and other miscellaneous solid wastes. These materials will be collected for recycling or off-site disposal in accordance with applicable regulatory requirements. Canal 3 will institute programs to maximize recycling through measures such as placing recycling containers in and around the facility to facilitate the recycling program. A private contractor will dispose of non-recyclable solid waste materials.

5.A.6.74 MPS E1.1: Redevelopment Energy Audit

Redevelopment shall perform an energy audit of existing conditions and incorporate recommendations into the project design. Guidance on audit components can be found in Technical Bulletin 09-002, Development of Regional Impact Guidelines for Energy Compliance, as amended.

Energy improvements to the existing Training Building will occur with development of the proposed Project. An energy audit of the Training Building is presented in Section 5.Q.1.

5.A.6.75 MPS E1.2: Designed to Earn ENERGY STAR® Certification

Nonresidential development and redevelopment shall be designed to earn the ENERGY STAR® Target Rating of 75 or higher.

No new inhabited buildings will be constructed. Energy efficiency improvements to the existing Training Building are proposed. Improvements to the Training Building will be consistent with the Leadership in Energy and Environmental Design (LEED) Certification. Section 5.Q.2 addresses the proposed energy improvements.

5.A.6.76 MPS E1.3: ANSI/LEED Standards

Nonresidential development and redevelopment shall comply with current ANSI/ASHRAE/IESNA Standard 90.1-2007, Section 5.4 – Insulation, Fenestration, and Doors or current prerequisite LEED-certified standard, or successor standards designated by the Commission.

Improvements to the Training Building will be consistent with current American National Standards Institute (ANSI)/LEED standards; compliance is discussed in Section 5.Q.3.

5.A.6.77 MPS E1.5: On-Site Renewable Energy Generation

Except for mixed-use projects located in designated Economic Centers as identified on the Regional Land Use Vision Map, non-residential commercial development and redevelopment involving net new construction shall provide a minimum of 10 percent of a building's projected annual electrical demand (kWh) through on-site renewable energy generation. In the case of

redevelopment, the 10-percent calculation shall be based solely on the gross floor area of the additional new development in excess of 10,000 square feet. EPA average energy-intensity levels by building type and square feet are used as a baseline to calculate the 10-percent energy demand. In addition, applicants may provide an energy model to determine annual site-demand input for their project. Guidance on calculating energy demand can be found in Technical Bulletin 09-002, as amended. The Commission may waive this requirement if:

- ***The project provides 5 percent of electrical demand through on-site renewable energy systems and participates in the Cape Light Compact Green Program for 100 percent of their remaining electricity needs.***

–or–

- ***The project is LEED certifiable.***

–or–

- ***The project demonstrates compliance with six of the following:***
  - ***Installs ENERGY STAR®-compliant reflective roofing, or a vegetated roof.***
  - ***Re-uses existing structures (including shell and non-shell).***
  - ***Incorporates renewable energy.***
  - ***Installs a geothermal heating system.***
  - ***Incorporates passive solar design.***
  - ***Installs energy-conserving landscapes (for example, native species).***
  - ***Complies with ANSI standards (6.4 – HVAC; 7.4 – Load Calculations, Equipment Efficiency, Service Hot Water Piping Insulation, Service Controls, Pools, Heat Traps; 9.4 – Lighting Control, Tandem Wiring, Exit Signs, Exterior Grounds Lighting).***

The Canal Community Solar Project is being developed on a 26-acre property south of Project Site by NRG Renew Canal 1 LLC, an affiliate of Canal 3. The 1.5-MW solar project will deliver electricity to the grid to be used by Cape Cod and Massachusetts residents. The solar arrays will annually generate over 15 times the electric load of the improved Training Building. Section 5.Q.4 further describes the Project's consistency with MPS E1.5.

5.A.6.78 MPS HPCC1.1: Historic Structures

An historic structure's form, massing, and key character-defining features, including the relationship to its site and setting, shall be preserved. Additions and alterations to historic structures shall be consistent with the building's architectural style and shall not diminish its historic and architectural significance. Removal or alteration of distinguishing original stylistic features or examples of skilled craftsmanship of historic or aesthetic significance shall be prohibited unless the Commission determines that such removal or alteration will not have a significant negative impact on the integrity of the historic property, surrounding historic district, or otherwise distinctive neighborhood. Demolition is considered only if a building or structure is found no longer eligible for listing on the National Register or no longer contributing to the historic significance of the district. There is a presumption in favor of retaining all National Register-eligible structures, and all contributing structures in an historic district due to the determination of significance by the Massachusetts Historical Commission and/or the National Park Service. If a demolition request is based upon structural instability or deterioration, a technical report prepared by a registered architect or engineer may be required, detailing the nature and extent of the problems and a reasonably adequate estimate of the cost to correct them. The Commission may hire its own structural engineer to evaluate the property and verify the content of the applicant's report, and the applicant may be required to pay a portion of that cost.

No historic structures exist within the 12-acre Project Site; however, the Canal Generation Station is listed as a historic structure on the MHC MACRIS database and is designated by the Town of Sandwich as a historic site within the District. Specifically located in the Town Neck neighborhood of the District, the Property is located on land once owned by Edmund Freeman, Sr., and his descendants. Freeman settled in the area in 1637 and is considered the founding father of Sandwich. While several historic resources associated with Freeman's decedents in vicinity of the Property have been destroyed, stonewalls and outbuilding remains may exist. The Project will not impact or disturb any structures associated with the Freeman Farmstead site. Discussion of historic resources in proximity of the Property is provided in Section 5.N. While the Project is located directly adjacent to the existing Station, no changes will be made to Station structures considered historic.

5.A.6.79 MPS HPCC1.2: Cultural Landscapes

The distinguishing original features of an historic or cultural landscape shall be preserved. New development adjacent to or within historic or cultural landscapes shall be located to retain the distinctive qualities of such landscapes and shall be designed to maintain the general scale and character-defining features of such landscapes. In particular, historic agricultural lands and other working agricultural lands shall be retained to prevent further loss of these dwindling resources that speak to the Cape's agricultural past.

The landscape in the northwest portion of the town of Sandwich within the vicinity of the Station is of mixed visual character. Since the mid 1970's, the existing Station has been a major visual element in this part of the town. Along State Route 6A, the visual character of the area is defined by the interspersing of single family homes and historic landmarks with recreation-oriented commercial establishments consisting of motels, specialty shops, and restaurants. East of the Property, the single family residential neighborhood and the Town Beach area impart a residential ocean community character.

Views of the Property from many surrounding areas are limited to the existing Station's 498-foot tall exhaust stack due to the mature forested ground cover and the topography of the area. The Project Site is not bordered by designated scenic roads or distinctive or noteworthy landscapes as identified in the Massachusetts Landscape Inventory, and is located within the already developed Property. Forested lands are scattered throughout the area, which restrict views of the existing Station.

The Project has been designed to result in the least visual change to the landscape in the northwest portion of the town of Sandwich and surrounding vantage points. The stack has been oriented to minimize the effect of new visual elements and to utilize the existing Station structures for their screening effect. The proposed stack will only be 10 feet taller than the adjacent Unit 2 power block building and less than half the height of the existing stack. As such, little visual change to the landscape will occur as a result of the proposed Project.

5.A.6.80 BDP HPCC1.4: Local Preservation Efforts

Development projects that do not include an historic preservation or rehabilitation component are encouraged to contribute to public or nonprofit preservation efforts in the community.

As part of its payment in lieu of taxes (PILOT) agreement with the Town of Sandwich, NRG will make significant payments to the Town of Sandwich's Community Preservation Fund. Created as part of the Town's adoption of the Community Preservation Act (CPA) in 2005, the Community Preservation Fund is used by the Town to acquire and protect open space, preserve historic buildings and landscapes, and create and maintain affordable housing. In its implementation of the Act, the Town established a Community Preservation Committee that makes recommendations to the Board of Selectmen and Town Meeting for the use of CPA funds.

5.A.6.81 BDP HPCC1.5: Preservation Restrictions

Protection of significant historic structures, cultural landscapes, and archaeologically sensitive areas is encouraged through conservation restrictions or preservation restrictions that ensure their long-term preservation.

The Project has been designed to minimize impact to preserve surrounding historic structures and cultural landscapes. The proposed Project is located adjacent to the existing Station, a state-listed historic structure and town of Sandwich-designated historic site, within the District. The Project will not alter any structures of the existing Station considered historic. The Project layout has been selected to minimize impact on the surrounding landscape to preserve views of the area, with the Project structures located as close as possible to the structures of the existing Station. As the MHC has concurred that the Project Site is located in an area where the presence of any intact below-ground archaeological resources is highly unlikely, the Project poses no impact to archaeologically sensitive areas.

5.A.6.82 MPS HPCC2.4: Consistency with Regional Context or Surrounding Distinctive Area

All development and redevelopment shall be consistent with the region's traditional development patterns, reflecting features such as modest building mass, height, scale, roof shape, roof pitch, building materials, and proportions between doors and windows. In areas with a distinctive character, such as historic districts, village centers, cultural landscapes, and historic properties, any design shall be consistent with the character of the area and reflect the surrounding context. Distinctive features of the area such as proximity to the street, views to historic structures, water and/or landscapes, and significant open spaces shall be preserved. A building design narrative is required as part of the DRI application to justify how the building relates to the surrounding context. Contemporary design and green design are encouraged and sometimes required in response to standards in the Energy chapter under Goal E.1, but must be supported by the design narrative.

Project design has been selected to be consistent with the character of the area and compatible with structures of the existing Station. The northwest region of Sandwich is predominated by mixed land use consisting of residences, recreation-oriented commercial businesses, such as motels, specialty shops and restaurants, and industrial facilities. The Project will not alter this mixed-use development pattern, but will expand an existing land use. To integrate most effectively the Project into the surrounding area, the Project aesthetic design will reflect features of the existing Station. Building materials and colors for the Project will be similar to those of the existing Station; however, Project buildings have been designed to be smaller and shorter than those of the existing Station. Project colors will include grey and green, as shown in the Site Development Plans in Section 4.0. Configuration of Project structures has been deliberately chosen to minimize the amount of visual change from off-site vantage points to maintain the character of the area, and Project structures have been placed as close as possible to existing structures to utilize the screening effect of the existing Station.

5.A.6.83 MPS HPCC2.5: Footprints over 15,000 Square Feet

For all new development, no individual structure shall exceed a footprint of 15,000 square feet unless it is designed as multiple distinct massings differentiated by significant variations in roofline and building footprint, or is fully screened. The method of screening shall be consistent with the character of the surrounding area, but shall typically consist of traditionally scaled frontage buildings within developed areas, and vegetated buffers of 200 feet in depth in outlying areas. Redevelopment projects may expand to a single massing of 50,000 square feet without full screening if the expansion occurs on previously developed impervious or landscaped areas.

No individual Project structure will exceed a footprint of 15,000 square feet.

5.A.6.84 MPS HPCC2.6: Building Forms and Façades

For all development and redevelopment involving new construction, the massing, façades, and roof configuration of a building shall be varied. If a building façade is more than 50 feet in length, it shall include a minimum of 10 feet of variation in the building footprint (set-back or projection in the building wall) for every 50 feet of façade length, and related changes in the roofline in order to reduce the apparent mass of the building.

The majority of the Project consists of structures and equipment to support energy generation, and few enclosed buildings will be constructed in association with the Project. The enclosure buildings have been designed to be compatible with existing structures on the Property. The Site Development Plans in Section 4.0 provide detailed building façade drawings and a roof plan of the proposed buildings. While a few building façades exceed 50 feet in length, the Project Site's multiple enclosures of various sizes will reduce the apparent mass of the buildings.

5.A.6.85 MPS HPCC2.7: Non-traditional Materials and Designs

In industrial parks or areas not visible from scenic or regional roadways or other distinctive areas noted above in MPS HPCC2.4, use of nontraditional materials, forms, and site designs may be appropriate. In such areas, maintenance of adequate buffers on the subject property shall be required to ensure that the proposed development is screened from view.

Materials and designs of the proposed Project were selected to be consistent with existing elements of the Station. The proposed Project materials will include painted steel and aluminum siding. The colors of proposed Project elements and structures will be primarily green and grey, consistent with those of the existing Station. As such, the Project will be compatible, but smaller in scale than the existing structures. The Site Development Plans in Section 4.0 provide elevation drawings and building and structure details.

5.A.6.86 MPS HPCC2.8: Parking to the Side or Rear of Buildings

The building and layout of all parking lots shall follow good design practices and reinforce regional development patterns. Parking for all development shall be located to the rear or the side of a building or commercial complex unless such location would have an adverse or detrimental impact on environmental or visual features on the site. In such cases, alternative means of minimizing environmental or visual impacts of the proposed parking shall be required.

A parking area to be used by Project employees and visitors is proposed in the southwest corner of the Project Site adjacent to the existing Training Building (see Section 4.0). The central location of the parking area is consistent with good design practices to reduce visual impact of parking facilities. Due to intervening structures, including the cooling fan module, demineralized water tank, water treatment area, service/fire water tank and pump house, the Project parking area will not be visible from Freezer Road.

5.A.6.87 MPS HPCC2.9: Landscaping Improvements for Redevelopment

Redevelopment shall significantly improve buffers between parking areas and the street, as well as interior parking-lot landscaping, and shall provide façade improvements and frontage buildings, as necessary and if appropriate, to improve the visual character of the site.

Landscaping will be improved with redevelopment of the Project Site to support the proposed Project. The Project Site is currently occupied by concrete-slab, aluminum-sided warehouses; two 60,000-gallon NH_3 storage tanks, several temporary trailers, and hard-packed gravel area used for temporary parking. Sparse existing vegetation on the Project Site consists of grasses and other herbaceous plant species, with non-native species adapted for disturbed conditions predominating. As shown on the Project's landscaping plan, provided in Section 4.0, landscaping will include buffers around the parking area and northern, eastern, and

southeastern Property boundaries, which will improve the visual character of the Project Site and Property from its existing conditions.

5.A.6.88 MPS HPCC2.10: Landscape Plan Requirements

All development shall provide landscaping that integrates buildings with their environment, enhances architectural features, fosters sustainable practices, clearly divides parking lots into smaller areas, includes tree planting, and provides amenities for pedestrians. All development shall implement a landscape plan that addresses the functional aspects of landscaping, such as drainage and innovative stormwater technologies, erosion prevention, screening and buffering, provision for shade, and energy conservation. When vegetative buffers are necessary to prevent adverse visual impacts from new development, existing vegetation shall be retained and unaltered in the buffer area. A maintenance agreement shall be provided by all development for a minimum of three growing seasons to insure vegetation is properly established.

Landscaping will be integrated into the Project design, as shown in the Project's landscaping plan presented in Section 4.0. Landscaping will include mulched beds along the Project's parking facility, Training Building, northern Property boundary, eastern Property boundary, and southeastern Property boundary. The trees and shrubs to be planted will include red maple (*Acer rubrum*), white oak (*Quercus alba*), eastern red cedar (*Juniperus virginiana*), white pine (*Pinus strobus*), summersweet clethra (*Clethra alnifolia*), inkberry (*Ilex glabra shamrock*), northern bayberry (*Myrica pensylvanica*), beach plum (*Prunus maritima*), staghorn sumac (*Rhus typhina*), little bluestem grass (*Schizachyrium scoparium*), and viburnum (*Viburnum dentatum*). Project landscaping will also consist of vegetated stormwater technologies, dually purposed to treat Project stormwater and improve existing stormwater conditions on the Project Site. There will be three vegetated infiltration basins coupled with sediment forebays, water quality swales and vegetated filter strips to pretreat sheet flow from areas such as the access roadways.

5.A.6.89 MPS HPCC2.11: Exterior Lighting

Site lighting and exterior building lights in all development shall meet the following standards. This Minimum Performance Standard shall not apply to aviation warning or marking lights as may be required by the Federal Aviation Administration.

- ***Employ —shoe-box type or decorative fixtures, consistent with the architectural theme of the development and which are fully shielded.***
- ***Use a mounting configuration that creates a total cutoff of all light at less than ninety (90) degrees from vertical (flood, area, and up-lighting are prohibited).***
- ***Provide total cutoff of all light at the property lines of the parcel to be developed.***
- ***Meet a maximum initial horizontal foot-candle level of not more than 8.0 foot-candles, as measured directly below the luminaire(s) at grade.***

Additional guidance can be found in Technical Bulletin 95-001, as amended.

An exterior lighting plan for the Project prepared in accordance with Technical Bulletin 95-001, *DRI Guidance for Exterior Lighting Design*, is provided in Attachment 5.P-1.

5.A.6.90 MPS HPCC2.12: Signage

The installation of billboards, off-site advertising (except approved directional signs), and internally lit or flashing signs shall not be permitted. The size and color of all signs shall be in scale and compatible with the surrounding buildings and street. When more than one sign is used, the graphics shall be coordinated to present a unified image. Wooden signs, either painted or carved, are usually most appropriate.

There will be no installation of billboards, off-site advertising, or internally lit flashing signs as part of the Project. The Project will utilize the existing sign for the Station, which is located along Freezer Road adjacent to the Property.

5.A.6.91 MPS HPCC2.13: Underground Utilities

All utilities for development including cable shall be placed underground except where the presence of natural features such as wetlands or archaeological resources prevent such placement.

Utility development to support the proposed Project will include a new natural gas interconnection pipeline, a new 12-inch fuel line to deliver ULSD, and a new 345-kV electrical transmission line. The natural gas pipeline and ULSD delivery line will be within Property boundaries and underground or within an existing aboveground pipe rack. To deliver electricity to the regional grid, the new 1,850-foot 345-kV transmission line will interconnect the Project to the Eversource switchyard located south of the Property. For engineering functionality and maintenance purposes, the electric transmission cables must be placed aboveground. The transmission line route has been chosen to avoid and minimize impacts to an off-site wetland and wetland buffer by spanning over the wetland.

5.A.6.92 BDP HPCC2.15: Conservation Restrictions for Landscapes and Viewsheds

Maintaining the integrity of natural landforms and broad, open views of the landscape as seen from any public way or waterway is encouraged and should include long-term protection through conservation restrictions or other means.

The Project layout and design elements were selected to ensure the Project is least visually intrusive on views of the surrounding landscape. Project structures will be shorter than the structures of the existing Station, and will be situated as close as possible to the existing Station structures to utilize their screening effect and consolidate development area. Views of the proposed Project will be mostly limited to views from the north and east. Figure 5.A-8 shows the locations where photographs were taken of the Property to document landscape views of the area. Figures 5.A-9 through 5.A-17 superimpose a three-dimensional model of the proposed Project on the photographs taken from these locations. As shown, current views from all locations where the proposed Project will be visible are dominated by the existing Station; therefore, the integrity of open views of the area will not be significantly altered.

5.A.6.93 BDP HPCC2.16: Specimen Trees and Original Topography

Preserving the distinguishing original features of a site such as specimen trees, existing plantings, and topography is encouraged.

The Project Site is highly developed and disturbed with sparse vegetation and no distinguished natural features. There are no specimen trees on the Project Site. The Project will utilize landscaping with native, non-invasive plant species upon completion of construction. Topography on the Project Site will be modified to accommodate for flood zones and anticipated sea level rise; however, significant alterations of topography have been limited to critical Project structures, which will be elevated to 16 feet NAVD88.

5.A.6.94 BDP HPCC2.17: Impervious Parking Areas

Shared parking, on-street parking, and community parking lots are encouraged in order to reduce the amount of land devoted to parking. In individual developments, methods to reduce exposed paved areas such as parking underground or in a portion or the building's first floor, separate parking structures consistent with the Commission's Design Manual, and use of alternate paving materials are encouraged.

As a simple-cycle energy generating facility, shared parking between the Project and adjacent off-site uses is not practicable due to security and safety concerns. While the Project may share parking with the existing Station, the Project is proposing to relocate the existing parking area close to the new Project structures in the southwest corner of the Project Site. Permeable pavement will be introduced into the parking area to minimize the amount of impervious surface.

5.A.7 Benefits Analysis

The proposed Project is designed to provide additional capacity to the SEMA/RI capacity zone, which would help to ensure resource adequacy and reliability, particularly during periods of peak demand. In addition, due to the Project's ability to start up and reach full load within 10 minutes, it will also play a critical role during abnormal grid operating conditions – typically caused by major weather events or unexpected equipment outages. Testimony submitted to the EFSB indicated that the proposed 350-MW Project will result in a net reduction of overall cumulative CO_2 emissions in the New England region by more than 143,600 tons over the 10-year study period. The analysis indicates that the Project will more than offset its own GHG emissions and will lead to overall reductions in GHG emissions from the region's electric system.

Moreover, since the Project cleared in FCA #10 in early February 2016, it will provide positive benefits for the region in the form of moderating capacity prices and increasing reliability. The Project also will help facilitate the integration of renewable resources by adding fast-start and quick ramping ability to the regional power system.

The Project will provide positive benefits locally by meeting and exceeding local development standards to be consistent with CCC's development goals for the region. As detailed in Section 5.A.6, not only does the Project meet the applicable RPP MPS, but also it meets or exceeds applicable BDP. Meeting or exceeding these standards allows the Project to be consistent with RPP goals related to: compact growth and resource protection; low-impact and compatible development; a balanced economy; general aquifer protection; stormwater quality; maritime industry, character, and public access; coastal hazard mitigation; coastal water quality and habitat; wetlands; wildlife and plant habitat; open space and natural resources; transportation safety; trip reduction and transportation balance; level of service and congestion management; hazardous materials and waste; solid waste; emissions and energy use; historic, cultural, and archaeological resources; and community character.

In addition, the proposed Project will benefit the town of Sandwich by increasing local employment opportunities and expanding the local economy during both the construction and operation phases. The Project will also significantly increase the property tax base for the town, potentially lowering the tax burden of local businesses and residents by offsetting the cost of many services in the local community. A more detailed analysis of the Project's economic benefit to the town of Sandwich is provided in the Economic and Fiscal Impact Analysis in Attachment 5.I-1.

5.B WRITTEN DESIGN NARRATIVE

5.B.1 Site Location and Surroundings

As shown on Section 4.0, the Project is proposed on the 12-acre Project Site, located within the existing 52-acre Property at 9 Freezer Road in Sandwich, Massachusetts, south of the Cape Cod Canal. The Property is zoned as IND, with most of the available space developed to support the existing Station. The Project Site is currently occupied by earthen- and concrete-slab, aluminum-sided warehouses, two 60,000-gallon NH_3 storage tanks, several temporary trailers, and a hard-packed open area used for temporary parking.

As shown in Section 4.0, the Property is located east of the boundary between the town of Sandwich and the town of Bourne; south of the Cape Cod Canal; west of the Sandwich Marina; and north of Rickeys Road and an active railroad ROW, owned by MassDOT and operated by the Cape Cod Central Railroad. Adjacent properties consist predominantly of forested, undeveloped land, with the Eversource electrical switchyard to the south, and a public marina to the east. Between the Cape Cod Canal and the Project Site is a USACE-maintained public walkway. Scusset Beach State Reservation is located on the north shore of the Cape Cod Canal.

The nearest residence is located proximate to the existing guard station, southeast of the Property, across the active railroad ROW. Additional residential development is located along Tupper Road, approximately 500 feet south of the Project Site, and beyond the Sandwich Marina, approximately 1,500 feet east of the Project Site.

The northwest portion of the town of Sandwich is an area of mixed use. Since the mid 1970's, the Station has been a major element in this area, while the adjacent Cape Cod Canal, Sandwich Marina, Cape Cod Canal Visitors Center, and Scusset Beach State Reservation have established a strong recreational identity for the area. Along State Route 6A, single family homes and historic landmarks are interspersed with the recreationally oriented commercial establishments such as motels, specialty shops, and restaurants. A residential community lies east of the Property, where the Cape Cod Canal enters Cape Cod Bay.

5.B.2 Design Concept

Since ISO-NE had identified the SEMA/RI load zone as the most constrained, the proposed Project has been designed to provide additional capacity to this load zone, helping to ensure resource adequacy and reliability, particularly during periods of peak demand. The Project is a highly flexible resource capable of providing capacity, energy, reserves, and other ancillary services (automatic generator control, frequency regulation, and voltage support). Under ISO-NE's pay-for-performance design, a capacity resource must be able to respond fully to a dispatch order within 30 minutes. With the ability to start up and achieve full load within 10 minutes, the Project satisfies this requirement. This fast-start capability allows the Project to play a critical role during abnormal grid operating conditions – typically caused by major weather events or unexpected equipment outages. Since the Project cleared in ISO-NE's most recent FCA #10, it will provide positive benefits for the region in the form of lowering capacity prices and increasing reliability. The Project will also help facilitate the integration of renewable resources by adding fast-start and quick ramping ability to the regional power system.

By using a state-of-the-art combustion turbine, the Project will be one of the most efficient peaking units in New England. Therefore, during times of peak demand on the bulk power system, when the Project is operating as an energy resource, the Project will be dispatched when it becomes the most efficient resource available.

Although designed to operate primarily on natural gas, the Project is also capable of operating on ULSD. The Project will normally operate on natural gas, unless it is not physically available. The Project will notify the natural gas suppliers in advance in order to obtain sufficient natural gas for startup and operation. Although ISO-NE's energy markets have been designed to accommodate this requirement, when the Project is operating as a reserve unit it must be able to start at a moment's notice and achieve full load within 10 minutes. Under these operating conditions, the Project will not be able to start on natural gas without disrupting service to downstream customers on Cape Cod. Therefore, the Project will start up on ULSD, and then work in conjunction with the natural gas pipeline operator to switch over to natural gas as soon as reasonably practicable.

5.B.3 Alternatives Considered

5.B.3.1 Size and Technology Alternatives

The objective of the Project is to be a fast-ramping, highly flexible, responsive, dual-fuel electric generating resource. Dual-fuel capability will allow the resource to provide winter reliability on the ISO-NE system, while the fast-ramping and flexible nature of the resource will support increasing renewable generation. A key objective of the Project is to supply at least 300 MW of capacity within 10 minutes of a cold start, as required by the Ten Minute Non-Spinning Reserve (TMNSR) market. To accomplish this objective, three alternative turbine designs and configurations were evaluated for the Project:

- one simple-cycle frame design, based on the GE 7HA.02;
- three simple-cycle aero derivative design, based on the GE LMS-100PA; and
- two fast-start combined-cycle design, based on the Siemens SGT6-5000F “Flex Plant” 10.

Due to the design and operation of the New England Reserve market, a key consideration in evaluating the turbine designs is how they compare over the first hour of operation, as these units often operate for only one hour at a time. Over the first hour of operation, the heat rate of the GE 7HA.02 is lower (better) than that of the Flex Plant 10 because the steam turbine portion of the Flex Plant 10 doesn’t become effective until after the first hour, when the Heat Recovery Steam Generator (HRSG) portion of the unit has warmed up. During the first hour, the Flex Plant 10 essentially operates similar to a simple-cycle unit. When operating in the TMNSR market, the Flex Plant 10 would often be required to shut down before it achieves combined-cycle operation, and a large portion of the benefit of combined-cycle efficiency would be lost. Additionally, the Flex Plant 10 alternative, which would require two units to provide a 10-minute output comparable to a single GE 7HA.02, would have a capital cost on the order of twice that of the GE 7HA.02. The Flex Plant 10 does have somewhat lower GHG emissions than the 7HA.02 on a pounds per net megawatt-hour (lb/net MW-hr) basis, when firing natural gas at steady-state. However, during first-hour operation on ULSD, the Flex Plant 10 has higher GHG emissions than either simple-cycle alternative.

In comparing the two simple-cycle options, the LMS-100PA does not offer the economy of scale that a 7HA.02 provides. The initial capital cost of using LMS-100PA technology is on the order of 25% greater than using an H-class simple-cycle unit. The LMS-100PA is also not a space-efficient machine. The LMS-100PA does compare favorably in terms of GHG emissions, noise impact, and water demand. GHG emissions are, on balance, comparable, and noise can be adequately mitigated for both turbines; however, water demand is significantly less for the 7HA.02 during natural gas firing.

Based on review of the available combustion turbine generating technologies, Canal 3 identified a single GE 7HA.02 simple-cycle unit as the alternative best suited for the Project. The size of the single 7HA.02 unit matches up well with the identified power needs, as it offers a very attractive combination of simple-cycle efficiency, size, and economy of scale along with its 10-minute generation capability.

5.B.3.2 Site Alternatives

NRG Energy, Canal 3’s parent company, is one of the largest energy companies in the United States. Its corporate philosophy has a strong sustainability focus, including development and operation of renewable energy resources, while integrating a balanced portfolio of energy generation technologies to provide for a reliable response to the nation’s energy demand. As part of its sustainability focus, NRG Energy aligns its development of additional fossil fuel-fired capability with the location of existing similar facilities in order to add efficiency, improve technology, and minimize new infrastructure impacts on host communities.

Since ISO-NE has identified the SEMA/RI load zone as the most constrained, sites located in this load zone were given the highest priority. NRG Energy’s corporate sustainability philosophy focused the site selection process on sites currently and formerly owned by NRG Energy and its subsidiaries, as well as other sites

that currently host electric generating facilities that NRG Energy had considered for possible expansion as part of its evaluation of those sites in recent divestiture opportunities.

In focusing on such sites, the significant environmental, community, and cost impacts associated with clearing and adapting a "greenfield" site to power generation were avoided. In addition, this approach minimized or eliminated the need for new infrastructure to connect the proposed Project to fuel sources and the electric grid. Consistent with these objectives, a total of 12 sites that NRG Energy owned or had recently owned, plus five sites in SEMA/RI that it had previously evaluated, were initially considered as candidate locations for the Project. The 17 candidate sites were:

- Brayton Point, Somerset, Massachusetts
- Canal Generating Station, Sandwich, Massachusetts
- Connecticut Jet Power Fleet (four sites):
    - Cos Cob
    - Branford
    - Torrington (Franklin Drive)
    - Torrington Terminal
- Dartmouth Power, Dartmouth, Massachusetts
- Devon Station, Milford, Connecticut
- Dighton Power, Dighton, Massachusetts
- Fore River Station, Weymouth, Massachusetts
- Middletown Station, Middletown, Connecticut
- Montville Station, Uncasville, Connecticut
- Norwalk Harbor Power Plant, Norwalk, Connecticut
- Oak Bluffs Plant, Martha's Vineyard, Massachusetts
- Somerset Power , Somerset, Massachusetts
- Tiverton Power, Tiverton, Rhode Island
- West Tisbury Generators, Martha's Vineyard, Massachusetts

Limiting initial consideration to sites currently or formerly owned by NRG Energy, as well as previously evaluated sites, allowed for enhanced knowledge of site characteristics beyond what might ordinarily be known when screening sites generally. The initial site screening was based on the following characteristics:

- an electric generating facility has operated on the site, indicating appropriate zoning and community acceptance;
- adequate space (10-15 acres) is available on the site for a new facility;
- access to an adequate fuel source and connectivity to the electric grid; and
- access to an adequate water supply to meet pollution control needs associated with ULSD firing for reliability enhancement.

Initial screening of the 17 potential candidate sites resulted in the selection of three finalist sites, which were subjected to a more detailed scrutiny. The three finalist sites (Brayton Point, Canal, and Middletown) were evaluated based on the following criteria:

- Locational Considerations
    - Sufficient readily buildable acreage
    - Proximity to electric load, with the greatest priority placed on the ISO-NE SEMA/RI load zone
    - Availability of natural gas
    - Availability and ease of electrical interconnection
    - Availability of water
    - Compatibility with local zoning and surrounding uses
    - Environmental Permitting Issues

- Environmental Considerations
  - Air quality
  - Wetlands and waterways
  - Zoning and land use
  - Water use and discharge
  - Noise
  - Historic and archaeological resources
  - Visual impact
  - Solid and hazardous waste
  - Material storage and safety
  - Traffic and transportation
  - Electric and magnetic field effect
  - Proximity of construction laydown
- Community Considerations
  - Likely support from municipal officials
  - Importance of additional tax revenues
  - Importance of project-related jobs
  - Support and/or buffer from neighbors

The ultimate selection of a site was designed to achieve the most appropriate balance among reliability, environmental, and least-cost objectives. Although all three finalist sites have attributes suitable for the proposed Project, the Canal site will result in the construction and operation of a generating facility that will contribute to a reliable energy supply with a minimal impact on the environment at the lowest possible cost, and appropriately balances the range of siting considerations.

5.B.4 Consistency with Technical Bulletin 96-001

The CCC strongly encourages the redevelopment of existing buildings and properties rather than development of pristine open or wooded lands. Redevelopment is defined as "the reconstruction, reuse or change in use of any developed property." Redevelopment can capitalize on existing infrastructure, reduce environmental impacts, and reinforce regional development patterns. The Project is considered redevelopment, as it is proposed on land already developed in support of the existing Station.

Technical Bulletin 96-001, *Designing the Future to Honor the Past – Design Guidelines for Cape Cod*, and the Addendum to Technical Bulletin 96-001, *Contextual Design on Cape Cod: Design Guidelines for Large-scale Development*, provides guidance on how to comply with the Community Character goals of the RPP. Although not regulations, this technical bulletin presents guidelines for design and construction of proposed development on Cape Cod. Discussion of the Project's consistency with Technical Bulletin 96-002 is provided below.

5.B.4.1 Selecting a Site for Development

As described in Section 5.B.3, NRG focused its site selection process on sites currently and formerly owned by NRG Energy and its subsidiaries, as well as other sites that currently host electric generating facilities that NRG Energy had considered for possible expansion. This approach focused on sites that would avoid the significant environmental, community, and cost impacts associated with clearing and adapting a "greenfield" site to power generation. In addition, this approach allowed NRG to minimize or eliminate the need for new infrastructure to connect the proposed Project to fuel sources and the electric grid.

The selected site has been used for power generation since the 1960s, with the existing 1,120-MW Station occupying the western portion of the Property. The Project is uniquely located such that it can take advantage of existing infrastructure, including the existing AGT natural gas pipeline interconnection and the adjacent Eversource switchyard.

The entire Property, including the 12-acre proposed Project Site, is located within the IND zoning district, as designated by the Town of Sandwich. The selected site would allow the Project to be consistent with local and regional land use development goals, as it is proposed on already disturbed land in a designated Economic Center. These Economic Centers, as defined by the CCC, through a collaborative effort with Cape Cod towns, are designated as areas of focused development. This designation indicates a desire for the area to be developed in support of further economic growth in the region.

5.B.4.2 Developing the Site

The topography of the Project Site was first altered with the construction of Cape Cod Canal in 1928, and later in the 1960s when Units 1 and 2 were constructed. The Project Site is currently occupied by warehouses, storage tanks, temporary trailers, and a hard-packed open area used for temporary parking. Limited natural vegetation exists on the Project Site, as the entire Property is extensively developed in support of the existing Station. In the sparse undeveloped areas, vegetation consists of grasses and other herbaceous plant species, with non-native species predominating. The Project Site contains no standing specimen trees (Section 4.0).

The Project has been designed to reduce the amount of impervious area on the Project Site by: limiting impervious areas to those covered by structures and supporting foundations; storage tanks and enclosures; and access driveways. The Project will also incorporate applicable low impact development techniques, such as permeable pavement on access driveways, to reduce further the total amount of impervious area on the Project Site. Vegetated infiltration basins will collect stormwater, and landscaped areas, which will be planted with native species, will surround the proposed Project footprint (Section 4.0).

Most of the Project Site is located within the FEMA 100-year floodplain, which is regulated under the Massachusetts WPA as LSCSF. Portions of the Project Site will need to be raised such that all critical Project components are located at a minimum elevation of 16 feet NAVD88 in order to elevate these features above the FEMA 100-year flood elevation, with adequate consideration of future sea level rise. As shown in Section 4.0, a grading plan has been developed, which raises the proposed equipment outside of the FEMA 100-year floodplain through the placement of approximately 43,000 cubic yards of fill. This material will likely include a combination of reusing the stockpiled soils already present on the Property, as well as new fill imported to the Project Site.

5.B.4.3 Special Considerations for the Coast

There are no filled tidelands located on the Property. The Massachusetts Geographic Information System (MassGIS) data layers associated with the determination of tideland jurisdiction indicated that the only areas of filled tidelands near the Property are located on the northern bank of the Cape Cod Canal.

The Station maintains several previously issued Chapter 91 licenses associated with historical in-water work. A minor modification to one of the existing Chapter 91 licenses will be sought in connection with the construction of an additional ULSD unloading pipeline, parallel and immediately adjacent to the existing unloading pipeline.

As discussed in Section 5.B.4.2, most of the Project Site is located within the FEMA 100-year floodplain. Critical Project features will be elevated to at least 16 feet NAVD88, above the FEMA 100-year flood elevation of 13.7 feet NAVD88 and allowing for future sea level rise.

5.B.4.4 Planning Open Space

Proposed in a designated Economic Center, on land already developed in support of an electric generating facility, the Project represents a redevelopment effort of less than 50% of the preexisting development. As such, the Project is not required to provide open space.

The Property is primarily composed of highly disturbed, industrial area with minimal existing open space. Both the proposed Project and the existing Station are electric generating facilities that are privately owned and will not be accessible to the public. For security and safety purposes, the entire Property is fully fenced with a 24-hour controlled access gate.

Recreational open space consisting of a USACE-maintained public walkway abuts the Station Property to the north. The USACE-maintained public walkway (Canal Service Road) formers the northern boundary of the Property. This recreational open space is used by the public for walking, jogging, bicycling, and fishing.

5.B.4.5 Streetscapes and Roadways

During construction, Canal 3 will designate a specific area on the Property for employee parking (Section 4.0). Construction laydown is also proposed within the 52-acre Property, which will minimize construction traffic on local roadways. Additionally, to minimize potential impact during peak commuting hours, deliveries will be scheduled during off-peak hours whenever possible. Construction shifts will vary over the phases of the Project; whenever possible, workers will be encouraged to avoid commuting during the peak commuting hours. A construction traffic management plan is provided as Attachment 5.C-1. Should actual conditions during construction result in unacceptable levels of traffic congestion, Canal 3 will work with Town of Sandwich and MassDOT officials to implement appropriate temporary mitigation measures.

No material additional trip generation for Project operation is anticipated. Therefore, the incremental traffic associated with the proposed Project is not expected to materially impact operating conditions on local roadways.

5.B.4.6 Architecture

The Project will be situated within the existing 52-acre Property, which is zoned as IND. The proposed Project was designed in accordance with all dimensional requirements, as set forth in Section 2600 of the Protective Zoning Bylaw, except for the maximum allowed building height of 45 feet. Canal 3 has submitted to the DPU a Petition for a Zoning Exemption pursuant to G.L. c. 40A, §3.

The Property contains numerous visual elements consistent with an electrical generating station and electrical transmission complex. In addition to the existing 498-foot tall stack and 210-foot tall power block buildings, there is a network of transmission towers and overhead transmission lines traversing the Property. Most notably, several of the on-site towers are situated along the roof of the Unit 2 power block building, extending higher than the top of the proposed Project stack.

The Project has been designed as a structurally and aesthetically compatible extension of the existing Property structures, consistent with the objectives of the Old King's Highway Act regarding the preservation of the economic contributions of historic sites. The proposed exhaust stack will be 220 feet tall, well below the existing exhaust stack and only slightly taller than the existing Unit 2 boiler room building directly to the west of the Project Site. All other proposed modifications are lower than the heights of existing structures and, with the exception of an overhead transmission line that will transmit the power produced by the Project to the adjacent Eversource switchyard, will be contained within previously disturbed portions of the Property.

While vegetation provides some visual screening of the existing Station, its structures are visible from several locations in the surrounding area, including from the Cape Cod Canal and Cape Cod Bay. Visual impact from the proposed Project will be minimal due to the Project's layout and orientation; impacts will be greatest from waterfront locations on the Cape Cod Canal and Cape Cod Bay, north and east of the Project Site. The Project is proposed immediately adjacent to existing structures, and is consistent with the existing visual landscape. Visual impacts will be considerably less than the current visual impacts of the existing Station, where the existing elements are considerably taller than the proposed Project, and in other

directions, the existing Station will screen the Project from view. Visual simulation depicting existing and future views from several vantage points are provided in Figures 5.A-8 through 17.

5.B.4.7 Adaptive Reuse

The Project has been designed to capitalize on the existing facilities and infrastructure of the Station wherever feasible. The Project Site has already been developed in support of the existing Station, occupied by earthen- and concrete-slab, aluminum-sided warehouses; two NH_3 storage tanks; several temporary trailers; and a hard-packed open area used for temporary parking. While the warehouses and trailers will be removed from the Project Site, in order to make space for the proposed Project, the two existing NH_3 storage tanks will be enclosed and serve both the existing Station and the proposed Project. The existing Training Building will continue to be used for operations and maintenance services and administrative offices. Additionally, the Project will utilize the following existing infrastructure:

- an existing oil storage tank and a day tank will be converted to hold ULSD and a new unloading pipe will be added on the fuel dock parallel to the existing unloading pipe;
- the existing natural gas interconnection with AGT will be employed for gas supply;
- the existing on-site wells (Nos. 2 and 3) will supply water to the Project; and
- existing buildings will be used for warehousing, storage, operations, and administration.

The Project will use existing sanitary facilities located in the Training Building. No additional sanitary facilities are proposed for the Project. Additionally, the Project will also utilize the existing 24-hour manned gate and full perimeter fence to restrict access.

5.B.4.8 Infill Construction

Infill construction is defined as “the development of new commercial or other structures on vacant or underutilized sites within existing substantially built-up areas.” The Project Site is situated on a portion of the Property that is currently occupied by warehouses, storage tanks, and temporary trailers. Development of this 12-acre area does not represent a significant change in land use, as the Property is zoned for industrial development and already developed in support of electric generation activities. The Project represents a more efficient use of the available space, as it will fill a regional need, providing power to the grid during periods of high energy demand.

5.B.4.9 Landscaping

The Project Site is currently occupied by earthen- and concrete-slab, aluminum-sided warehouses, storage tanks, several temporary trailers, and hard-packed open area used for temporary parking. The sparse vegetation that is currently present on the Property includes grasses and other herbaceous plant species, such as dock, white sweet clover, rabbit-foot clover, and butter-and-eggs. In general, the vegetated areas are characterized by non-native species adapted for disturbed conditions.

As can be seen in the Landscaping Management Plan in Section 4.0, the primary goal for selecting and managing the landscape features was be based on selecting native, low maintenance plants. Selection of planting materials was based on CCC’s resource documents, including the *Sustainable Landscape Design Guidelines* and *Native Plants Suitable for Landscape and Low Impact Development*. Landscaped areas will be maintained in accordance with CCC’s *Sample Landscape Maintenance Contract/Maintenance Plan*. Landscape maintenance will be incorporated into the overall Operations and Maintenance Plan developed for the Project. Final landscape elements will be developed during the final design of the Project.

5.B.4.10 Alternatives to the Automobile

Canal 3 has developed a Construction Traffic Management Plan to accommodate the specific needs of the Project during construction, which is provided as Attachment 5.C-1. The Construction Traffic Management

Plan will include programs to encourage carpooling by construction workers in an effort to minimize construction-related traffic.

Natural gas is supplied to the Property via an existing pipeline, and ULSD will continue to be delivered by barge. Using the same delivery practices as are currently used for the Station, NH_3 will continue to be delivered by rail.

5.B.4.11 Accessibility

The Station's existing Training Building will continue to be used for operations and maintenance services and administrative offices. Parking at this building currently includes two handicap spaces, with a relatively flat surface between the parking lot and the building entrance. The relocated parking area, north and west of the Training Building, will continue to include dedicated handicap spaces. Most of the Property is relatively flat, with no significant limitation to accessibility. The generating equipment is not intended to be occupied, and access will be limited to infrequent, scheduled maintenance activities.

5.B.4.12 Parking

During construction, Canal 3 plans to designate a specific parking area for construction workers. A total of 200 parking spots will be provided. As shown in Section 4.0, the proposed location allows for multiple access and egress points, which will help the flow of traffic during both the beginning and end of the shift.

Upon completion of construction, the temporary parking area will be regraded and landscaped, in accordance with the Project's Landscaping Management Plan (Section 4.0). Although on-site parking will be relocated to accommodate the Project, no new full-time employees are required to operate the Project, and additional parking is not proposed. Once the Project is operational, existing parking areas are expected to be sufficient.

5.B.4.13 Utilities

Natural Gas

Natural gas for the Project will be delivered via an interconnection to the AGT pipeline. An existing interconnection already serves the Station; however, the proposed Project will require its supply of natural gas at a reliably consistent pressure. Therefore, a new 3,590-foot natural gas pipeline will be constructed along the Property's northern boundary, from the existing natural gas meter station to the new gas compressor building and gas (dew point) heater (Section 4.0).

ULSD

ULSD will be transported to the Project by barge, using the same delivery practices as currently used for the Station. A new unloading pipe will be installed immediately adjacent to the existing unloading line. Storage of ULSD will be within existing tanks equipped with full secondary containment. A new approximately 4,000-foot pipeline within the Property will connect the ULSD storage tank, day tank, and the CTG (Section 4.0).

Electricity

Six utility poles will support the proposed 1,850-foot electrical transmission line, which will connect the Project to the Eversource switchyard, located adjacent to the south of the Property. Additional equipment will be installed within the Eversource switchyard. The design of the transmission line and switchyard equipment will comply with all applicable electrical codes.

Water/Wastewater

The cumulative process water demand for the Project and the existing Station will be met using two existing groundwater wells on the Property (Well Nos. 2 and 3), located on the Property, adjacent to the Project

Site. The cumulative water demand of the existing units and the proposed Project will be well within currently permitted volumes. No significant increase in potable water demand will result from the Project. Therefore, no new offsite water interconnections will be required.

The Project will utilize a near-zero liquid discharge design, thereby avoiding any direct discharge of wastewater. Any liquid process streams that cannot be treated and recycled on-site (e.g., turbine wash water, evaporative cooler blowdown) will be collected and trucked off-site for treatment and disposal. As a result, there will be no new offsite wastewater interconnections.

The Project will use existing sanitary facilities located in the Training Building. No additional sanitary facilities are proposed for the Project.

5.B.4.14 Outdoor Lighting

As shown in the Project's Lighting Plan (Section 4.0 and Attachment 5.P-1), the exhaust stack will be equipped with medium-intensity flashing white aviation obstruction lighting, as required by the FAA. All exterior lighting shall be arranged and installed such that the lighting is directed downward and inward, minimizing light spillage onto adjacent properties. All permanent light sources shall be directional and shielded fixtures, which cast light downward.

5.B.4.15 Signage

Signage is currently present along the access driveway (Rickeys Road) just off Freezer Road, denoting the Station's presence. No new signage is proposed.

5.C TRAFFIC IMPACT ANALYSIS

Traffic associated with operation of the Project will have a negligible impact on local traffic conditions. The following sections describe the analyses of potential traffic impacts associated with the Project. A construction traffic management plan is presented in Attachment 5.C-1.

5.C.1 Existing Conditions

Traffic analyses were conducted for three intersections in the immediate vicinity of the Project Site:

- Old King's Highway (Route 6A), Tupper Road, and Route 130;
- Tupper Road and Freezer Road; and
- Old King's Highway (Route 6A) and Tupper Road.

This section describes the existing roadway network in the study area including intersection geometry, traffic control, and peak hour traffic volumes. The three "gateway" intersections expected to be used by construction workers to travel to and from the site are described in Table 5.C-1 and shown on Figure 5.C-1.

Table 5.C-1: Traffic Study Intersections

Location	Traffic Control	Jurisdiction
Old King's Highway (Route 6A) / Tupper Road / Route 130	Stop sign	Town of Sandwich
Tupper Road / Freezer Road	Stop sign	Town of Sandwich
Old King's Highway (Route 6A) / Tupper Road	Signal	MassDOT

5.C.1.1 Roadways

A brief description of major roadways providing access to the Project Site is provided below.

Route 6A (Old King's Highway)

Route 6A is functionally classified as an Urban Minor Arterial and is under the jurisdiction of MassDOT. Route 6A is generally an undivided two-lane roadway with a posted speed limit of 40 miles per hour (mph). It extends from the Sagamore Bridge to the Mid-Cape Highway rotary located at the Orleans/Eastham town line. Within the study area, Route 6A provides sidewalks at its signalized intersections with Merchant Road and Tupper Road (East). No bicycle accommodations are provided. Adjacent land uses are residential and commercial.

Tupper Road

Tupper Road is an Urban Minor Arterial, under the jurisdiction of the Town of Sandwich. Within the study area, Tupper Road forms two intersections with Route 6A; both are evaluated in this study. Tupper Road is approximately 23 feet wide, undivided, with one travel lane in each direction. Sidewalks are provided along the north side of Tupper Road from Briarwood Avenue to its easterly intersection with Route 6A. Adjacent land uses are commercial and residential.

Freezer Road

Freezer Road is a short local road under USACE jurisdiction. It runs north/south extending from Tupper Road to the Canal Service Road and provides access to the existing Station. Approximately 350 feet north of Tupper Road, is an active railroad crossing on Freezer Road. Freezer Road is approximately 22 feet wide accommodating one travel lane in each direction. No sidewalks or bicycle accommodations are provided. Adjacent land uses are generally commercial or light industrial.

5.C.1.2 Intersections

Detailed description of the study area intersections are provided below.

Old King's Highway (Route 6A) / Tupper Road / Route 130

The intersection of Route 6A with Tupper Road and Route 130 is a four-legged unsignalized intersection. Both approaches on Route 6A include a single lane with a channelized right turn. On the eastbound approach, right turns onto Route 130 are accommodated via a short road that begins approximately 350 feet west of the intersection and intersects the west side of Route 130 approximately 120 feet south of Route 6A. The minor approaches of Tupper Road and Route 130 provide one approach lane, a short median island, and are under Stop sign control. Both Tupper Road and Route 130 widen as they approach Route 6A allowing right turning vehicles to pass vehicles waiting to either turn left or proceed across Route 6A. No pedestrian accommodations are provided. No speed regulations are posted on the two minor approaches. The surrounding land uses are primarily open/vacant space, residential, and commercial.

Tupper Road / Freezer Road

Freezer Road intersects the north side of Tupper Road to create a three-legged unsignalized intersection. Freezer Road forms the minor approach and is under Stop sign control. All three legs of the intersection consist of a one approach lane. A pedestrian crosswalk is provided across the southbound Freezer Road approach. A sidewalk is located along the north side Tupper Road. The surrounding land uses are primarily residential, utility, and commercial.

Old King's Highway (Route 6A) / Tupper Road

Tupper Road forms a skewed, four-legged, signalized intersection with Route 6A approximately 1.2 miles east of the Route 6A/Tupper Road/Route 130 intersection. Both Route 6A approaches consist of a shared left turn/through lane and a shared through/right turn lane. The Tupper Road northbound approach provides one lane. A shared left turn/through lane and shared through/right-turn lane are provided on the Tupper Road southbound approach. Pedestrian accommodations include a crosswalk on the Route 6A westbound

approach, and sidewalks located on both sides of Route 6A, east of Tupper Road, and along the east side of Tupper Road. The traffic signal operates with four phases including separate phases for both Tupper Road approaches. A pedestrian push button activates the exclusive pedestrian phase that allows pedestrians to cross Route 6A. The surrounding land uses are generally residential and commercial.

5.C.1.3 Existing Traffic Volumes

Traffic counts were conducted during the roadway peak hours and the construction traffic peak periods at the study area intersection in July 2015 reflecting peak morning (6:00 – 7:00 a.m.) and afternoon (4:00 – 5:00 p.m.) conditions

Daily Traffic Volumes

Daily traffic counts, performed with automatic traffic recorders, were conducted for a 48-hour period on the Property driveway (Rickeys Road), west of Freezer Road. Over the course of a weekday, approximately 200 vehicles travel in and out of the Property. The Property generates its highest traffic volumes from 6:00 a.m. to 7:00 a.m. with an average of 26 entering and four exiting trips. From 4:00 p.m. to 5:00 p.m., the Property generates approximately two entering trips and six exiting trips.

Peak-Hour Traffic Volumes

Traffic counts were conducted at the three study area intersections on July 29, 2015 from 6:00 a.m. to 9:00 a.m. and from 3:00 p.m. to 6:00 p.m. encompassing both the street and construction peak periods. In the morning, the data indicate that traffic generally peaks at the intersections from 7:00 a.m. to 8:00 a.m. However, the Site generates very few trips during this hour. Therefore, the traffic volumes utilized for the analysis of the morning period study are based on data collected from 6:00 a.m. to 7:00 a.m. (when site-related traffic is at its greatest). In the afternoon, the data indicate that traffic generally peaks at the intersections from 4:00 p.m. to 5:00 p.m.

MassDOT traffic data were evaluated to determine if seasonal adjustments were necessary for the new traffic count data collected for this study. Traffic volumes for the entire month of July 2013 and July 2014 were obtained from the MassDOT permanent Count Station #20 located on Pilgrim Highway (Route 3), north of the town of Bourne. This location was the closest permanent Count Station to the study area for which recent traffic data were available. The average traffic volume for the month of July at this location was then compared to the Average Annual Daily Traffic for that same year. The July counts indicate that traffic in July of 2013 and 2014 was 30 percent higher than average conditions. Therefore, to provide a conservative analysis, measured traffic volumes were not adjusted. MassDOT traffic data for Count Station #20 is provided in Attachment 5.C-2.

The existing morning and afternoon peak hour volumes during construction peak hours are shown on Figure 5.C-2.

5.C.1.4 Existing Operating Conditions

Traffic conditions during the site-related commuter peak hours were evaluated at the study area intersections. Existing peak hour traffic operations were determined by comparing observed volumes to calculated capacities as described in greater detail below.

Level of Service Criteria

LOS is a term used to describe the quality of the traffic flow on a roadway facility at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating levels of service are reported on a scale of A to F, with an A representing the best operating conditions and an F representing the worst. Depending upon the type of facility being analyzed, level of

service A represents free-flow or uncongested conditions with little or no delay to motorists, while level of service F represents long delays with traffic demands sometimes exceeding roadway capacity.

The following sections describe the specific criteria used to evaluate operations of each facility type.

Intersection operating LOS was calculated following the methodologies defined in the Highway Capacity Manual (HCM) (Transportation Research Board, 2000) for signalized and unsignalized intersections. For both signalized and unsignalized intersections, the operating LOS is based on travel delays. Delays can be measured in the field but are generally calculated as a function of traffic volume, peaking characteristic of traffic flow, percentage of heavy vehicles in the traffic stream, type of traffic control, number of travel lanes and lane use, intersection approach grades, pedestrian activity, and signal timing, phasing, and progression, where applicable. The specific criteria applied per the HCM (Transportation Research Board, 2000) are summarized in Table 5.C-2. The calculated average delay per vehicle for signalized intersections applies to all vehicles entering the intersection and under control of the traffic signal. For unsignalized intersections, it is assumed that through movements on the main street have the right-of-way and are not delayed by side street traffic. Consequently, the total delay values in Table 5.C-2 for unsignalized intersections apply only to the major street left-turn movements and the minor street intersection movements, which must yield to on-coming traffic.

For this study, the SYNCHRO 8.0 software package was used to analyze peak hour operations at the study intersections. SYNCHRO 8.0 is a windows-based analysis tool that follows the procedures defined in the HCM. Use of the HCM output from SYNCHRO 8.0 was required for this analysis because the HCM methodology does not support intersections with exclusive pedestrian phasing, which are present within the study limits.

Table 5.C-2: Intersection Level of Service Criteria

Level of Service	Average Delay per Vehicle (seconds)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	>10 and ≤ 20	>10 and ≤15
C	>20 and ≤ 35	>15 and ≤ 25
D	>35 and ≤ 55	>25 and ≤ 35
E	>55 and ≤ 80	>35 and ≤ 50
F	>80	>50

Source: *Highway Capacity Manual, Special Report 209, Third Edition*, Transportation Research Board, 2000.

Intersection Operating Conditions

The procedures described above were used to determine existing peak hour operations at the study area intersections during the hours that experience the greatest impacts of site-related traffic workers. Table 5.C-3 presents the results of the 2015 existing conditions operations analysis.

As shown in Table 5.C-3, the signalized intersection in the study area, Route 6A at Tupper Road, operates at LOS B during the morning peak hour and at LOS C during the afternoon peak hour. Table 5.C-3 also shows mixed results for the two unsignalized intersections in the study area. At the Route 6A, Tupper Road, and Route 130 intersection, the Route 6A eastbound and westbound left turns and the Tupper Road southbound approach operate at LOS C or better during both peak hours. However, the Route 130 approach to Route 6A operates at LOS F during the afternoon peak hour.

At the intersection of Tupper Road at Freezer Road, all approaches operate at LOS A or B during peak hours. Capacity analysis worksheets are included in Attachment 5.C-2.

Table 5.C-3: 2015 Existing Intersection Level of Service Results

Name	2015 Existing AM Peak Hour			2015 Existing PM Peak Hour		
	V/C[1]	DELAY[2]	LOS[3]	V/C[1]	DELAY[2]	LOS[3]
Unsignalized Intersections						
Rte. 6A & Tupper Rd./Rte. 130						
EB L	0.07	3	A	0.10	3	A
WB L	0.00	0	A	0.00	0	A
NB LTR	0.25	18	C	*	**	F
SB LTR	0.10	10	A	0.36	15	C
Tupper Rd. & Freezer Rd.						
EB L	0.04	5	A	0.09	3	A
SB LR	0.08	10	A	0.29	15	B
Signalized Intersections						
Rte. 6A & Tupper Rd.						
EB LTR	0.09	13	B	0.54	25	C
WB LTR	0.17	13	B	0.58	26	C
NB LTR	0.54	25	C	0.67	26	C
SB LTR	0.20	22	C	0.60	28	C
Overall	**0.25**	**17**	**B**	**0.60**	**26**	**C**

[1]v/c = volume to capacity ratio
[2]Delay = Average delay in seconds per vehicle
[3]LOS = Level of Service
* v/c greater than 1.20
** Delay is greater than 120 seconds

5.C.1.5 Safety Analysis

A safety analysis was performed at the study intersections to identify any possible safety issues. Crash data from the three most recent years available from MassDOT (2011 – 2013) were used for the analysis. The results of the crash analysis, including the crash rate sheets, are provided in Attachment 5.C-2 and summarized in Table 5.C-4, which provides a breakdown of crashes per year at each intersection, as well as the crash rates.

The crash rate, which represents the number of crashes at the intersection per million entering vehicles, provides an indication of how the intersection compares with the other similar intersections (signalized or unsignalized) within the region or the state. MassDOT calculates the average crash rate for intersections on a state-wide basis and for each of its six engineering districts. Sandwich is located within MassDOT District 5.

The three locations have crash rates lower than average for District 5 as well as for the State. Approximately 50 percent of all study area crashes involved personal injuries. No pedestrian or bicycle crashes were reported during the three-year study period.

Table 5.C-4: Crash Data Summary

Intersection	Route 6A / Tupper Road / Route 130	Freezer Road / Tupper Road	Route 6A / Tupper Road
2011	3	0	0
2012	5	1	2
2013	1	1	0
Total	**9**	**2**	**2**
Angle	4	2	0

Intersection	Route 6A / Tupper Road / Route 130	Freezer Road / Tupper Road	Route 6A / Tupper Road
Rear-end	1	0	2
Head-on	2	0	0
Sideswipe	1	0	0
Single Vehicle	1	0	0
Unknown	0	0	0
Total	**9**	**2**	**2**
Property	6	0	1
Injury	3	2	1
Fatality	0	0	0
Unknown	0	0	0
Total	**9**	**2**	**2**
Pedestrians	0	0	0
Bicyclists	0	0	0
Vehicles Only	9	2	2
Total	**9**	**2**	**2**
Clear	6	2	1
Cloudy	2	0	0
Rain	1	0	1
Snow	0	0	0
Sleet	0	0	0
Fog	0	0	0
Unknown	0	0	0
Total	**9**	**2**	**2**
7:00 am to 9:00 am	1	0	1
9:00 am to 4:00 pm	5	1	1
4:00 pm to 6:00 pm	2	0	0
6:00 pm to 7:00 am	1	1	0
Total	**9**	**2**	**2**
Crash Rates			
Statewide Rate	0.60	0.60	0.80
District 5 Rate	0.58	0.58	0.77
Intersection Rate	**0.52**	**0.22**	**0.10**

5.C.2 Operational Traffic Impacts

Operation of the proposed Project is expected to result in no changes in staff traveling to the Station and Project, and negligible changes in truck traffic for routine deliveries. Therefore, new trip generation associated with operation of the Project is expected to be nominal and no material impact to the operation of the transportation network is expected. A stamped letter by a certified traffic engineer concurring with these findings is presented in Attachment 5.C-3.

5.D NITROGEN LOADING ANALYSIS

The CCC has established a standard of 5 ppm nitrate-nitrogen (NO_3-N) as a guideline for maximum groundwater loading to protect the quality of groundwater on Cape Cod. The Commission's Technical Bulletin 91-001, *Nitrogen Loading*, provides a method for estimating loading rates based on land-use and wastewater discharge to groundwater.

Existing development does not exceed the 5 ppm NO_3-N loading standard. The Project will employ a near-zero liquid discharge design, with any liquid process stream that cannot be treated and recycled on-site collected and trucked off-site for treatment and disposal. Therefore, no additional wastewater discharge will be generated due to Project operations, and it is expected that groundwater quality will be improved through the collection and treatment of currently untreated stormwater run-off from portions of the Project Site.

Preliminary calculations, provided in Attachment 5.D-1, indicate that Project's nitrogen loading will be 1.3 ppm, significantly less than 5 ppm NO_3-N standard.

5.E PROPOSED MONITORING WELL PLAN

Several monitoring wells are present on the Property; however, no contamination exists requiring on-site monitoring. Since the Project does not require groundwater monitoring, the Applicant believes this section is not applicable.

5.F GROUNDWATER DISCHARGE PERMITS

No process wastewater will be discharged to groundwater and no groundwater discharge permit will be issued to the Project.

The Project will employ a near-zero liquid discharge design. All liquid wastewater streams that cannot be recycled on-site will be collected for off-site treatment and disposal. As a result, there will be no additional wastewater discharged due to operation of the Project.

The Project will implement structural and non-structural stormwater BMPs, including deep sump catch basins, vegetated water quality swales, vegetated strips and infiltration basins with sediment forebays, and leaching catch basins. This design emphasizes infiltration and pretreatment pollutant removal efficiencies through the introduction of vegetation. Stormwater overflow will utilize the two existing discharge points that currently serve the existing Station. The Project is eligible for coverage under the USEPA's MSGP for discharge of stormwater during Project operation.

5.G ENVIRONMENTAL CONTAMINATION

5.G.1.1 Reporting Process

Pursuant to G.L. c.21E, rules for reporting, assessing, and remediating releases of oil and hazardous materials are the subject of the Massachusetts Contingency Plan (MCP). Section 40.0300 of the MCP contains explicit criteria on: the types and magnitude of releases that must be reported to MassDEP; who is required to make those notifications; and the timeframes and procedures for those notifications. Reportable Quantities have been established for sudden spills of oil or hazardous materials while Reportable Concentrations have been established for soil and groundwater contaminants.

Each release reported to MassDEP is given a unique RTN that is used by MassDEP to track and document MCP compliance. RTNs represent a reported release; multiple RTNs may apply to a single site.

Following a release, the nature and extent of contamination is determined and a risk assessment is undertaken to determine whether a condition of No Significant Risk exists, needs to be achieved, or has been achieved. The MCP allows for different levels of cleanup, depending upon existing and future land uses. The three types of cleanup include: those where a cleanup was conducted; those where a cleanup was deemed unnecessary; and those where a Temporary Solution was implemented because a Permanent Solution was not feasible. In all cases, site cleanups must attempt to remove contamination to levels that achieve or approach a background condition, to the extent technologically and economically feasible. Once

a condition of No Significant Risk has been demonstrated or achieved, a Permanent or Temporary Solution Statement must be filed with MassDEP.

Site closure may be achieved at any point in the assessment process once the site has been sufficiently characterized and all applicable MCP performance standards have been met. In cases where remediation to the most protective use cannot be reasonably achieved, a Notice of AUL must be attached to the deed of the contaminated property to document and provide notice of residual contamination, and to minimize the possibility of future exposures to these contaminants.

5.G.1.2 Releases Associated with the Project Site

Like many industrial sites, releases of oil and other hazardous substances previously occurred on the Property. Any historic releases on the Project Site have been fully addressed and closed.

MassDEP's Waste Sites and Reportable Releases database[5] lists several RTNs associated with the existing Station. Tables H.G-1 and H.G-2 describe the release and current status of each identified RTN. Those in bold denote an RTN that has not yet reached closure.

Table 5.G-1: RTNs Associated with 9 Freezer Road

RTN	Date	Description	RAO Class/Phase
4-0010231	1994-01-25	Release of 200 gallons of #6 fuel oil on soil and groundwater	A2
4-0010297	1995-02-25	Release of 35 gallons of sodium hydroxide on soil	A1
4-0010303	1994-02-28	Release of 25 gallons of lubricating oil	A1
4-0010584	1994-06-29	Release of 3,039 gallons of hypochlorous acid/sodium salt and 10 pounds of sodium hypochlorite on soil and groundwater	A1
4-0013525	**1997-11-19**	**Release to soil and groundwater of:** - **230 ppb aromatics** - **380 ppm aromatics** - **120 ppb arsenic** - **6.5 ppm benzo(a)anthracene** - **0.2 ppb benzo(a)pyrene** - **5.9 ppm benzo(a)pyrene** - **6.6 ppm benzo(b)fluoranthene** - **64 ppb lead** - **120 ppb nickel**	**C1 / Phase IV**
4-0013791	1998-05-04	Release of 5,000 ppb of C9 through aliphatic hydrocarbons and 25,000 ppm of total petroleum hydrocarbons on soil and groundwater	A2
4-0013851	1998-05-04	Release of 300 ppm of aromatics on soil and groundwater	B1
4-0013963	1998-06-17	Release of 10 gallons of transformer oil on soil and groundwater	A2
4-0014588	1999-03-12	Release of 500 gallons of #2 fuel oil and an unknown amount of magnesium oxide on soil and groundwater	A2
4-0014831	1999-07-07	Release of 25 gallons of mineral oil on soil and groundwater	A1
4-0015444	2000-04-26	Release of 60 gallons of transformer oil	A1
4-0018844	2005-01-01	Release of 5,000 gallons of #6 oil on soil & groundwater	A2
4-0021809	2009-02-27	Release of 2,000 gallons of #6 fuel oil on soil and groundwater	A2
4-0022326	2009-12-03	Release of 48 mg/kg of chromium on soil and groundwater	A2
4-0024673	**2013-07-15**	**Release of 800 gallons of non-PCB transformer oil**	**Phase II**

[5] Massachusetts Department of Environmental Protection. *Waste Site/ Reportable Releases LookUp, Version: 1.0.0.2 ~ Built Date: 5/5/2015*. http://public.dep.state.ma.us/SearchableSites2/Search.aspx.

RTN	Date	Description	RAO Class/Phase
4-0024883	2013-11-23	Release of 25 gallons of #6 fuel oil on soil	A2
4-0024946	2014-01-04	Release of 50 gallons of #6 fuel oil on soil	A1

Table 5.G-2: RTNs Associated with Freezer Road

RTN	Date	Description	RAO Class/Phase
4-0011049	1995-01-11	Release of 40 gallons of #2 fuel oil on soil and groundwater	A2
4-0012223	1996-05-29	Release of 10 gallons of #6 fuel oil and 16 ppm of 2-Methylnphthalene on soil and groundwater	A2

As shown in Tables H.G-1 and H.G-2, all but two of the RTNs have reached closure. Status updates regarding these two RTNs are detailed below:

- RTN 4-0013525, dated November 19, 1997, represents the release of several constituents onto soil and groundwater. As of 2014, this case had reached a C1/Phase IV status indicating that a Selected Remedial Action Alternative and Remedy Implementation Plan had been implemented. Annual groundwater sampling is conducted to monitor groundwater quality over time as part of a natural attenuation remedial approach.
- RTN 4-0024673, dated July 15, 2013, represents the release of 800 gallons of non-polychlorinated biphenyl (PCB) transformer oil. As of July 2014, following the completion of the Phase I and Immediate Response Action, the site was considered in Phase II, indicating that a Comprehensive Site Assessment was being conducted. Since that time, and in support of this phase, quarterly groundwater samples have been collected and analyzed to determine the nature and extent of the release, and characterize the risks, if any, posed to public health, welfare, and the environment. Installation of an additional well on the west side of the transformer is planned in 2016 to delineate further the extent of the release.

No AULs exist on the Property. Additionally, neither of the above “open” RTNs are located on the Project Site. Therefore, no existing hazardous waste contamination that would affect Project operation is believed to be present on the Project Site.

Although there are ongoing remediation efforts on the Property, no construction or operation activity associated with the proposed Project Site, including site grading and stormwater management system installation and operation, is anticipated to impact these efforts. There are no open RTNs associated with the Project Site and no contamination remaining from closed RTNs is present on the Project Site.

The proposed onsite ULSD and natural gas interconnection lines will traverse the Property near the location of RTN 4-0024673, the release of non-PCB transformer oil. Prior to installation of the lines, soils along this portion of the route will be tested. Any contaminated soil encountered will be removed for offsite disposal at a properly licensed facility and replaced with clean soil, as appropriate.

5.H PLANT AND WILDLIFE HABITAT ASSESSMENT

TRC Environmental Corporation (TRC) conducted an inventory of natural resources present at the proposed Project Site and prepared a Natural Resource Inventory Report in accordance with the guidelines issued by the CCC for plant and wildlife habitat assessment (Technical Bulletin 92-002). This report is provided in Attachment 5.H-1.

The location of various plant communities, specimen trees, and wetland resource areas on the Property and surrounding area, as well as the presence of wildlife habitats and invasive plant species, were evaluated and identified by TRC.

5.H.1 Soils

Soils within this area are within the Udipsamment (smoothed) soil series. Udipsamment soils represent soils that have been disturbed through prior excavation or filling.

Vegetation was removed from the surface of the Property during construction of Units 1 and 2 in the 1960s. Fill material, originating from the construction of the Cape Cod Canal and other undocumented sources, was placed on the Project Site. The grade on the Property was leveled with a fill thickness ranging from 1 to 10 feet with a mix of sand, gravel, and clays.

With approximately 100 geologic borings advanced in support of the construction of the existing Station, and an additional eight borings installed in 2001, the understanding of subsurface conditions and the lithology of the glacial sediments on the Property is extensive. At the surface, fill, marsh, and swamp deposits have been identified, followed at depth by coarse sand and gravel with locally interbedded fine sand and silt, typically less than 50 feet in thickness. Distinct sedimentary layers have been described in the subsurface under the Project Site, and include the following at increasing depth from the ground surface:

- fill material consisting of silty sand with varying amounts of gravel, and occasional lumps of organic and clay soils (the thickness of fill material ranges from non-existent in the wetland area adjacent to the Eversource switchyard just south of the Project Site, to approximately 10 feet near the border of the Cape Cod Canal);
- organic silt or peat;
- interbedded glacial outwash, containing a mix of gravelly sand and fine sand and silt;
- plastic clay or silt; and
- consolidated glacial outwash and lacustrine deposits, comprised of poorly graded gravelly sand to uniform sandy silt.

The depths of the individual sedimentary facies presented above are variable across the Property, as the stratigraphic unit dips to the north. The subsurface borings on the Property extended to a maximum depth of approximately 120 feet below the ground surface.

5.H.2 Plant and Animal Species and Habitat

The proposed Project is located within a previously developed property, which does not contain significant natural resources. The Property is extensively developed in support of the existing Station, with equipment, structures, and oil storage tanks surrounded by paved areas with minimal natural vegetation. The sparse vegetation that is present on the Property includes grasses and other herbaceous plant species such as dock, white sweet clover, rabbit-foot clover, and butter-and-eggs. In general, the vegetated areas are characterized by non-native species adapted for disturbed conditions.

Based on correspondence with the NHESP, no state-listed or federally listed rare plant or animal species inhabit the Project Site. In addition, certified vernal pools or exemplary natural communities are not present on or in the vicinity of the Project Site.

According to the NHESP (Attachment 5.H-2), a portion of the Property overlaps with Priority Habitat 15 and Estimated Habitat 79. The rare species associated with these habitat areas include two bird species, the least tern (*Sternula antillarum*) and common tern (*Sterna hirundo*), classified as Species of Special Concern. However, only a very small portion of the Property is within the mapped habitats, and the limit and scope of work associated with the Project does not reach these areas. On September 14, 2015, NHESP

confirmed no further review is required (Attachment 5.H-2). Based on this information, the Project will not impact state-listed threatened or endangered species.

The United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) on-line tool identified two bird species, the red knot (*Calidris canutus rufa*) and the roseate tern (*Sterna dougallii dougallii*), and a bat species, the northern long-eared bat (*Myotis septentrionalis*), as potentially occurring on the Property; however, no critical habitat for any of these species was identified (Attachment 5.H-3). A review of the USFWS New England Field Office Endangered Species Consultation web site found no federally listed, proposed, and/or candidate species or associated habitats identified with the proposed Project Site.

5.H.3 Wetland Resource Areas

The entire Project Site and the majority of the Property lies within the FEMA 100-year flood zone, an area designated as LSCSF and regulated under the Massachusetts WPA and Sandwich Wetland Bylaws. A wetland delineation found no jurisdictional vegetated wetlands on the Project Site. Three wetland areas were identified on the Property; however, these wetlands and associated buffer zones will not be impacted by the proposed Project.

South of the Property, the Project's proposed electrical interconnection will traverse a bordering vegetated wetland, with two utility poles located within the 100-foot buffer to the wetland. Canal 3 filed a Request for Determination of Applicability with the Sandwich Conservation Commission in December 2015 to confirm the delineation of resource areas, and the Conservation Commission approved the delineated boundaries on January 20, 2016 in a letter provided as Attachment 5.H-4.

5.H.4 Mitigation

The transmission line from the Project to the Eversource switchyard may result in the need to limit the heights of existing overstory trees; however, no clearing or fill will occur within vegetated wetlands. Proposed mitigation includes maintaining the heights of overstory trees to 15 to 20 feet and establishing an understory scrub-shrub wetland community comprised of native shrub species. Both primary mitigation activities are subject to the approval of the Sandwich Conservation Commission. Proposed shrub species for planting in this area will focus on native species that are valuable to wildlife for both food and cover.

5.I ECONOMIC IMPACT INFORMATION

An Economic and Fiscal Impact Analysis for the Project is provided in Attachment 5.I-1.

5.J AFFORDABLE HOUSING

MPS AH3.1 of the RPP states that non-residential developments must mitigate the impacts of development on the need for affordable housing through monetary contributions. The contributions are to be used with the purpose of creating affordable housing needed as a result of the proposed development, assuming that the development results in the creation of jobs paying less that the regional average wage.

The proposed Project will not result in an increase in operational staff at the Station. New positions associated with the proposed Project will be filled by the staff employed at the existing Station. Jobs at the proposed Project will be paid comparably to those at the existing Station, and these salaries are well above the regional average wage. Staff employed at the existing Station have acquired housing and the creation of new positions associated with the Project will not affect their housing needs. As the proposed Project will not create a need for affordable housing, development mitigation contributions are not required and the Applicant believes that this section is not applicable.

5.K SALES PRICE AND/OR RENT

The Project does not include construction of housing for purchase or rent; therefore, the Applicant believes this section is not applicable.

5.L HAZARDOUS MATERIALS AND SOLID AND HAZARDOUS WASTE

5.L.1 Hazardous Materials

5.L.1.1 Construction

The construction contractor will be responsible for the proper storage, handling, and management of any potentially hazardous materials used during construction of the Project. Fuels, oils, lubricants, paints, stains, and varnishes will be located in covered, secured areas at all times. All potentially hazardous material storage areas will be equipped with spill containment and cleanup equipment/supplies.

5.L.1.2 Operation

A variety of chemical reagents and materials will be stored and used in conjunction with operation and maintenance of the Project. The type and character of these materials will be the same as or comparable to those currently used in the operation of the existing Station. The SPCC Plan, which is currently being maintained for the existing Station, will be modified to reflect the Project's proposed chemical storage.

All potentially hazardous materials will be received and handled in accordance with written control procedures and stored in designated containment areas, which will be segregated and marked appropriately, as required by Resource Conservation and Recovery Act regulations and National Fire Protection Association requirements. For all applicable materials, Material Safety Data Sheets will be available in a central location.

As is the current practice at the Station, most routine chemical deliveries will be by truck. Secondary containment in the form of curbs, berms, and concrete pits will be used where hazardous chemicals are stored, including unloading areas. Containment areas will be drained to appropriate collection sumps or tanks for recycling or off-site disposal. Piping and tanks exposed to potential traffic hazards will be protected by traffic barriers. Two existing 60,000-gallon welded-steel tanks will continue to receive aqueous NH_3 through rail delivery. A new structure will be installed around these existing tanks, which are not currently enclosed.

Safety showers and eyewashes will be provided in appropriate chemical storage and use areas. Personnel who may be required to handle hazardous materials will be properly trained to perform their duties safely, and to respond to emergency situations that may occur in the event of an accidental spill or release. Table 5.L-1 provides a list of the current and future quantities of hazardous materials stored on the Property, and the overall change this volume represents.

Table 5.L-1: Quantity of Hazardous Materials Stored

Hazardous Material	Current Capacity (gallons)	Future Capacity (gallons)	Change (gallons)
#2 Fuel Oil (ULSD)	42,376	7,721,404	7,679,028
#6 Fuel Oil	50,367,560	42,688,532	-7,679,028
19.5% Aqueous Ammonia	120,000	120,000	0
29% Aqueous Ammonia	4,112	4,112	0
Sulfuric Acid	6,768	6,768	0

Hazardous Material	Current Capacity (gallons)	Future Capacity (gallons)	Change (gallons)
Magnesium Hydroxide	18,960	18,960	0
Transformer Oil	69,276	72,776	3,500
Sodium Hydroxide	16,544	16,544	0
Urea	36,500	36,500	0
Turbine Lube Oil	57,625	71,175	13,550
Sodium Hypochloride	12,784	12,784	0
Aluminum Sulfate	0	100	100
Turbine Wash Detergent	0	1,200	1,200

5.L.2 Solid and Hazardous Waste

Based on current volumes of generated hazardous waste, the Station is registered with the Massachusetts Department of Environmental Protection as a Large Quantity Generator of waste oil and a Small Quantity Generator of (non-oil) hazardous waste, as defined under 310 CMR 30.010, and complies with applicable requirements for these categories (inspections, training, emergency planning, etc.). The existing Station's MassDEP registration number is MAD071708929. The proposed Project is not expected to change the current generator classification.

Normal maintenance activities will generate small quantities of solid waste on a periodic basis. Typical wastes generated during operation and maintenance include: scrap metal and plastic; insulation material; paper; glass; empty containers; and other miscellaneous solid wastes. These materials will be collected for recycling or off-site disposal, in accordance with applicable regulatory requirements. Canal 3 will institute programs to maximize recycling and ensure separation of potentially hazardous waste from non-hazardous solid waste. Solid waste that cannot be recycled will be stored in on-site dumpsters or similar containers, until it can be removed and disposed of by a licensed contractor.

Hazardous waste streams generated during operation of the Project will be related to equipment maintenance, including items such as oily rags, waste oils, spent aerosol cans, waste cleaning solvents, and/or waste paint. Additional waste streams (e.g., mercury-containing devices, batteries, and pesticides) are designated as "universal waste." In accordance with 310 CMR 30.00 *et seq.*, these wastes will be segregated from non-hazardous wastes and collected for recycling or disposal at licensed facilities, following similar procedures already in place at the existing Station. Spent SCR catalysts from the air pollution control system will either be returned to the manufacturer or sent to a facility specializing in catalyst regeneration.

5.M OPEN SPACE

MPS OS1.3 of the RPP requires all development projects qualifying as a DRI to provide permanent open space areas. Further, OS1.3 establishes open space requirements determined by the size of the proposed development and its location in relation to Significant Natural Resource Areas and Economic Centers; greater amounts of open space are required for development within Significant Natural Resource Areas and less open space is required for development within Economic Centers. To encourage redevelopment within appropriate locations, OS1.3 does not require open space for redevelopment occurring within designated Economic Centers. Redevelopment is defined to include projects expanding into greenfields that do not exceed 50% of the preexisting development area on a site.

The Project is proposed in a designated Economic Center within the town of Sandwich, Massachusetts. There are no Significant Natural Resource Areas located on the Property or Project Site. The Project is proposed on land already developed in support of electricity generation facility. As redevelopment of this

area will be below the threshold of 50% of the preexisting development, the Project is not required to provide open space and, therefore, the Applicant believes this section is not applicable.

5.N HISTORIC STRUCTURES

The Station is listed on the MHC's State Register of Historic Places and has been designated by the Town of Sandwich as a Historic Site within the District. The Property is located in the Town Neck neighborhood of the District, on land once owned by Edmund Freeman, Sr., the founding father of the Town of Sandwich. The Property was acquired by Canal Electric in 1980. While many historic resources associated with Freeman's descendants located in the vicinity of the Property have been destroyed or removed, stone walls and outbuilding remains may exist. The Project will not impact or disturb any structures associated with the Freeman Farmstead site. The Site Development Plans in Section 4.0 shows the approximate location of the Freeman Farm.

There are three historical resources located in proximity of the Property (Section 4.0).

- A ca. 1795 farmhouse, built by a descendent of Edmund Freeman, Sr., was located south of the Cape Cod Central Railroad right-of-way that defines the Property's southern boundary. The farmhouse burned in 1982, and a large associated barn was later relocated off-site.
- The graves of Edmund Freeman, Sr. and his wife, Elizabeth, are located on the south side of Tupper Road, east of Route 6A. Identified as the Saddle and Pillion burial area in the local histories and the MACRIS database, the graves are located outside the boundaries of the Property, approximately 0.6 miles from the proposed Project Site.
- Two other early settlers, Thomas Burgess and Samuel Briggs, are known to have owned land on the north side of Tupper Road in the vicinity of the Property; however, no surviving resources associated with these men have been identified or noted in the local histories or MACRIS.

The Project is proposed on disturbed and filled land that is unlikely to contain intact archaeological resources and is not occupied by any recognized historic structures. Although the Station is a registered Historic Site and the proposed Project is proposed adjacent to the existing facility, its construction will not impact or alter any historic structures on the Property. The Project has been designed as a structurally and aesthetically compatible extension of the existing Property structures, consistent with the objectives of the Old King's Highway Act regarding the preservation of the economic contributions of historic sites.

Photographs of the Project Site are provided in the PNF that was submitted to the MHC on July 29, 2015 (Attachment 2B). On October 2, 2015, the MHC confirmed it had no comments in association with the Project. Per MHC's guidance, a Certificate of Appropriateness will be sought from the Sandwich Old King's Highway Historic District Committee.

5.O REHABILITATION AND/OR ALTERATION OF HISTORIC STRUCTURES

The Project is proposed on disturbed and filled land on which no recognized historic structures are present. Although demolition of several concrete slabs and aluminum-sided warehouses will be required within the Project Site, none of these structures are designated as historic. The Project is proposed adjacent to the Station, which was designated by the Town of Sandwich as a Historic Site within the District; however, the Project will not alter any existing Station structures designated as historic.

The Project has been designed as a structurally and aesthetically compatible extension of the existing Property structures, consistent with the objectives of the Old King's Highway Act regarding the preservation of the economic contributions of historic sites.

A PNF was submitted to the MHC on July 29, 2015 (Attachment 2B). On October 2, 2015, the MHC confirmed it had no comments in association with the Project. Per MHC's guidance, a Certificate of Appropriateness will be sought from the Sandwich Old King's Highway Historic District Committee.

5.P EXTERIOR LIGHTING

An exterior Lighting Plan for the Project is provided in Section 4.0 and Attachment 5.P-1.

5.Q ENERGY USE

RPP's MPS E1.1 through E1.3 address energy conservation requirements for commercial and residential development projects. These standards encourage development projects to meet RPP E1 goal of "[promoting] a healthy and sustainable economic, natural, built and social environment by reducing greenhouse gas emissions and energy costs through design and construction practices that increase energy conservation, promote energy efficiency, and promote self-sufficiency through the use of locally distributed renewable energy."

The Project is itself an energy generation project, which is being designed in compliance with all federal and state environmental requirements for environmental impacts and efficiency including the MEPA Greenhouse Gas Policy. Much of the proposed Project will consist of uninhabitable and/or unenclosed structures and equipment in which energy conservation technologies would not be appropriate. The only portion of the Project to which MPS E1.1 through E1.3 is applicable is the existing on-site Training Building. The Project is planning to improve the existing 4,000-square-foot Training Building, located in the southwestern corner of the Project Site. The Training Building will continue to be used for operations and maintenance services, as well as administrative offices. Energy efficiency improvements will be made to the building, consistent with LEED certification.

Technical Bulletin 09-002, *DRI Guidance for Energy Compliance*, provides guidance on the preparation of data to evaluate compliance with MPS E1.1 through E1.3. Discussion of the Training Building improvements in accordance with Technical Bulletin 09-002 is provided below.

5.Q.1 E1.1 Redevelopment Energy Audit

Consistent with the requirements of MPS E1.1, an energy audit of the Training Building has been conducted. The energy audit documentation requirements are as follows:

i. The energy auditor was AECOM.

ii. The Training Building is currently heated and cooled with electricity. The average electric load for the Training Building over the most recent 24-month period (2014-2015) is 15,250 kilowatt-hours (kW-hrs) per month, or 183,000 kW-hrs per year. It is estimated that approximately two-thirds of the building electric load is associated with heating, ventilation, and air conditioning (HVAC) (both heating and cooling) or 122,000 kW-hrs per year.

iii. An upgrade to building insulation is recommended, which is estimated to reduce the HVAC electric load by an average annual value of 23%, reducing the annual average HVAC load to approximately 93,940 kW-hrs. Then, an additional recommended upgrade to the HVAC units is estimated to reduce this value by an additional 28%, or to 67,640 kW-hrs. The total annual reduction in electric load due to the Training Building energy efficiency upgrades is estimated to be 54,360 kW-hrs.

Table 5.Q-1 presents the full audit findings and recommended efficiency improvements to the Training building. The Project proposes to implement all of the recommended improvements as shown.

Table 5.Q-1: Proposed Efficiency Improvements to the Existing Training Building

	Existing	Proposed	% Improvement	Comment
Training Building				
Measure/Area	100 feet x40 feet / 4000 sq. feet		For the most recent 24 month the average monthly building energy use has been 15,250 kW-hr/month.	The existing annual electric load for the Training Building is 183,000 kW-hrs (66 tpy CO_2). The existing electric load for heating and cooling is estimated to be 122,000 kW-hrs (44 tpy CO_2).
Area Window/Area Wall	357 sq. feet/ 2194 sq. feet			
Building Insulation				
Roof R-value	R-19	R-19 + R-19=R-38	Building thermal envelope is improved by 49%: Design energy will decrease approximately 25% for heating and 22% for cooling.	Install new 2 1/2" material insulation roof panels **(Note 1)**
Window U-value	1.xx	R-3.5		Install new integrated insulated low "e" windows **(Note 2)**
Walls R-value	R-13	R-13+R-22=R-35		Install 3" material insulation wall panels **(Note 3)**
Building Insulation Summary				Annual average reduction in heating and cooling electric loads is estimated at 23% of 122,000 kW-hrs. Annual reduction is 28,060 kW-hrs (10 tpy CO_2).
HVAC Units (Note 6)				
Unit 1	30,000 btu/hr.	30,000 btu/hr.		HVAC upgrade reduction in heating and cooling loads estimated at 28% of the load as reduced by the building insulation upgrade: (122,000 kW-hrs -28,060 kW-hrs) (0.28) = 26,300 kW-hrs additional reduction (10 tpy CO_2)
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (Energy Efficiency Ratio [EER]) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Unit 2	36,000 btu/hr.	36000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Unit 3	36,000 btu/hr.	36,000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Unit 4	36,000 btu/hr.	36000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	

	Existing	Proposed	% Improvement	Comment
Other				
End wall hollow metal doors		R-13		Install new exterior insulated doors with gasketing **(Note 4)**
Entrance doors and curtainwall		R-3.5		Install new energy efficient entrance doors and curtainwall **(Note 5)**
Sunshades				Add sunshades at windows
Lighting				Install new led lighting fixtures w/ motion controls & dimmers
Plumbing fixtures				Install new WaterSense plumbing fixtures

Note 1: Install New Centria's Vesapanel Roof Panels 2 1/2" thick, R-19.34 on top of existing roof.
Note 2: Replace existing windows with Centria's Formavue 600 series integrated windows within the new horizontal wall panel system. Windows to have 1" insulated low "e" glass with solar reflective tinting in thermally broken frames.
Note 3: Install New Centria's Formawall Horizontal Dimension Series/Graphix Series Insulated Metal Panels 3" Thick R-22 Wrapping the exterior envelope of the building.
Note 4: Install new Pioneer Insulated Hollow Metal doors with weather-stripping and gasketing, 2" thick R-13
Note 5: Install new fawner AA425 Thermal Entrance Doors and Kawneer Trifab Versa Glaze Thermal Framing System R-3.5
Note 6:

- Better temperature and humidity control can be achieved by providing the AC indoor section supply fan with variable speed motor.
- The existing AC units are estimated to have an EER value between 9 and 10.
- Capacities are nominal manufacturer standard capacities. The actual design loads represent 88% of the unit's capacity serving the building.
- Energy design usage is decreased by 28% average across the entire year.

5.Q.2 E1.2 Designed to Earn ENERGY STAR® Certification

The Training Building improvements will be done consistent with LEED Certification. A summary of proposed improvements is provided as Attachment 5.Q-1.

5.Q.3 E1.3 ANSI/LEED Standards

The improved Training Building will comply with current ANSI/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2007, Section 5.4 – Insulation, Fenestration, and Doors.

5.Q.4 E1.5 On-Site Renewable Generation

NRG Renew Canal 1 LLC, an affiliate of NRG Unit 3, is developing the Canal Community Solar Project on the 26-acre Southern Area of the Station Property, southwest of the existing Canal Station Generating Units. The Solar Project will be a nominal 1.5-MW community solar project, consisting of two separate arrays on the two distinct lots that comprise the Solar Site. Array 1 consists of 3,591 305-watt solar panels, with a combined output of approximately 1.10 MW. Array 2 consists of 1,862 305-watt solar panels, with a combined output of approximately 0.57 MW.

The Canal Community Solar Project will supply approximately 2,023,000 kW-hours of electricity to the grid annually. The improved Training Building will have an annual electric load of approximately 128,640 kW-hrs. The Canal Community Solar Project will generate over 15 times the annual electric load of the improved Training Building. This is well in excess of the Technical Bulletin 09-002 on-site renewable generation requirements.

5.R TELECOMMUNICATIONS FACILITIES

The Project does not include construction of any new wireless telecommunication facilities; therefore, the Applicant believes this section is not applicable.

FIGURES

Figure 5.A-1
Proposed Major Facility Components

NRG Canal 3 Development LLC
Sandwich, MA

Legend *

1 - Ammonia Tank
2 - Training/Administration Building
3 - Gas Turbine
4 - Generator
5 - SCR Catalyst
6 - Tempering Fans
7 - Stack
8 - CEMS
9 - Emergency Generator (Behind Stack)
10 - Gas Compressor Building
11 - Gas Heater
12 - GSU Transformer
13 - Cooling Fan Module
14 - Hydrogen Tanks
15 - CO_2 Tanks
16 - Demineralized Water Tanks
17 - Water Treatment Area
18 - Service/Fire Water Tank
19 - Service/Fire Water Pump House
20 - Underground Water-Wash Tank
21 - Infiltration Basin 1
22 - Infiltration Basin 2
23 - Infiltration Basin 3
24 - DCS Enclosure

* **NOTE:** With the exception of Item 2 (Training/Administration Building (existing)) and item 17 (Water Treatment Area) all structures are at elevation 16' AMSL or protected by containment walls to prevent equipment being impacted by flooding.

Overview Map

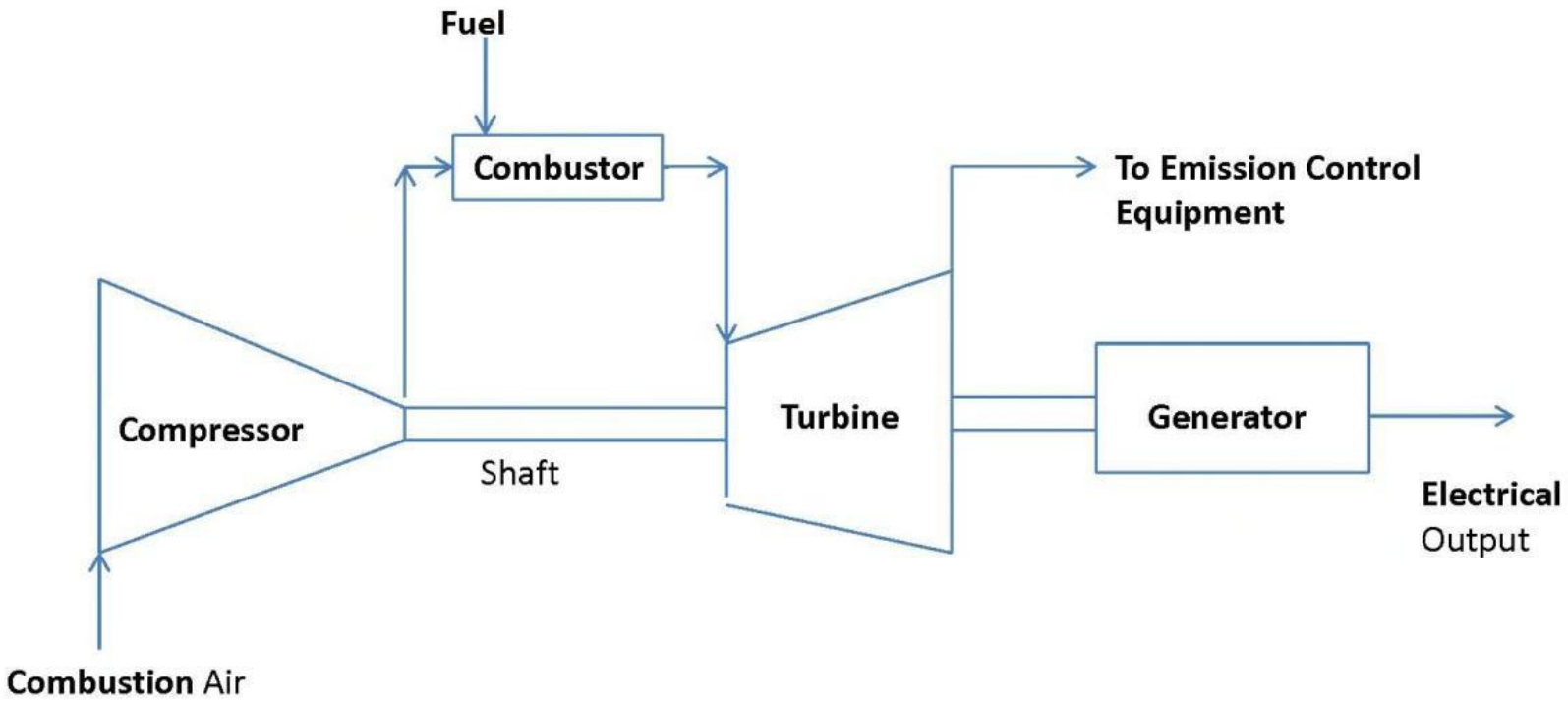


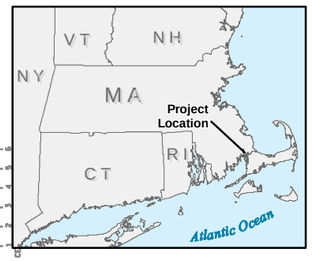
Figure 5.A-2
Process Flow Diagram

NRG Canal 3 Development LLC
Sandwich, Massachusetts

31380-B024-16-11-AERIAL

NN
PLANT NORTH
TRUE NORTH

LEGEND
020 NEW GAS LINE
021 NEW FUEL OIL LINE
022 NEW ULSD LINE W/CONTAINMENT PIPE



Legend

- Proposed Natural Gas Interconnection
- Proposed Electrical Interconnection
- Proposed ULSD Dock Interconnection
- Proposed ULSD Interconnection

REVISION APPROVAL RECORD				REV		PLT	DATE	REVISIONS	BY	CHKR
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE	A	11/18/15	ISSUED FOR ENF PERMITTING	RST	RLR
ARCH.			MECHANICAL			B	11/23/15	INCORPORATED CLIENT COMMENTS	RST	RLR
BUILDING SERVICES			PIPING							
CIVIL			PROCESS							
ELECTRICAL			QA / QC							
ENVIRON.			STRUCTURAL							
GEN. ARRANG.										
I & C										

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	B	11/23/15	PKS	PKS
APPROVED FOR CONSTRUCTION				

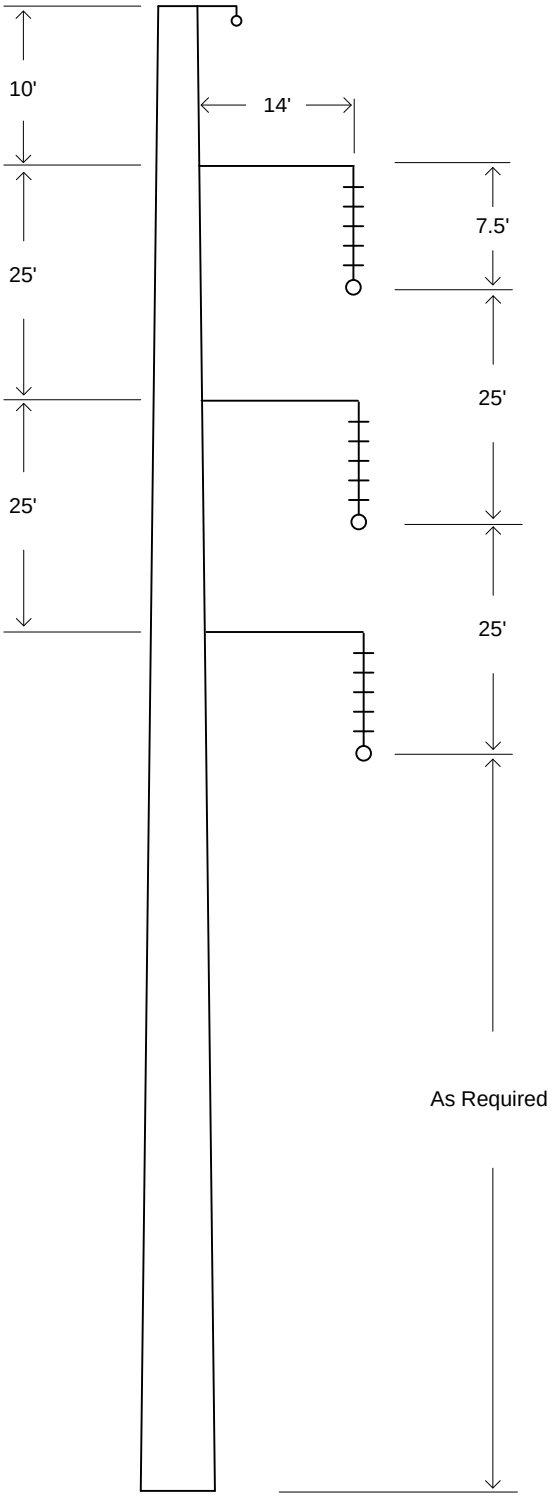
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REV.NO.

PROJECT NO.: 31380
DRAWN: RST DATE: 11/17/15
CHECKED: RLR DATE: 11/18/15
SCALE: 1" = 100'-0

50' 0 50' 100' 150'
SCALE: 1" = 100'

Figure 5.A-3
Facility Site Aerial Photograph

NRG Canal 3 Development LLC
Sandwich, Massachusetts

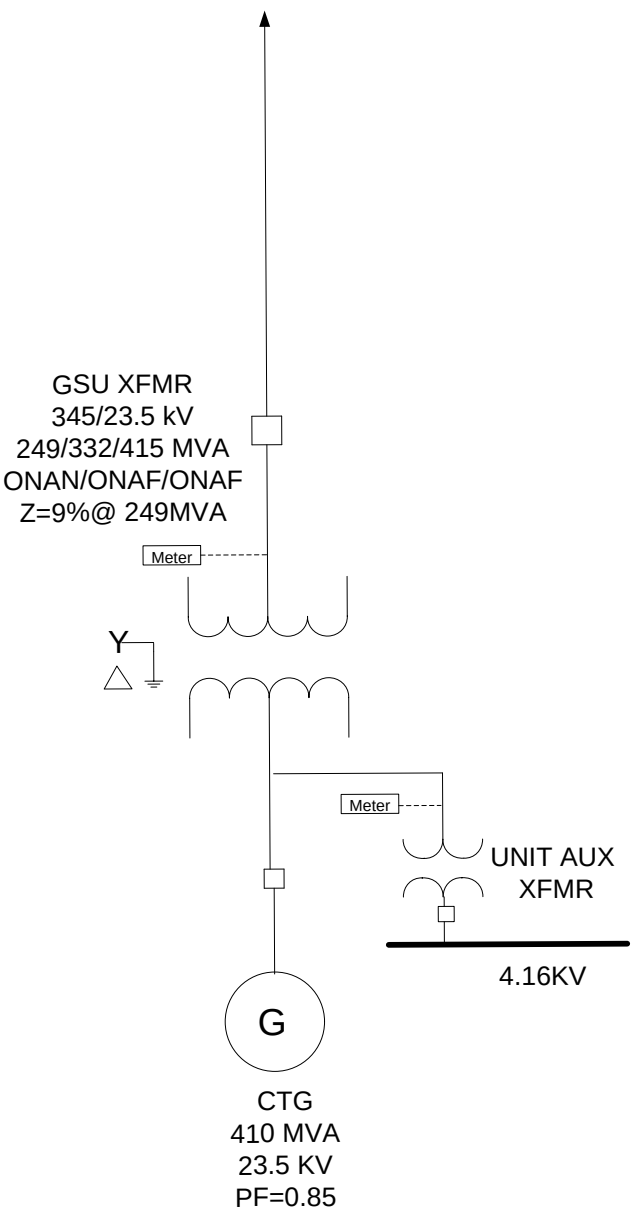


Note:

- Configuration shown is preliminary, to be finalized during detail design.
- Lowest conductor above railroad will be 40'.
- Lowest conductor above road will be 32'.
- Drawing is not to scale.

Figure 5.A-4
Cross-Sectional View of Conductor Arrangement

NRG Canal 3 Development LLC
Sandwich, Massachusetts



Note:

1. One set of metering equipment capable of measuring the full output of the generator is provided at the HV side of the GSU Xfmr.
2. One set of metering equipment is provided on the HV side of the Unit Aux Xfmr to measure the unit auxiliary load.
3. Ratings and equipment configuration shown are preliminary and will be finalized during detail design.

Figure 5.A-5
Electrical One-Line Diagram

NRG Canal 3 Development LLC
Sandwich, Massachusetts

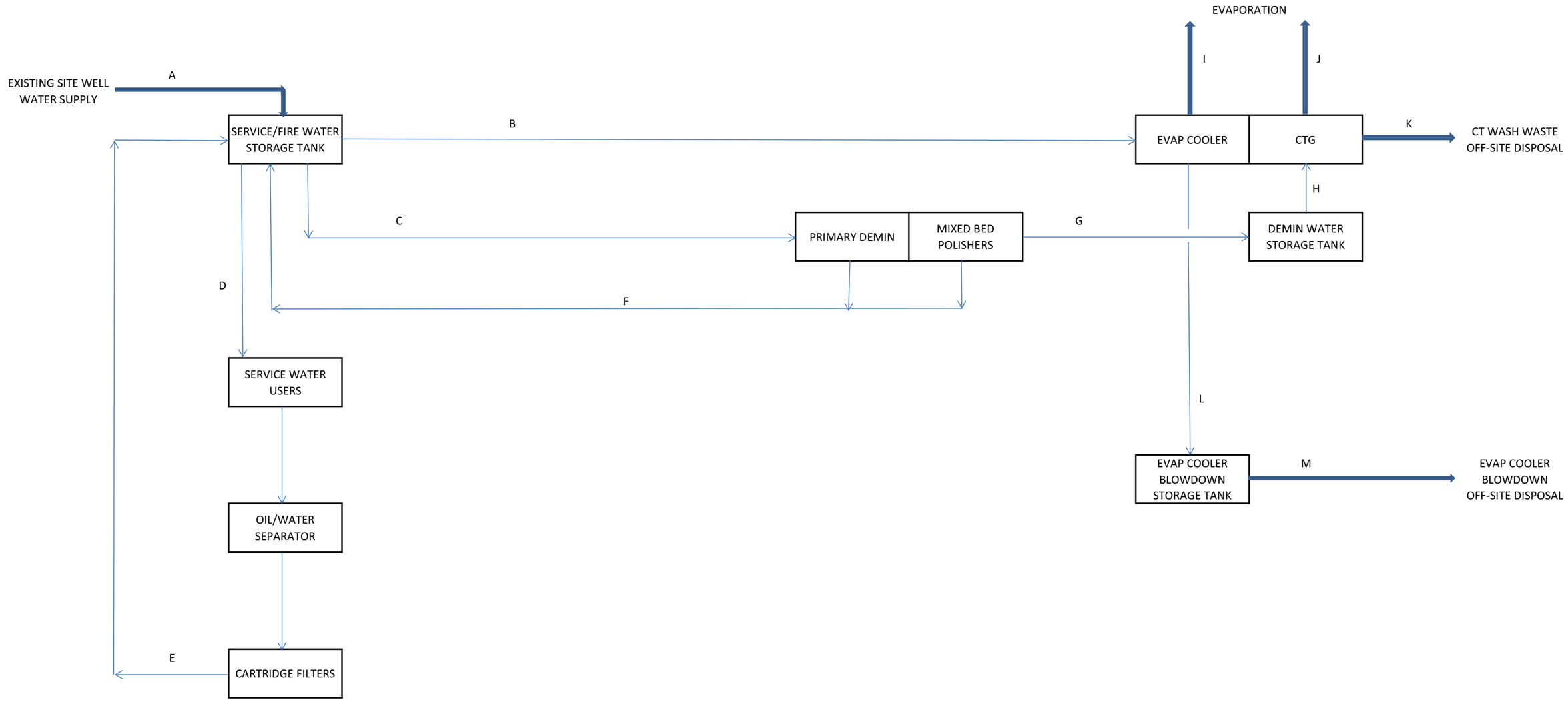


Figure 5.A-6
Water Balance
NRG Canal 3 Development LLC
Sandwich, Massachusetts

Stream ID	Case ID	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Daily Average (gpm)	Maximum Daily (gpm)	Annual Flow (GPY)	Percent Flow
	Operating Hours per Year	3,660	0	0	0	720	0	0				
	Ambient Temperature, °F	90	90	90	90	50	20	0				
	Relative Humidity, %	56	56	56	56	60	66	40				
	Plant Gross Output (MW)	333	319	340	329	351	364	363				
	Inlet Air Cooler Status	On	Off	On	Off	Off	Off	Off				
	Fuel Type	Gas	Gas	Oil	Oil	Oil	Oil	Oil				
	Description Number of CT's in Service	1	1	1	1	1	1	1				
A	Raw (Well) Water - Total Supply	37	0	479	442	472	468	465	109	479	28,515,600	100%
B	Evaporative Cooler - Service Water Makeup	37	0	37	0	0	0	0	31	37	8,125,200	**28%**
C	Demineralizer System Feed	0	0	442	442	472	468	465	78	472	20,390,400	72%
D	Service Water - Plant Users	2	2	2	2	2	2	2	2	2	525,591	2%
E	Recycled Plant Drains	2	2	2	2	2	2	2	2	2	525,591	2%
F	Total Demin Service Rinse	0	0	0	0	0	0	0	0	1	28,000	0%
G	Mixed Bed Polisher Effluent	0	0	442	442	472	468	465	78	472	20,390,400	72%
H	CTG - Demin Water Feed	0	0	442	442	472	468	465	78	472	20,390,400	72%
I	Evaporative Cooler - Evaporation	30	0	29	0	0	0	0	25	30	6,588,000	23%
J	CTG - Nox Water Injection	0	0	442	442	472	468	465	78	472	20,390,400	**72%**
K	CT Wash Waste - Off-Site Disposal	0	0	0	0	0	0	0	0	3	4,000	0%
L	Evaporative Cooler - Blowdown	7	0	7	0	0	0	0	6	7	1,537,200	5%
M	Evaporative Cooler Blowdown Off-Site Disposal	7	0	7	0	0	0	0	6	7	1,537,200	5%

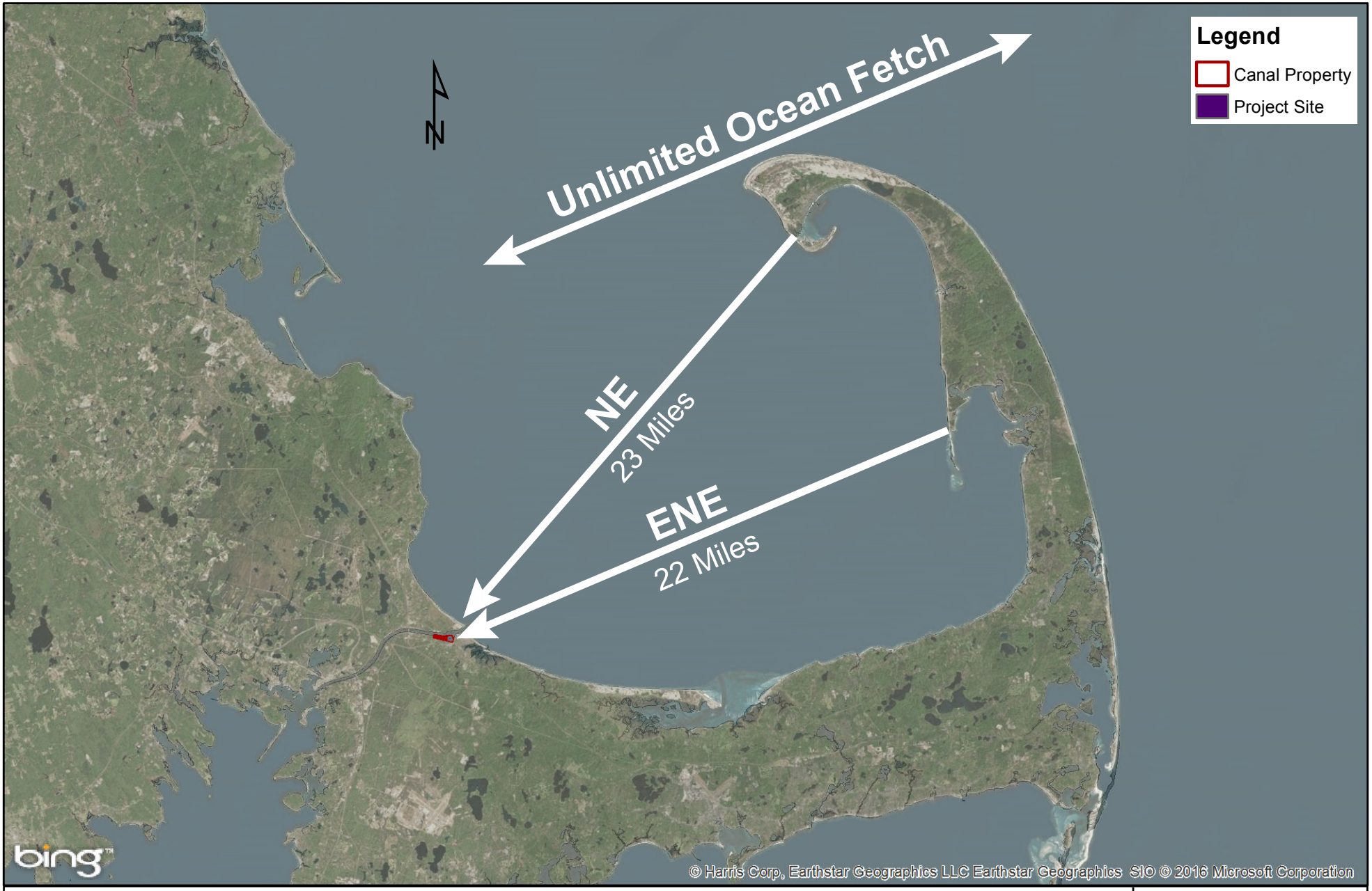
INPUTS		
1	Evaporative Cooler COC	5.0
2	Plant Service Water Users Rate, gpm	2.0
3	Plant Demin Water Users Rate, gpm	2.0

OTHER DEMIN USERS		
1	Chemical Feed Dilution, gpm	0.0
2	AUX Boiler Makeup, gpm	0.0
3	CTG Wash Water, gpm	0.0
4	Sample Panel	2.0

NOTES

1. All flows are in gallons per minute (GPM).
2. Operating hours based on 50% CF and 100% utilization of evaporative cooler when burning gas.
3. Daily Average and Annual flows are weighted and calculated based on the operating hours of each case.
4. Demineralizer throughput is based on meeting the overall plant demand; not the mobile demin max. flow.

Figure 5.A-6
Water Balance (cont.)
NRG Canal 3 Development LLC
Sandwich, Massachusetts



TETRA TECH

1 in = 6 miles

0 3 6

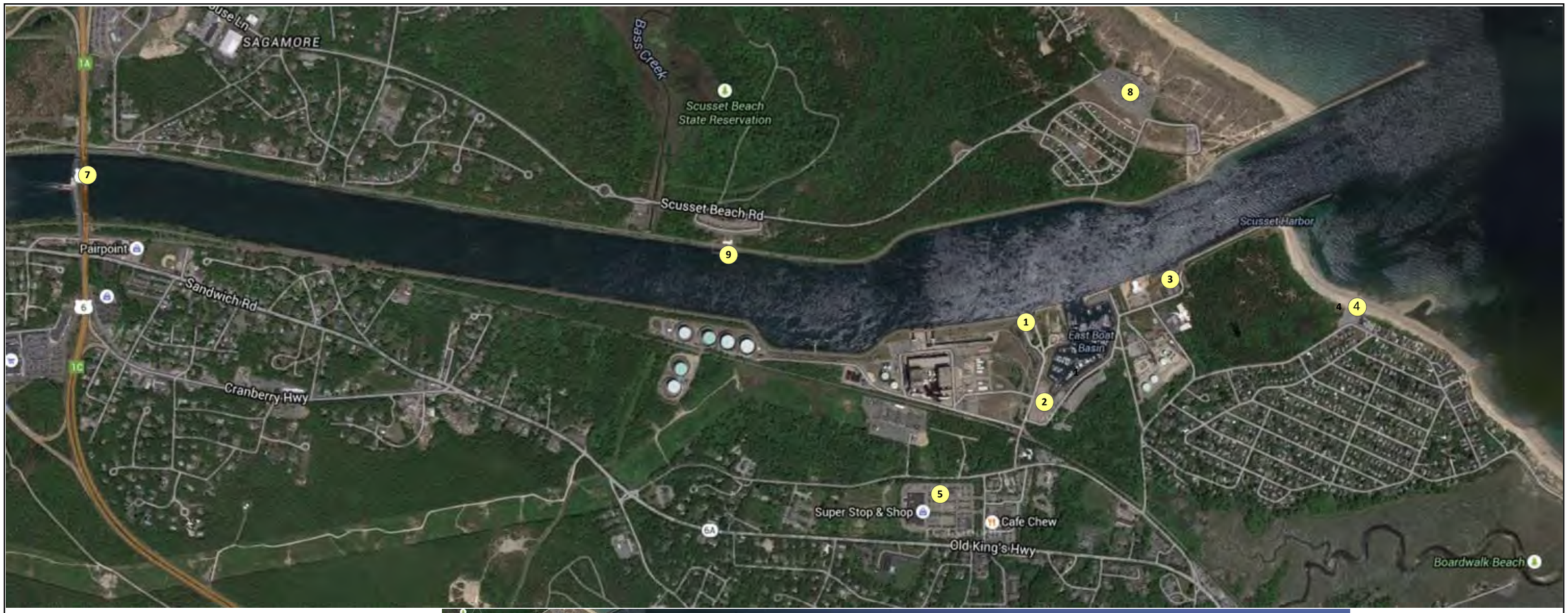
Miles

Base Map:
Bing Aerial

Cape Cod Bay

Figure 5.A-7
Cape Cod Bay Fetch

NRG Canal 3 Development LLC
Sandwich, Massachusetts



CANAL STATION PHOTOGRAPHS

Site 1: Entrance to USACE Public Walkway:
Pictures DSC6423-26
41°46'19"N
70°30'18 W

Site 2: Sandwich Marina Parking Area:
Pictures DSC6427-32
41°46'12"N
70°30'16 W

Site 3: Cape Cod Canal Visitors Center:
Pictures DSC6433-36
41°46'21"N
70°29'58 W

Site 4: Public Beach Parking:
Pictures DSC6437-39
41°46'20"N
70°29'32 W

Site5: Supermarket (Stop & Shop) Plaza:
Pictures DSC6440-43
41°46'20"N
70°29'32 W

Site 6: Sandy Neck Beach:
Pictures DSC6444-50
41°44'19"N
70°22'52 W

Site 7: Sagamore Bridge:
Pictures DSC6452-60
41°46'32"N
70°32'35 W

Site 8: Scusset Beach Parking:
Pictures DSC6461-64
41°46'35"N
70°29'55 W

Site 9: Scusset Beach Rd Pier:
Pictures DSC6467-73
41°46'27"N
70°31'01 W

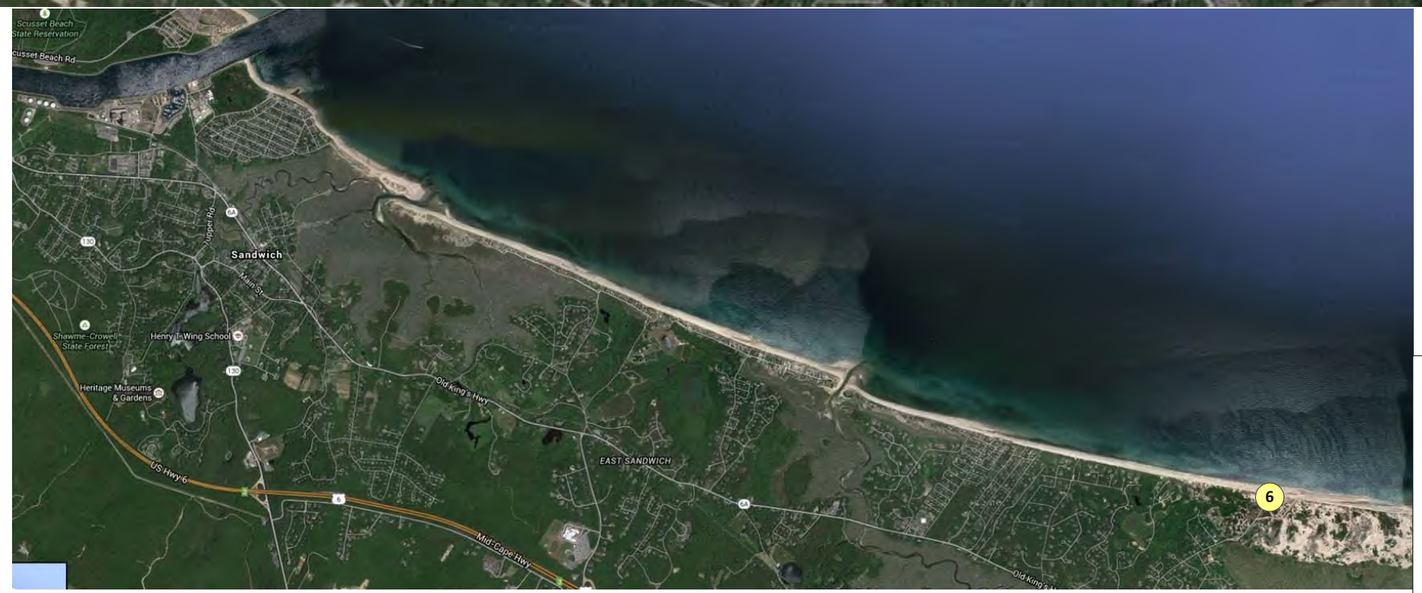


Figure 5.A-8
Photograph Key

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-9a
Entrance to USACE Public Walkway – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-9b
Entrance to USACE Public Walkway – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-10a
Sandwich Marina Parking Area – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-10b
Sandwich Marina Parking Area – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-11a
Cape Cod Canal Visitors Center – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-11b
Cape Cod Canal Visitors Center – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-12a
Public Beach Parking – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-12b
Public Beach Parking – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-13a
Supermarket (Stop & Shop) Plaza – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-13b
Supermarket (Stop & Shop) Plaza – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-14a
Sandy Neck Beach– Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-14b
Sandy Neck Beach – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-15a
Sagamore Bridge – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-15b
Sagamore Bridge – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-16a
Scusset Beach Parking – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-16b
Scusset Beach Parking – After

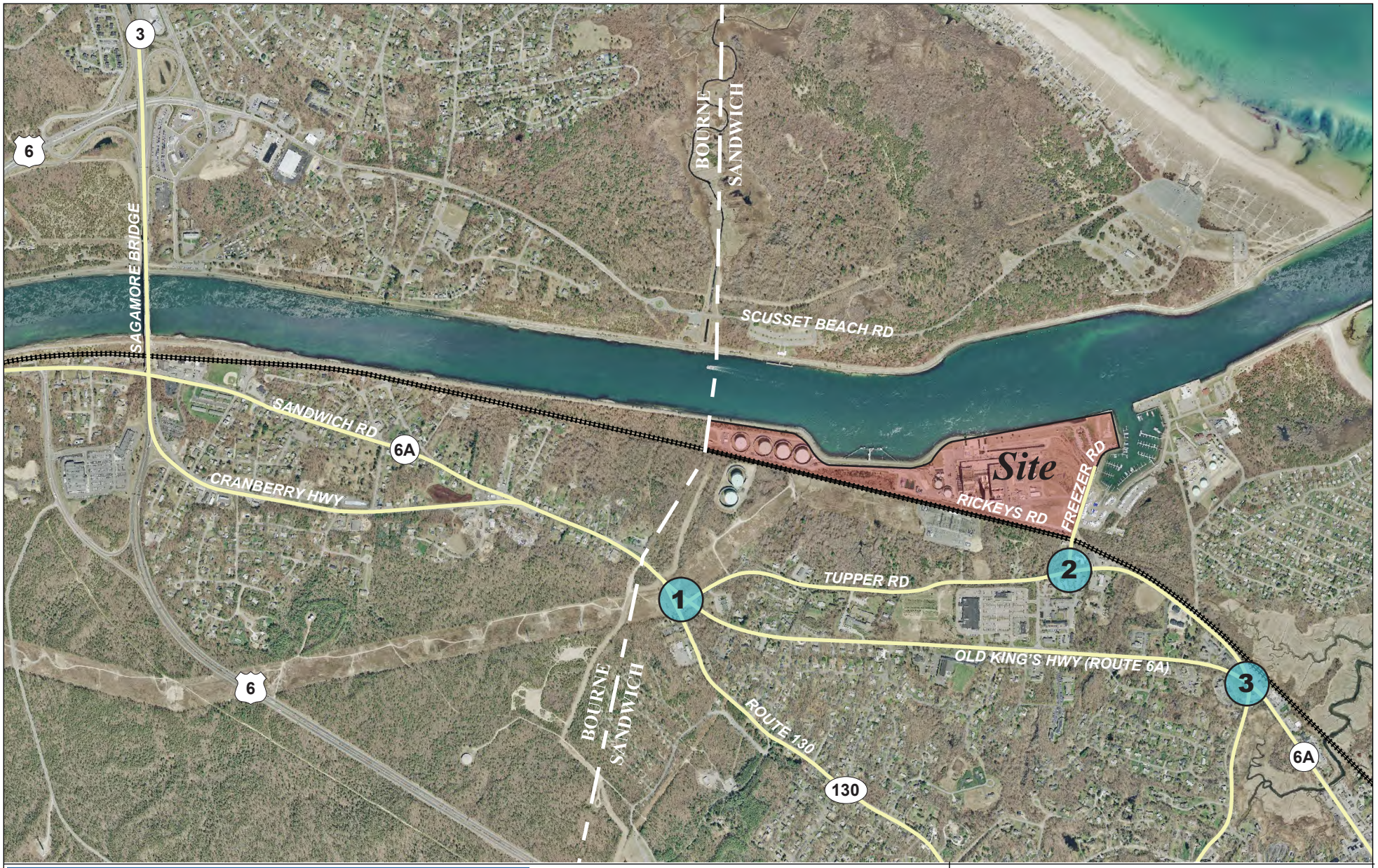
NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-17a
Scusset Beach Road Pier – Before

NRG Canal 3 Development LLC
Sandwich, Massachusetts

Figure 5.A-17b
Scusset Beach Road Pier – After

NRG Canal 3 Development LLC
Sandwich, Massachusetts



ID	Location	Traffic Control
1	Old King's Highway (Route 6A) / Tupper Road / Route 130	Stop Sign
2	Freezer Road / Tupper Road	Stop Sign
3	Old King's Highway (Route 6A) / Tupper Road	Signal

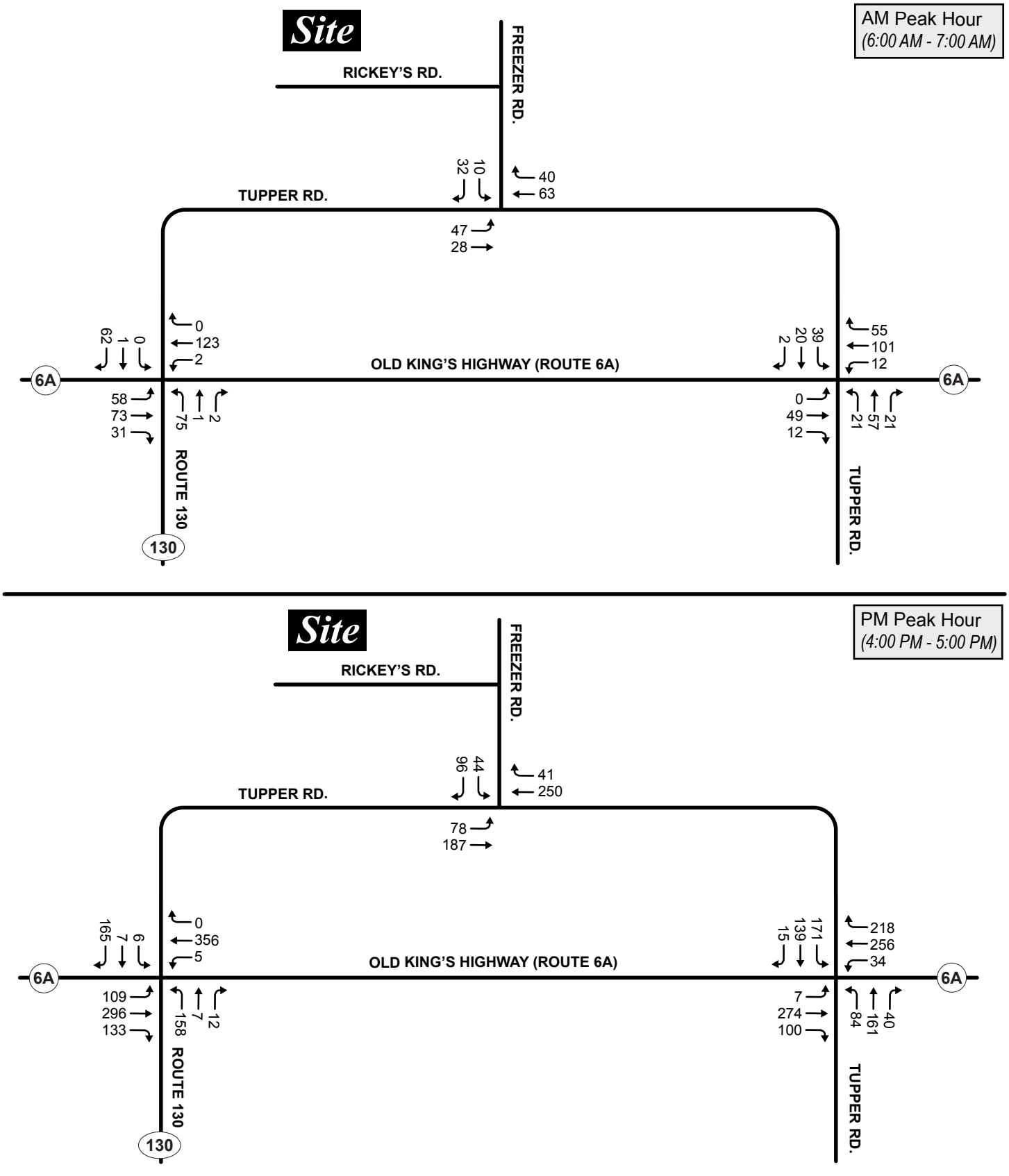
N

1500 0 375 750 1500

Approximate Scale in Feet

Figure 5.C-1
Studied Intersections

NRG Canal 3 Development LLC
Sandwich, Massachusetts



N

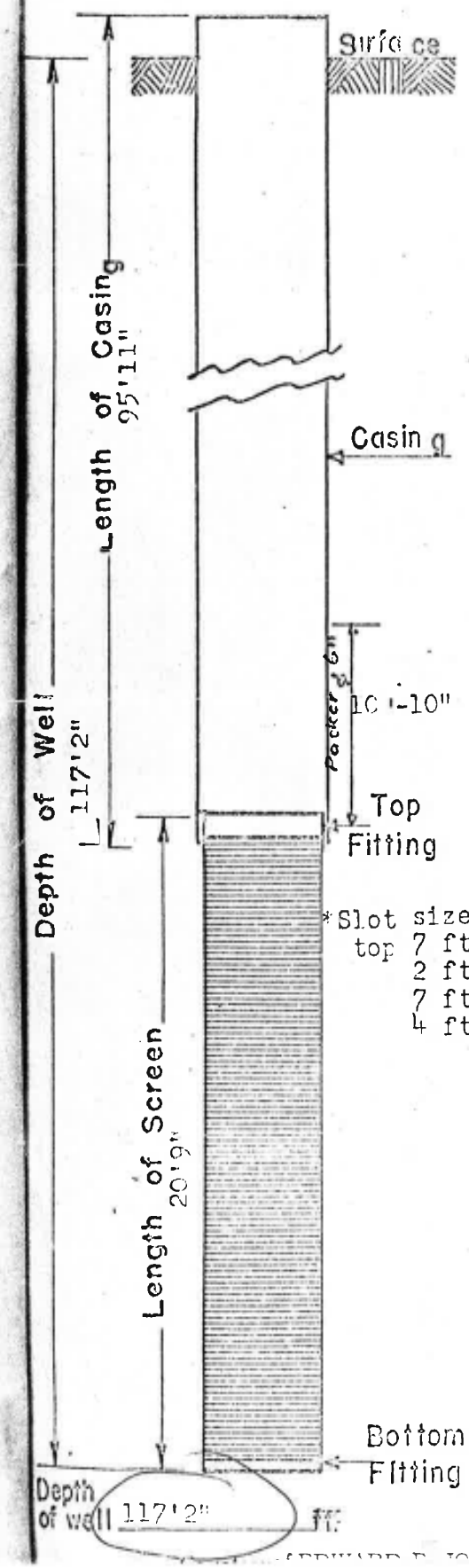
Not To Scale

Figure 5.C-2
Existing Peak Hour Traffic Volumes (2015)

NRG Canal 3 Development LLC
Sandwich, Massachusetts

ATTACHMENT 5.A-1: WELL CONSTRUCTION LOGS

CONSTRUCTION RECORD



WELL OWNER Canal Electric Company, Sandwich, Massachusetts.

WELL NO. 2

Date September 26, 1966

CASING DETAILS

Length 95' 11" ft.

Diameter 8" in.

Kind Blk. Steel

SCREEN DETAILS

Make Johnson

Length 20 ft ft.

Diameter Telescope 8" in.

Slot size See note* below

Metal 304 Stainless Steel

SCREEN FITTINGS

Top 6" Pipe ext. and lead packer

Bottom Bail

PUMP TEST

Controlled by tide

Static level 16" to 28" ft.

Rate 339 g.p.m.

Draw down 25 ft.

Hours pumped 26 hrs.

ARTIFICIALLY GRAVEL TREATED

Yes ____ No X

Thickness ____ in.

Size of gravel ____

DRILLER E. H. Hartley

A/C 169

A-3010.18

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No.
Preliminary
Item

Client: Canine Plastic Location Est. No. J.O. No. 11130

Subject: Pumping Test Well No 2 Date By

Checked By

Based on Revised By

TIME	D.D.G.	ORIFACE	G.P.M.	OBSER. WELL	REMARKS
Sept. 1, 1966		2 hr pump test			continued
12:00 N	38'	7½"	339	7'4"	
1:00	38	7½"	339	7'4"	
2:00	38	7½"	339	7'4"	
3:00	38	7½"	339	7'4"	
4:00	38	7½"	339	7'4"	
4:30	38	7½"	339	7'4"	

Orifice take calculations by Purdue Univ.

Samples for analysis taken at 1:00 PM. Sept 1, 1966 and delivered to Sherman Skinner 227 California St. Newton, Mass

Recovery after shutdown

30 sec	13 ft
1 min	10 ft.
2 min	5 ft
15 min.	4 ft
30 min	3 ft
2 hrs	3 ft.

A-3010.18

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. _____
Preliminary _____
Item _____

Client: Cruise Plant | Location: | Est. No. | J.O. No. 11120

Subject: Pumping Test Well No 2 | Date | By

Checked | By

Based on | Revised | By

TIME	D.D.G.	ORIFICE	G.P.M.	OBSER. WELL	REMARKS
24 hr continuous pump test started 2:30 P.M. Sept 1, 1966 F.A. Hartley all reading by static in pumped well 1ft from gr. elev. static in obs. well 6'8" from gr. elev. from top of casing 6" above ground.					Well #2 nearest stopped 4:30 P.M. Sept 1, 1966 F.A. Hartley or either E.H. Hartley or reading taken
2:30 PM	3ft	6½"	316	7'4"	
2:35	30	7	328	7'4"	
2:45	37	7½	339	7'4"	
2:55	37	7½	339	7'4"	
3:05	37	7½	325-339	7'4"	
3:15	37	7½	325-339	7'4"	
3:30	37	7½	325-339	7'4"	
4:00	37	7½	325-339	7'4"	
4:30	37	7½	325-339	7'4"	
5:00	38	7½	325+	7'4"	
5:30	38	7½	325+	7'4"	
6:00	38	7½	325+	7'4"	
6:30	38	7½	325-339	7'4"	
7:00	38	7½	325-339	7'4"	
8:00	38	7½	325-339	7'4"	
9:00	38	7½	339	7'4"	
10:00	38	7½	339	7'4"	
11:00	38	7½	339	7'4"	
12:00 M	38	7½	339	7'4"	
1:00 AM	38	7½	339	7'4"	Sept 1, 1966
2:00	38	7½	339	7'4"	
3:00	38	7½	339	7'4"	
4:00	38	7½+	339	7'4"	
5:00	38	7½+	339	7'4"	
6:00	38	7½+	339	7'4"	
7:00	38	7½	339	7'4"	
8:00	38	7½	339	7'4"	
9:00	38	7½	339	7'4"	
10:00	38	7½	339	7'4"	
11:00	38	7½+	339	7'4"	

NOTED SEP-2 '66 J.F.B.

R. E. CHAPMAN COMPANY
TEST BORINGS · DRILLED WELLS · GRAVEL WELLS · COMPLETE WATER SYSTEMS

MAIN OFFICE:
OAKDALE, MASSACHUSETTS 01539 TELEPHONE: 617-835-6231

October 17, 1974

Canal Electric Company and
Montaup Electric Company
c/o Stone & Webster Engineering Corp., Agent
P. O. Box 398
Sandwich, Massachusetts 02563

Attention: Mr. Ward Sears

Gentlemen: Re: Water Analysis - 8" Well #3

Enclosed herewith is water analysis on 8" well No. 3, taken at completion of 48-hour pump test.

All results look O.K. except for coliform bacteria. I think this is only a temporary condition unless there is a source of sanitary pollution close by. In any event, a massive does of chlorination, along with pumping, should be done on the well to substantially reduce the count, if not eliminate it. This could be done when the permanent pump is installed.

If you have any questions, please feel free to contact me at your convenience.

Yours very truly,

R. E. CHAPMAN COMPANY

Richard M. Chapman

RMC:mg

CC: Stone & Webster Engineering Corp.
Box 2325
Boston, Mass. 02107
Attention: Mr. Bob Plaska

R. E. CHAPMAN CO.

OAKDALE, MASS.

Name of Driller Charles E. Fiske Names of Helpers William Ordway

Job: Name & Location Canal Elec. Montoup Elec. Sandwich Mass

Date Started 9/30/74 Date Finished 10/7/74

Hole No. Well #3

Depth From	Depth To	Classification of Material
0	20	Gravel Fill
20	40	Clay Hardpan
40	50	Hardpan Boulders
50	60	Boulders
60	70	Boulders
70	80	Gravel Boulders
80	90	Coarse Gravel
90	100	Med Gravel
100	110	Coarse Sand

Feet of Screen Exposed 20'-2"

Size of Screen & Slot 40 SB 60 or 20

Screen Left in 20'-2"

Screen Pulled Out

Pipe Left in 91'

Pipe Pulled Out

Remarks

Pump Test on Hole No.

Date	Time	Dr. Down	G. P. M.	Static and Other Info.

Date Started Date Finished

Hole No.

Depth From	Depth To	Classification of Material

Feet of Screen Exposed

Size of Screen & Slot

Screen Left in

Screen Pulled Out

Pipe Left in

Pipe Pulled Out

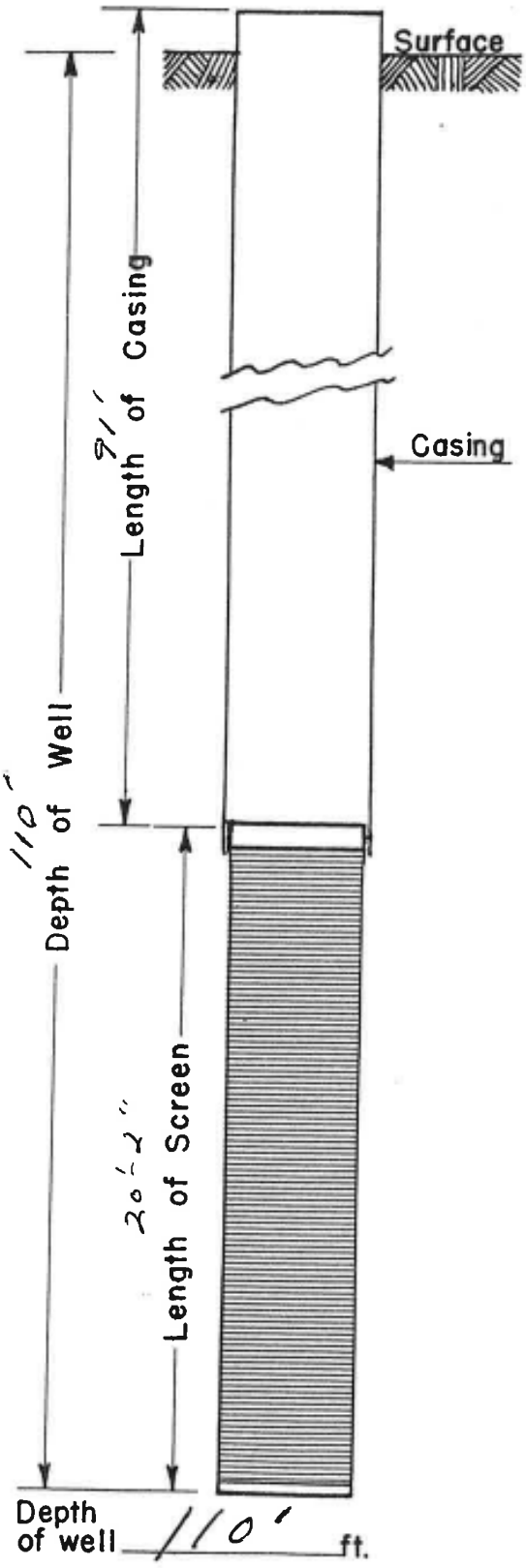
Remarks

Pump Test on Hole No.

Date	Time	Dr. Down	G. P. M.	Static and Other Info

R. E. CHAPMAN CO.

WELL CONSTRUCTION RECORD



WELL OWNER Canal Electric
Montaup Electric

WELL NO. 3

Date 10/9/74

CASING DETAILS

Length 91' ft.
Diameter 8" in.
Kind Steel

SCREEN DETAILS

Make Johnston
Length 20'-2" ft.
Diameter 8" in.
Slot size .040"
Metal Stainless

SCREEN FITTINGS

Top WELD ON FITTING S.S.
Bottom S.S. PLATE

PUMP TEST

Static level 3' ft.
Rate 425 g.p.m.
Draw down 23'-6" ft.
Hours pumped 48 hrs.

ARTIFICIALLY GRAVEL TREATED

Yes ✓ No
Thickness 2 in.
Size of gravel #2 C.M.

DRILLER Charles Frost

. Stone + Webster

R. E. CHAPMAN CO., OAKDALE, MASS. 01539

CUSTOMER Canal Elec. & Montaup Elec

TOWN Sandwich Mass

STREET Freezer Rd STATE Mass

OWNER OF PROPERTY: Canal Elec. & Montaup Elec.

OPERATORS: Charles Trud William Dadong

SIZE & TYPE OF PUMP: 5" turbine

DISCHARGE LINE: Size 4 in.; Length 20 feet.

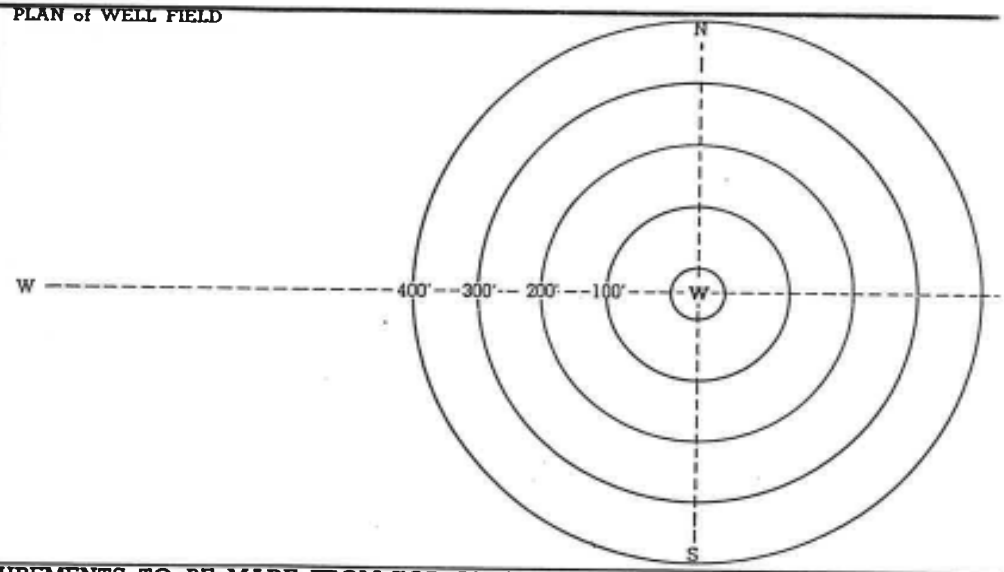
ORFICE PIPE 6 in.; SIZE ORFICE PLATE 5 in.

DESCRIPTION OF WELL BEING PUMPED: 8" Gravel

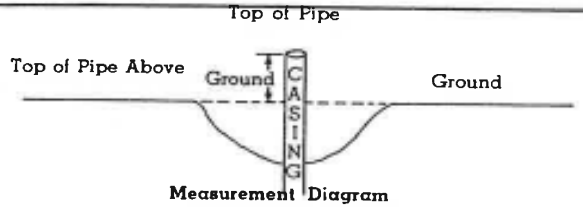
LENGTH OF DUNKER ON TAPE 2 in ADD TO READINGS (When you make read.)

LENGTH OF ALTITUDE LINE FROM CENTER OF GAUGE 8 ft. in.

PLAN of WELL FIELD



ALL MEASUREMENTS TO BE MADE FROM TOP OF CASINGS



FINISHED WELL NO 3

DEPTH OF WELL 10'

TOP OF PIPE ABOVE GROUND 6"

STATIC READING 3'

2½" SBS EXIST GW

Observation Wells Informa

No. 1	No 2	No.	No.
Depth	Depth	Depth	Depth
Pipe AG 8"	Pipe AG	Pipe AG	Pipe AG
Static 3'	Static 6'	Static	Static

START PUMP TEST READINGS BELOW THIS LINE

Date, Weather and Sample Taken	Time	Water Temperature	Alt. Gauge Reading	Tape Meas'nt in Well	Office Head in Inches	GPM	Water Level	Water Level	Water Level	Water Level
10/7/74 Fair	9:01		24		12	425	11-7"			
	10:02		25		12	425	12-4"			
	9:03		25		12	425	12-9½			
	10:04		25		12	425	13-3			
	10:05		25		12	425	13-6			
	10:06		25		12	425	13-8½			
	10:07		25		12	425	13-11			
	10:08		25		12	425	14-1			
	9:09		25		12	425	14-2½			

Krizik & Corrigan Inc., Worcester, Mass.

CUSTOMER Stone & Webster Const Elec.

R. E. CHAPMAN CO., OAKDALE, MASS.

NO. 2

LO

TEL. WEST

START PUMP TEST READINGS BELOW THIS LINE

Date, Weather and Sample Taken	Time	Water Temperature	Alt. Gauge Reading	Tape Meas'nt in Well	Orfice Head in Inches	GPM	2½" Obs. #1 Water Level	1" #2 Water Level	Water Level	Water Level
10/7/74 Fair	10:10		25		12	425	14-4½			
	10:11		25		12	425	14-5½			
	10:12		25		12	425	14-6½			
	10:13		25		12	425	14-8			
	10:14		25		12	425	14-9			
	10:15		25		12	425	14-10	43'		
	10:30		25-6		12	425	15-4½	43'		
	10:45		26		12	425	15-11	44'		
	11:00		26		12	425	16-2½	44'		
	11:15		26		12	425	16-3½	44'		
	11:30		26		12	425	16-4¼	44'		
	11:45		26		12	425	16-4¼	44'		
	12: NOON		26		12	425	15-11"	11'	← Pump off	
	12:30		25		12	425	14-4	9'		
	1:00		24-6"		12	425	14-2	9'		
	1:30		24'		12	425	14-0½	9'		
	2:00		25-6		12	425	15-8	44'	← Pump on	
	3:00		26		12	425	15-10	44'		
	4:00		24		12	425	13-8	9'	← Pump off	
	5.00		25		12	425	15'0	43'	Pump on	
	6:00		25-6		12	425	15'-8"	44'		
	7:00		24-6		12	425	14-0	10'	Pump off	
	8:00		25		12	425	15'-4	44'	Pump on	
	9:00		26		12	425	16'-4	45'		
	10:00		25		12	425	14'-11	11'	Pump off	
	11:00		25		12	425	14'-7	10'	" "	
	12: Mid.		26-6		12	425	16'-7	45'	PUMP ON	
10/11/74 FAIR	1:00 AM		26'		12	425	15'-4	11'	PUMP OFF	
	2:00 AM		24'-6		12	425	14-3	10'	" "	
	3:00 AM		25'		12	425	15'-0	43'	PUMP ON	
	4:00		26'		12	425	16'-	45	" "	

CUSTOMER Stow & Hudson Cond Elec

R. E. CHAPMAN CO., OAKDALE, MASS.

NO. 3

LOG

TEL. WEST BO

START PUMP TEST READINGS BELOW THIS LINE

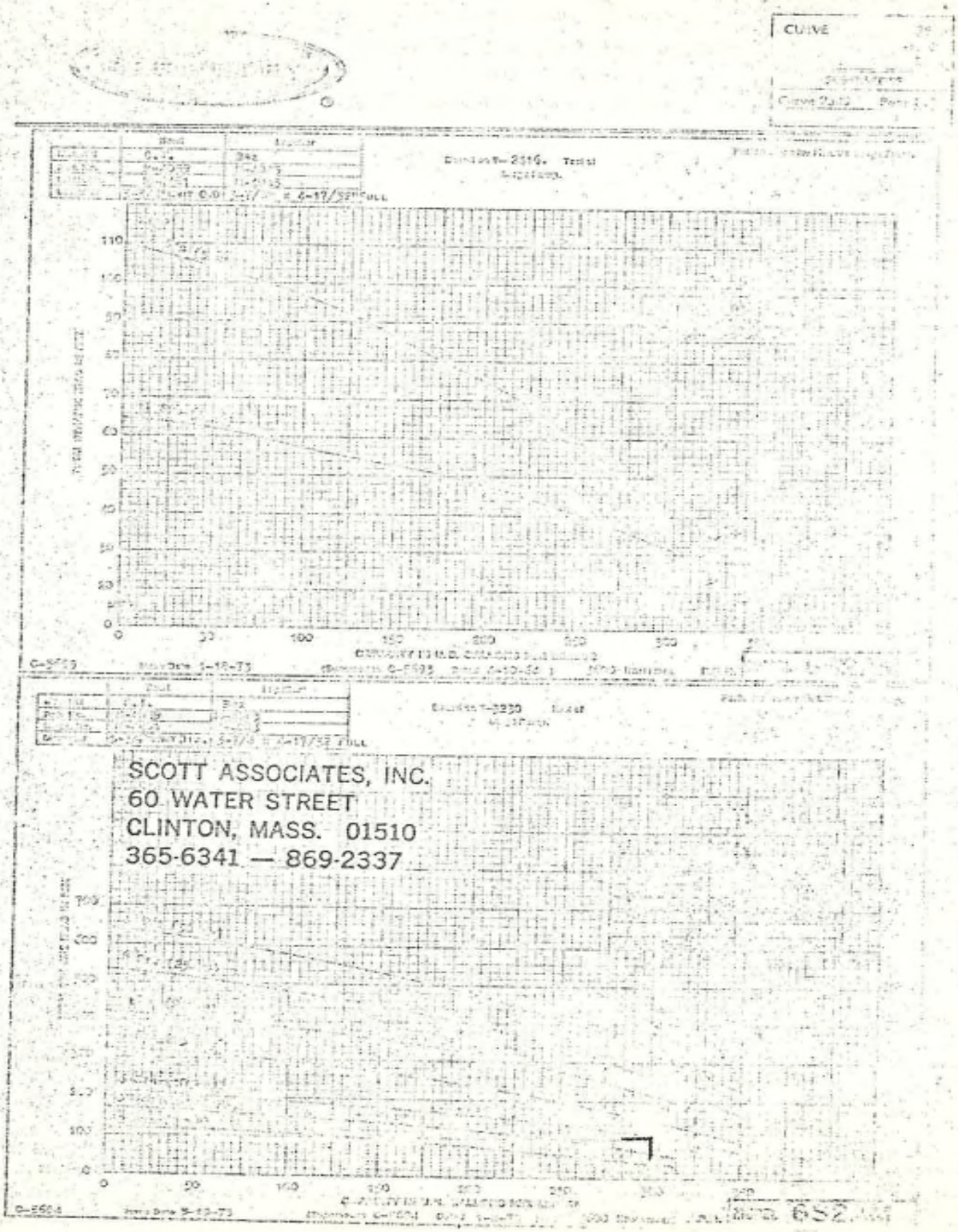
Date, Weather and Sample Taken	Time	Water Temperature	Alt. Gauge Reading	Tape Meas'nt in Well	Orfice Head in Inches	GPM	8½" Obs. #1 Water Level	8" Obs. #2 Water Level	Water Level	Water Level	W
10/8/74 FAIR	5:00 AM		25'		12	425	15'-3½"	15'	PUMP OFF		
	6.00		24'-6"		12	425	13'-11½	10'	" "		
	7.00		25'		12	425	15'-11"	45'	PUMP ON		
	8.00		26'		12	425	16'-2	44	" "		
	9.00		26'-6"		12	425	16'-7½	43'	" "		
	10.00		25'		12	425	14'-10½	25'	PUMP OFF		
	11.00		26'-6"		12	425	16'-9½	44'	PUMP ON		
	12:00 NOON		26'-6"		12	425	16'-8½	45'	" "		
	1:00		26'		12	425	15'-11½	11'	PUMP OFF		
	2:00		25'		12	425	14'-4½	10'	" "		
	3:00		26'		12	425	15'-11"	44'	Pump on		
	4:00		26'		12	425	15'-11"	12'	PUMP OFF		
	5:00		24'-6"		12	425	13'-10"	9'	" "		
	6:00		25'		12	425	14'-5	43'	pump on		
	7:00		26'		12	425	15'-10½	44'	" "		
	8:00		25'		12	425	14'-2	10'	pump off		
	9:00		25		12	425	14'-3	10	" "		
	10:00		26-6		12	425	16'-5½	45	pump on		
	11:00		26'		12	425	15'-5	11	Pump off		
	12:mid		26'		12	425	14'-11½	40	PUMP ON		
10/9/74 FAIR	1:00AM		26'-6		12	425	16'-8"	45	" "		
	2:00AM		27'		12	425	16'-10	46	" "		
	3:06		25		12	425	14-7	12	PUMP OFF		
	4.00		26		12	425	15'-9	43	PUMP ON		
	5:00		26		12	425	16'	44	" "		
	6.00		24-6		12	425	14'-3	10	PUMP OFF		
	7.00		24		12	425	14'	25	" "		
	8.00		26		12	425	16'-1½"	43	PUMP ON		
	9:00		25		12	425	14'-10"	27	PUMP OFF		
	10.00		25		12	425	15'-2½	43	PUMP ON		

CUSTOMER Stone & Webster Canal Elec. R. E. CHAPMAN CO., OAKDALE, MASS. NO. 4 LOG

TEL. WEST B(

START PUMP TEST READINGS BELOW THIS LINE

Date, Weather and Sample Taken	Time	Water Temperature	Alt. Gauge Reading	Tape Meas'nt in Well	Orfice Head in Inches	GPM	Water Level	Water Level	Water Level	Water Level
10/9/14 FAIR					9½ QUERY		20 8 HI	8 Water Level		
	10:00				SHUT DOWN			#2		
	10:02		8				7-3			
			7				6-9			
	10:03		7				6-5½"			
	10:04						6-3½"			
	10:05		6-6				6-1"			
	10:0		6							
	10:07		6				10-0			
	0:0		6				55-01			
	10:09									
	10:10		6				5-9			
	10:11		5				55-8¼			
	10:12		5							
	10:13		5				5-7			
	10:14		5				5-6½"			
	10:15		5				5-5½			
	10:30		5				5-2½	42		
	10:45		4-6"				5-1½	41		
	11:00		4-6"				5-1"	41		
	12 NOON						5-1"	41		
	1:00						35-0"	41		
	2:00							8 ← Pump off		



SUBMERSIBLE TURBINE PUMPS
6" AND 7" LINES
PERFORMANCE CURVES

City Well Readings during Pump Test

Sheet 1

10-7-24

TIME	Obsvn.	CITY WELL READING	CITY WELL ELEV	TIDE Read.	TIDE ELEV
10:30		8.00	10.14	-12.00	-7.00
10:45					
11:00	WELL	8.00	10.14		
11:15	TIDE			-10.65	-1.65
11:30	WELL	8.05	10.09	-10.165	-1.165
12:00 NOON	WELL TIDE	8.05	10.09		
1:00	WELL	8.00	10.14		
1:10	TIDE			-7.65	+1.35
1:40	WELL	7.975	10.165		
1:50	TIDE			-6.50	+2.50
2:10	WELL	7.975	10.165		
2:20	TIDE			-5.45	+3.55
2:30	WELL	7.95	10.19		
3:30	WELL	7.95	10.19		
3:40	TIDE			-4.00	+5.00
4:10	WELL	7.90	10.24		
4:20	TIDE			-4.20	+4.80
4:55	WELL	7.70	10.24	4.7	
5:00	tide			4.70	+4.30
6:00	WELL	7.95	10.19		
6:10	tide			6.20	+2.80
6:55	WELL	7.95	10.19		
7:00	TIDE			8.00	+1.00
7:55	WELL	8.00	10.14		
8:00	TIDE			10.10	-1.10

3 M CITY : 10.14
3 M TIDE : 9.00

TIME	LOCATION	CITY WELL Rept ELEV		TIDE REAL	TIDE mg2 ELEV
8:55 9:00	WELL TIDE	8.00	10.14	12.30	-3.30
9:55 10:10	WELL TIDE	8.05	10.09	12.80	-3.80
10:55 11:00	WELL TIDE	8.06	10.03	12.70	-3.70
11:50	WELL TIDE	8.10	10.04'	12.25	-3.25
10/8/74					
12:50 1:00	WELL TIDE	8.10	10.04'	8.40	0.6
1:55 2:05	WELL TIDE	8.10	10.04'	8.00	1.0
2:55 3:05	WELL TIDE	8.10	10.04'	6.7	2.3
4:00 4:10	WELL TIDE	8.00	10.14	6.3	2.7
4:56 5:10	WELL TIDE	8.00	10.14	5.7	3.3
6:00 6:05	WELL TIDE	8.00	10.14	5.4	3.6
7:00 7:05	WELL TIDE	8.00	10.14	7.8	1.2
7:45 7:55	WELL TIDE	8.00	10.14	8.7	.3
9:05 9:20	WELL	8.05	10.19	8. 10.85	-2.85
10:40 10:50	WELL TIDE	8.10	10.24	11.5	-2.50
11:30 11:40	WELL TIDE	8.15	10.29	11.7	-2.70

TUESDAY / WEDNESDAY 10/8/94 — 10/9/74

12:10 12:20	WELL TIDE	8.15	10.29 -.025	11.1	-2.1
1:05 1:10	Well Tide	8.125	10.315	9.00 9.05	-0.05
2:05 2:15	WELL TIDE	8.10	10.29	7.15	1.85
3:05 3:15	Well Tide	8.10	10.29	5.60	3.40
4:09 4:20	Well Tide	8.025	10.215	4.25	4.75
5:15 5:20	WELL TIDE	8.00	10.14	4.00	5.00
6:05 6:15	WELL TIDE	8.00	10.14	5.11	4.00
7:10 7:15	WELL TIDE	8.00	10.14	6.25	2.75
7:05 8:10	WELL TIDE	8.00	10.14	7.70	2.30
9:00 9:05	WELL TIDE	8.05	10.09	10.10	-1.00
9:55 10:00	WELL TIDE	8.05	10.01	11.70	-2.70
11:05 11:10	WELL TIDE	8.10	10.04	13.00	-4.00
11:50 12:05	WELL TIDE	8.15	9.99	12.50	-3.50
12:55 1:05	WELL TIDE	8.15	9.99	11.00	-2.00
1:55 2:05	WELL TIDE	8.15	9.99	9.60	-.60

10/8/1974

2:55 3:05	WELL TIDE	8.15	9.99	8.3	.7
4:10 4:20	WELL TIDE	8.10	10.0	5.95	+3.05
4:55 5:05	WELL TIDE	8.10	10.04	5.30	+3.40
5:55 6:05	WELL TIDE	8.10	10.04	5.20	+3.50
6:55 7:05	WELL TIDE	8.10	10.04	6.10	+2.90
7:40 7:50	WELL TIDE	8.05	10.09	6.90	+2.10
9:10 9:20	WELL TIDE	8.04	10.13	9.70	-0.79
10:15 10:25	WELL TIDE	8.10	10.14	10.5	-1.50

R. E. CHAPMAN COMPANY
Contractor for
TEST BORINGS · DRILLED WELLS · GRAVEL WELLS · COMPLETE WATER SYSTEMS

MAIN OFFICE:
OAKDALE, MASSACHUSETTS 01539 TELEPHONE: 617-835-6231

WRS AR ERBERT File.
(P2 1l

October 17, 1974

L-1254

Canal Electric Company and
Montaup Electric Company
c/o Stone & Webster Engineering Corp., Agent
P. O. Box 398
Sandwich, Massachusetts 02563

OCT 21 1974
E. L. W.

Attention: Mr. Ward Sears

Gentlemen: Re: Water Analysis - 8" Well #3

Enclosed herewith is water analysis on 8" well No. 3, taken at completion of 48-hour pump test.

All results look O.K. except for coliform bacteria. I think this is only a temporary condition unless there is a source of sanitary pollution close by. In any event, a massive does of chlorination, along with pumping, should be done on the well to substantially reduce the count, if not eliminate it. This could be done when the permanent pump is installed.

If you have any questions, please feel free to contact me at your convenience.

Yours very truly,

R. E. CHAPMAN COMPANY

Richard M. Chapman

Richard M. Chapman

RMC:mg

William Cummings

NOTED OCT 21 1974 W.L.S.

CC: Stone & Webster Engineering Corp.
Box 2325
Boston, Mass. 02107
Attention: Mr. Bob Plaska

RECEIVED
OCT 21 1974
STONE & WEBSTER ENG. CORP.
SANDWICH, MASS.

REITZEL ASSOCIATES
INDUSTRIAL & RESEARCH CONSULTANTS
CONSULTING ENGINEERS
10 KENDALL PLACE BOYLSTON, MASSACHUSETTS 01505 U. S. A.
PHONE (617) 869-2893

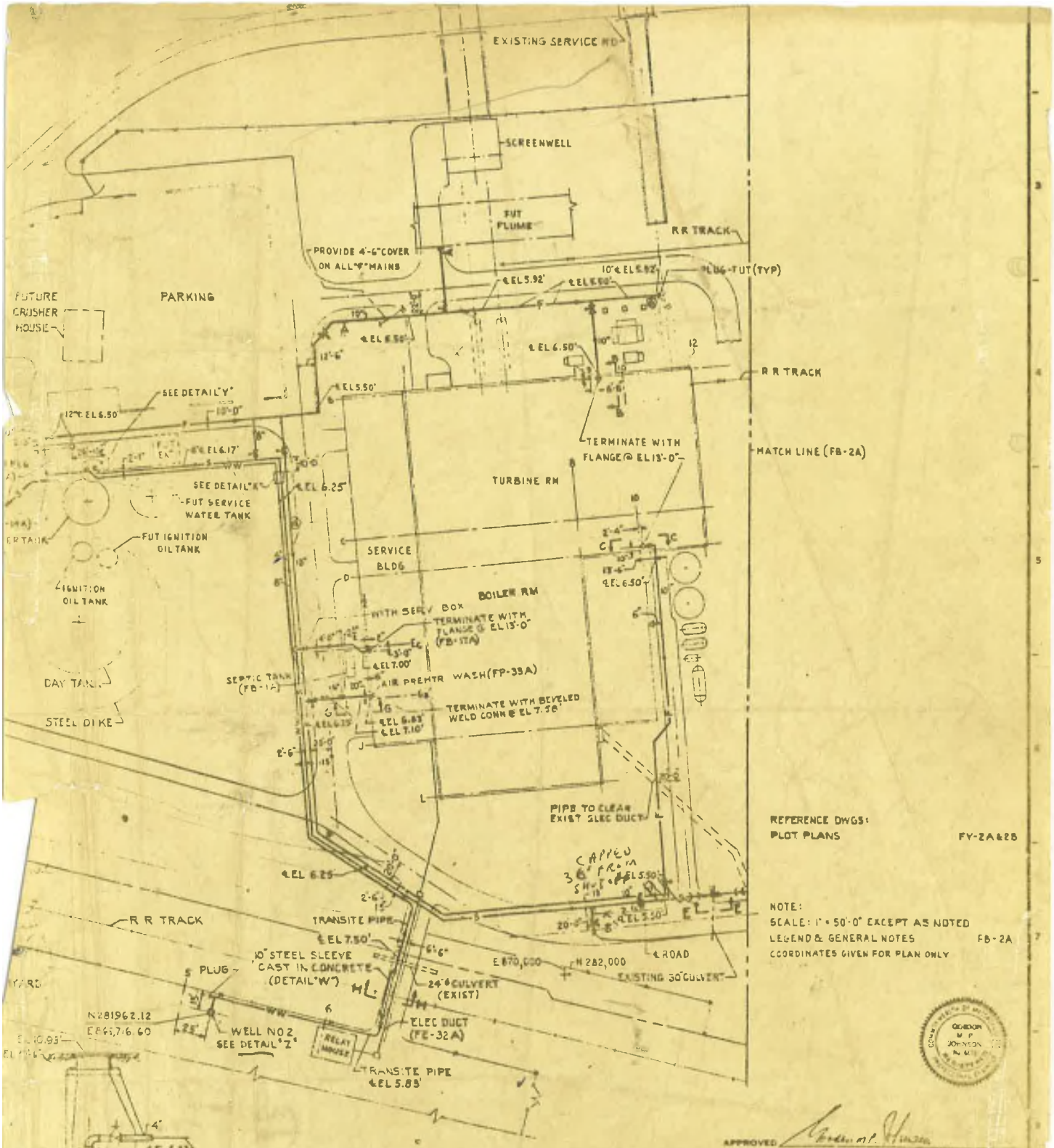
NICOLAS M. REITZEL, R.P.E.

Parameter	Unit	Result
Specific Conductivity	mg/l as NaCl	38
Specific Conductance	μ MHO/cm	81
Total Hardness	mg/l as $CaCO_3$	12
Phenolphtalein Alkalinity	mg/l as $CaCO_3$	0
Methyl Orange Alkalinity	mg/l as $CaCO_3$	10
pH	----	6.9
Free CO_2	mg/l	15
Color	Pt. Color Units	0
Total Suspended Solids	mg/l	0
Total Dissolved Solids	mg/l	41
Calcium	mg/l	3.4
Magnesium	mg/l	0.4
Sodium	mg/l	6
Sulfates	mg/l	0
Chlorides	mg/l as NaCl	12
Nitrates	mg/l as N	0.4
Nitrites	mg/l as N	0.0
Total Silica	mg/l	0.0
Total Iron	mg/l	0.0
Manganese	mg/l	< 0.1
Total Phosphate	mg/l as P	0.13
Total Volatile Solids	mg/l	30
Copper	mg/l	0.15
Total Aluminum	mg/l	0.04
Total Coliform Bacteria	No./100 ml.	Too numerous to count

REITZEL ASSOCIATES
INDUSTRIAL & RESEARCH CONSULTANTS
CONSULTING ENGINEERS
10 KENDALL PLACE BOYLSTON, MASSACHUSETTS 01505 U. S. A.
PHONE (617) 869-2893

NICOLAS M. REITZEL, R.P.E.

Parameter	Unit	Result
Specific Conductivity	mg/l as NaCl	38
Specific Conductance	u MHO/cm	81
Total Hardness	mg/l as $CaCO_3$	12
Phenolphtalein Alkalinity	mg/l as $CaCO_3$	0
Methyl Orange Alkalinity	mg/l as $CaCO_3$	10
pH	----	6.2
Free CO_2	mg/l	15
Color	Pt. Color Units	0
Total Suspended Solids	mg/l	0
Total Dissolved Solids	mg/l	4[illegible]
Calcium	mg/l	2.4
Magnesium	mg/l	2.4
Sodium	mg/l	6
Sulfates	mg/l	8
Chlorides	mg/l as NaCl	12
Nitrates	mg/l as N	0.4
Nitrites	mg/l as N	0.0
Total Silic	mg/l	0.0
Total Iron	mg/l	0.0
Manganese	mg/l	<0.1
Total Phosphate	mg/l as [illegible]	0.15
Total Volatile Solids	mg/l	30
Copper	mg/l	0.15
Total Aluminum	mg/l	0.04
Total Coliform Bacteria	No./100 ml.	Too numerous to count



APPROVED

REGISTERED PROFESSIONAL ENGINEER NO.
COMMONWEALTH OF MASSACHUSETTS

FIRE PROT. & WATER LINES - YARD
SH - 2

CANAL PLANT
PLYMOUTH COUNTY ELECTRIC COMPANY
NEGEA SERVICE CORPORATION, AGENT
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 1130 - FB - 2B

CANAL ELECTRIC CO.
FORMERLY
PLYMOUTH COUNTY ELECTRIC CO

NOTE SITES CHANGED						ORIGINAL ISSUE					
DESCRIPTION	CHKD	CORR	APPD	DATE	ISSUE	DESCRIPTION	CHKD	CORR	APPD	DATE	

Mirant New England
Canal Electric Plant
Service Water Supply

Pumping Test Results
Canal Electric Plant
Well No. 4

Prepared by Metcalf & Eddy, Inc.

April 20, 2001

TABLE OF CONTENTS

LIST OF FIGURES

Figure

ATTACHMENTS

Introduction

The Canal Electric Plant is currently registered to withdraw 164.25 million gallons per year (mgy) of groundwater for its service water system. This annual total is equal to an average of 0.45 million gallons per day (mgd), or 312 gallons per minute (gpm). Mirant has initiated a project to increase the generating capacity at the plant by adding a series of turbine units. The new units will increase the water demand to an annual average 305.1 mgy, equal to an average of 0.84 mgd or 580 gpm. The maximum rate of sustained water demand will be about 770 gpm.

The service water system is currently supplied by two wells, No. 2 and No. 3. When tested in 1997, the maximum combined capacity with both well pumps operating was 470 gpm; however, when installed, the wells produced 339 and 425 gpm, respectively. The current plan is to equip the existing wells to pump 370 and 400 gpm, and to develop a new water source that would also be equipped to pump 400 gpm. In that way, the maximum rate of sustained demand of 770 gpm could be delivered with any one well out of service.

The planned new source of groundwater is the recently constructed Well No. 4 on the plant property. This report describes a pumping test that was conducted at this new supply well.

Subsurface Conditions

About 100 borings were drilled at the Canal Electric Plant site during the designs of Unit 1 and Unit 2. The report prepared by Stone & Webster (July 12, 1972) regarding subsurface investigations for Unit 2 includes logs from those borings, as well as numerous geologic cross-sections. More recently, eight borings (CS-301 to -308) were drilled on the site east of Unit 2, providing additional subsurface data. These borings indicate that four basic strata exist beneath the property: sandy fill; glacial outwash consisting largely of sand or gravelly sand; interbedded sandy silt and silty clay; and dense fine to medium sand with silty lenses. The two existing supply wells are reportedly screened in the fourth layer. No. 2 is screened from a depth of 96 to 117 feet, and No. 3 is screened from a depth of 90 to 110 feet. During the previous episode of subsurface exploration at the site, two monitoring wells (MW-301 and MW-303) were installed in the planned area for the new construction. These wells are also screened in the fourth layer. Only one of these wells (MW-301) is still available for monitoring.

During the previous investigations at the site, borings were typically drilled to depths of 50 to 70 feet. Most of the borings in the central and northern parts of the site encountered silty or clayey strata, generally 10 to 30 feet thick, within this depth range. Two deeper borings, drilled to a depth of about 100 feet between the northeast corner of the site and the Canal, encountered clay throughout the bottom 70 to 90 feet of the hole. These results suggest that the silty and clayey strata are not continuous but are commonly present in the northeastern part of the site. These strata may cause the seaward displacement of the interface between fresh groundwater and salt water in this

eventually pinch out against the recessional moraine.

According to regional cross-sections prepared by the USGS, the bedrock surface along the eastern end of the Canal is projected to be at a depth of about 220 feet. The regional cross-sections indicate that, from the bedrock surface up to a depth of about 150 feet, the glacial drift that overlies the bedrock is lake-bottom deposits of very fine sand, silt, and clay. The test drilling for this water supply exploration program has suggested that the soils below 150 feet are mostly fine-grained.

The groundwater throughout the plant site exhibits tidal fluctuations. Background monitoring has indicated that, in response to tidal fluctuations of about 10 feet in the Cape Cod Canal, the deep wells (145 ft +/-) have shown tidal fluctuations up to about 4 feet, while the water table wells have shown fluctuations of 0.05 to about 1 foot.

Well Construction Details

Well No. 4 was constructed by the R.E. Chapman Company between December 2000 and February 2001. A pair of 2.5-inch diameter test wells (TW-3 and -3A) that were previously drilled at the site of Well No. 4 indicated the presence of moderately permeable sands between depths of about 120 and 150 feet. To construct the supply well, 12-inch diameter casing was first driven to a depth of 146 feet. Soil samples from depths of 110 to 145 feet indicated that the desired well yield of 400 gpm could be obtained from a "naturally-developed" (no gravel pack) well with an 8-inch diameter telescope-size screen from 117 to 142 feet.

A screen was selected with 0.03-inch openings in the top 10 feet and 0.02 inch openings in the bottom 15 feet. The screen was lowered to a depth of 142 feet inside the 12-inch diameter casing, after which the casing was raised to expose the screen to the aquifer. The well was then developed, to remove the fine soil particles from the aquifer around the screen. At the end of development, when pumping at 200 gpm, the well had a specific capacity of 12.5 gpm/ ft. The 400-gpm test pump was then installed and cycled on and off until the discharge was sand-free upon startup.

Pumping Test Design

Figure 1 is a map showing the location of Well No. 4 (PW-4). Streams and wetlands within 1,000 feet, and known supply wells within one-half mile of the supply well, are also shown. Known supply wells within one-half mile include the two existing supply wells at the Canal Electric Plant (No. 2 and No. 3), about 750 and 1,100 feet to the west; the supply well(s) at the fish processing plant at the end of Freezer Road, about 1,200 feet to the north; and the Sandwich Water District Well No. 1 site, about 1,500 feet to the southeast.

A wetland exists to the west of Well No. 4 (Figure 2), along the railroad tracks and east of the switchyard. The wetland is largely overgrown with cattails, but a program has been developed to remove undesirable species and restore the wetland. The wetland area east of the switchyard was partly flooded with shallow water at the time of the pumping test. At the northwest corner of this area, surface water was flowing out into a small stream that empties into the wetland ditch alongside

eventually pinch out against the recessional moraine.

According to regional cross-sections prepared by the USGS, the bedrock surface along the eastern end of the Canal is projected to be at a depth of about 220 feet. The regional cross-sections indicate that, from the bedrock surface up to a depth of about 150 feet, the glacial drift that overlies the bedrock is lake-bottom deposits of very fine sand, silt, and clay. The test drilling for this water supply exploration program has suggested that the soils below 150 feet are mostly fine-grained.

The groundwater throughout the plant site exhibits tidal fluctuations. Background monitoring has indicated that, in response to tidal fluctuations of about 10 feet in the Cape Cod Canal, the deep wells (145 ft +/-) have shown tidal fluctuations up to about 4 feet, while the water table wells have shown fluctuations of 0.05 to about 1 foot.

Well Construction Details

Well No. 4 was constructed by the R.E. Chapman Company between December 2000 and February 2001. A pair of 2.5-inch diameter test wells (TW-3 and -3A) that were previously drilled at the site of Well No. 4 indicated the presence of moderately permeable sands between depths of about 120 and 150 feet. To construct the supply well, 12-inch diameter casing was first driven to a depth of 146 feet. Soil samples from depths of 110 to 145 feet indicated that the desired well yield of 400 gpm could be obtained from a "naturally-developed" (no gravel pack) well with an 8-inch diameter telescope-size screen from 117 to 142 feet.

A screen was selected with 0.03-inch openings in the top 10 feet and 0.02 inch openings in the bottom 15 feet. The screen was lowered to a depth of 142 feet inside the 12-inch diameter casing, after which the casing was raised to expose the screen to the aquifer. The well was then developed, to remove the fine soil particles from the aquifer around the screen. At the end of development, when pumping at 200 gpm, the well had a specific capacity of 12.5 gpm/ ft. The 400-gpm test pump was then installed and cycled on and off until the discharge was sand-free upon startup.

Pumping Test Design

Figure 1 is a map showing the location of Well No. 4 (PW-4). Streams and wetlands within 1,000 feet, and known supply wells within one-half mile of the supply well, are also shown. Known supply wells within one-half mile include the two existing supply wells at the Canal Electric Plant (No. 2 and No. 3), about 750 and 1,100 feet to the west; the supply well(s) at the fish processing plant at the end of Freezer Road, about 1,200 feet to the north; and the Sandwich Water District Well No. 1 site, about 1,500 feet to the southeast.

A wetland exists to the west of Well No. 4 (Figure 2), along the railroad tracks and east of the switchyard. The wetland is largely overgrown with cattails, but a program has been developed to remove undesirable species and restore the wetland. The wetland area east of the switchyard was partly flooded with shallow water at the time of the pumping test. At the northwest corner of this area, surface water was flowing out into a small stream that empties into the wetland ditch alongside

Sixteen observation wells and two piezometers were available at the site to monitor the drawdown and recovery of groundwater levels during the test (Figure 2). The observation wells and piezometers were installed at the plant for a variety of purposes. A seventeenth well, Obs-4 at the Sandwich Water District (SWD) Well No. 1 site, was used as an ambient well during the test.

Four of the monitored wells (MW-5, MW-7, MW-8, and MW-13) are shallow wells that were installed to sample groundwater quality in different parts of the site. One of these wells, MW-8, is at a waste area that has not yet reached a Remedial Action Outcome. MW-8 is about 800 feet from the proposed supply well site, and the contaminants are at a shallow depth.

Another four of the observation wells (TW-1, TW-1A, TW-2, and TW-2A) are permanent monitoring wells that will be used to monitor for possible encroachment of saline water along the north and east sides of the site. These wells are more fully described in the following section.

Seven of the wells were installed as part of the groundwater exploration program. These wells are at the following locations relative to the pumped well: 5 feet away (TW-3 and TW-3A); 127 feet to the west (TW-4); 265 feet to the west (TW-5); 311 feet to the south-southwest (TW-7); and 430 feet to the north (TW-6 and TW-6A). The wells are parallel and perpendicular to the direction of groundwater flow (north) and are situated between the proposed supply well and significant hydrologic features (wetlands, a waste release site, and other supply wells to the west; the Canal to the north; and the East Boat Basin and another water well to the northeast).

The sixteenth observation well (MW-301) was installed during a recent exploration program in the proposed area for expansion of the plant. Obs-4 was installed at the SWD Well No. 1 site for observation of water levels during test pumping at that location.

In addition to the observation wells, a set of piezometers (small diameter, shallow observation wells) were installed in the wetland, near the channel and the northeast corner of the switchyard. One deep (PZ-5) and one shallow (PZ-6) piezometer at this location were intended to observe the effects of the pumping on the wetland.

Saltwater Intrusion Monitoring Wells

The possibility of saltwater intrusion affecting the long-term viability of the service water supply wells at the Canal Electric Plant was raised during the EIR process. Although the position of the salt/fresh water interface in the vicinity of the plant is not known, some evidence regarding its position is available.

The first evidence comes from the private water supply well at a commercial facility at the end of Freezer Road, about 1,200 feet north-northeast of the site of the proposed new well (Figure 1). This well is believed to produce fresh water at a rate up to 60 gpm. Considering the proximity of this well to the Canal and to the East Boat Basin, it seems likely that 1) the well is screened beneath a

Additional information regarding the position of the salt/fresh water interface comes from a pair of permanent monitoring wells (TW-2 and -2A) drilled on the north side of the plant property near the Cape Cod Canal. The deeper well is screened from 164 to 169 feet, and the shallower well is screened from 72 to 77 feet. Both of these wells exhibit tidal fluctuations, and water samples from both had specific conductance values in the fresh water range (90 and 200 umhos/cm, respectively).

Two additional permanent monitoring wells (TW-1 and -1A) were drilled on the east side of the plant property near the East Boat Basin. Like the two wells near the Canal, these wells are intended for use as long-term sampling points to monitor for saline water intrusion. The East Boat Basin (Figure 1) is actually a little closer to the proposed new well location than the Canal. The existing geologic information suggests that the thickest confining layers may not extend as far south (inland) as the basin does. Nonetheless, the discharge of fresh water to the basin may prevent downward movement of saltwater into the aquifer. TW-1 is screened at a depth of 154 to 159 feet, while TW-1A is screened from 15 to 20 feet. Both of these wells also exhibit tidal fluctuations and specific conductance values in the fresh water range (70 and 290 umhos/cm, respectively).

Pumping Test and Results

The pumping test was conducted at a rate of 400 gpm, the rate for which approval will be sought for this source. The pumped water was discharged to the cooling water discharge flume, which empties into the Cape Cod Canal.

The pumping test results were analyzed to estimate the aquifer transmissivity and storage coefficient. The data were also used to estimate the effects of the groundwater withdrawal on other water resources in the area.

Pre-Test Conditions. Groundwater conditions prior to the start of the pumping test are shown on Figure 3. The contours on this figure represent groundwater flow in the zone in which the supply well and the deep observation wells are screened. In the southern part of the site, the direction of groundwater flow was generally to the north-northeast. The hydraulic gradient was 0.002, indicative of a transmissive aquifer.

In the northern part of the site, the piezometric surface sloped upward toward the Canal, in response to the high tide. The piezometric surface in TW-2 (near the Canal) was about 2 feet higher than the water in the Canal. At the three locations where deep and shallow wells were installed, the water levels in the shallow wells were about one foot lower than those in the deep wells.

During pre-test monitoring of groundwater levels, it was determined that the lag between the times of high tide in the Cape Cod Canal and peak groundwater levels is about 10 to 20 minutes at the deep observation wells at the Canal Electric plant site.

Conditions During the Pumping Test and Recovery Phase. Pumping began at 1440 on February 12th, 20 minutes after high tide. Pumping ended at 1320 on February 17th, 15 minutes after low tide. Water level recovery was monitored through February 22nd. During the pumping phase on February

During the entire 10-day test cycle, the plant withdrew water continuously from existing Well No. 3 at a rate of 310 gpm to supply the service water system. As a result, the total groundwater extraction rate from the aquifer was 710 gpm during the pumping phase, which is greater than the proposed average withdrawal rate of 580 gpm and slightly less than the projected peak extraction rate of 770 gpm.

Aquifer Characteristics and Well Yield. The drawdown and recovery curves for the deep observation wells showed responses indicative of either a leaky confined aquifer or an unconfined aquifer with delayed yield. Due to the tidal fluctuations at the site, some of the curves were corrected; however, it was found that the drawdown and recovery trends could be reasonably determined by using the tidal maxima or minima. Transmissivities of about 14,000 ft^2/day were estimated based on the semi-logarithmic plots of the time-drawdown and time-recovery curves (Attachment 2). A transmissivity of 7,500 ft^2/day was estimated from the semi-logarithmic plot of the distance-drawdown curve, using drawdown from early in the test. The estimated storage coefficient is 0.004.

Well No.4 yielded 400 gpm during the test with about 35.3 feet of drawdown. The specific capacity was about 11.3 gpm/ft.

Effects on Wetlands. The water level in the channel that flows out of the wetland area to the east of the switchyard did not change during the test. The shallow piezometer (PZ-6) showed a drawdown of about 0.05 feet before the precipitation on the fourth day of pumping. As a result of the precipitation, the water level rose to its pretest elevation. PZ-6 was screened from a depth of 2 to 4 feet, just below the organic layer in the wetland.

The deeper piezometer (PZ-5) had a drawdown of about 0.2 feet. The screen in this piezometer is from 4.5 to 6.5 feet below the surface.

This wetland has existed since the construction of the plant despite its proximity to the two existing water supply wells. The large vertical gradients in the soils immediately beneath the wetland indicate the presence of poorly permeable deposits. These two pieces of evidence indicate that the additional groundwater withdrawals from the new well will not adversely affect the wetland. During the critical early weeks of the growing season each spring, it is predicted that water levels will be adequately high to prevent the encroachment of upland species. Wetland monitoring can be done during operation of the new supply well to confirm this expectation.

Intrusion of Saline Water. Except for the existing Well No. 2 and Well No. 3 at the plant, the nearest known water supply well is at the fish processing plant on Freezer Road, about 1,200 feet from Well No. 4. Although the drawdown at this well due to operation of the three plant supply wells is expected to be relatively minor, the main concern related to this well and to the long-term viability of the Canal Electric Plant wells is the possible shoreward movement of saline water.

[illegible] feet higher than the tidal water level, indicating that salt water could not move into the aquifer.

Figure 5 shows the piezometric surface in the deep part of the aquifer at low tide, at the end of the pumping phase. At low tide, the groundwater gradient had reversed, so the piezometric surface sloped toward the Canal. Since the tidal fluctuation in the Canal was greater than that in the groundwater near the Canal, the piezometric surface was 5.6 to 6.2 feet higher than the water in the Canal at low tide. Under average tidal conditions, the piezometric surface would still have been several feet higher than the tidal waters, and the gradient would have been from the aquifer to the saline water.

At the conclusion of the pumping test, water levels appeared to have stabilized, suggesting that additional drawdown would have been minor with continued pumping. However, with the large-scale tidal fluctuations in the aquifer, it was not possible to precisely correct the data and determine the water-level trend. Due to this uncertainty, the amount of drawdown that would occur in response to long-term pumping could not be reliably predicted.

No conditions were observed during the testing which would allow saline water to move into the aquifer. However, the decline in the piezometric surface due to the higher rate of groundwater pumping will probably cause a slow landward shift in the position of the interface between fresh and saline water in the aquifer. The landward shift will only continue until a new equilibrium position is established. As stated earlier in this report, the current position of the interface is not known, although it is suspected to be some distance offshore. In order to confirm that the interface does not move far enough shoreward to adversely affect water quality in the supply wells, the permanent monitoring wells (TW-1, TW-1A, TW-2, and TW-2A) should be sampled for chloride every 4 to 6 months.

Conclusions

The testing of the site has demonstrated that Well No. 4 will yield 400 gpm, with a pumping water level about 40 feet below the ground surface. No adverse impacts on the wetlands east and north of the switchyard are anticipated. Although the piezometric surface near the Canal is not expected to be lowered below sea level by the additional groundwater withdrawal, some decline of water levels will occur. This decline will probably cause a landward shift in the position of the interface between fresh water and salt water. Water quality monitoring is recommended to confirm that the shift is not of sufficient magnitude to adversely affect water quality in the supply wells at the plant or at the fish processing facility.

An agreement between the SWD and Mirant regarding designation of the Well No. 1 site as a contingency future water supply is being made. The contingency supply would be activated in the event that saline water intrusion is detected and cannot be mitigated by other means.

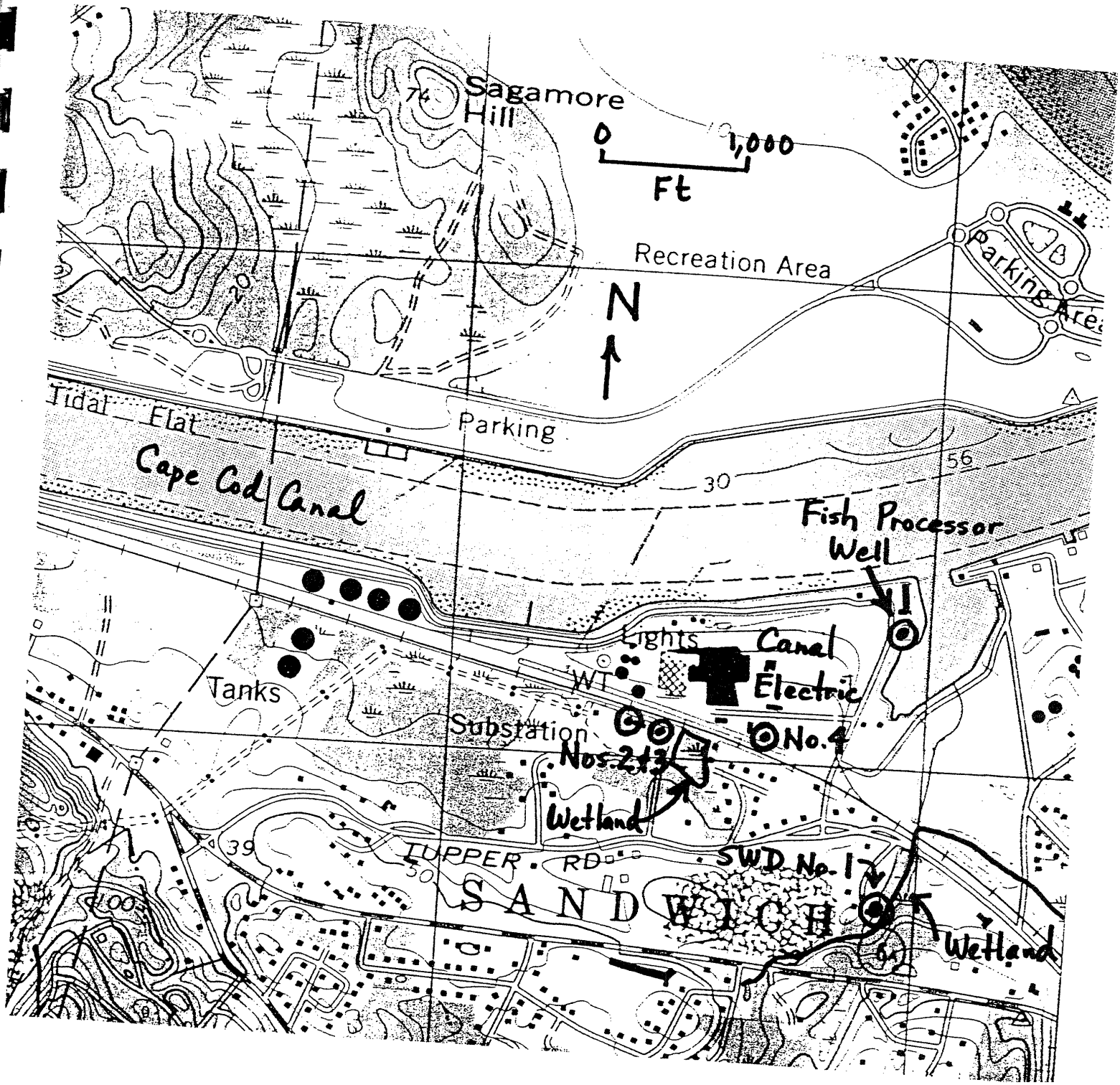
current plan is to include both the SWD Well No. 1 site and Well No. 4 on the permit as authorized withdrawal points, with approved daily volumes of 1.11 mgd (770 gpm) and 0.58 mgd (400 gpm), respectively.

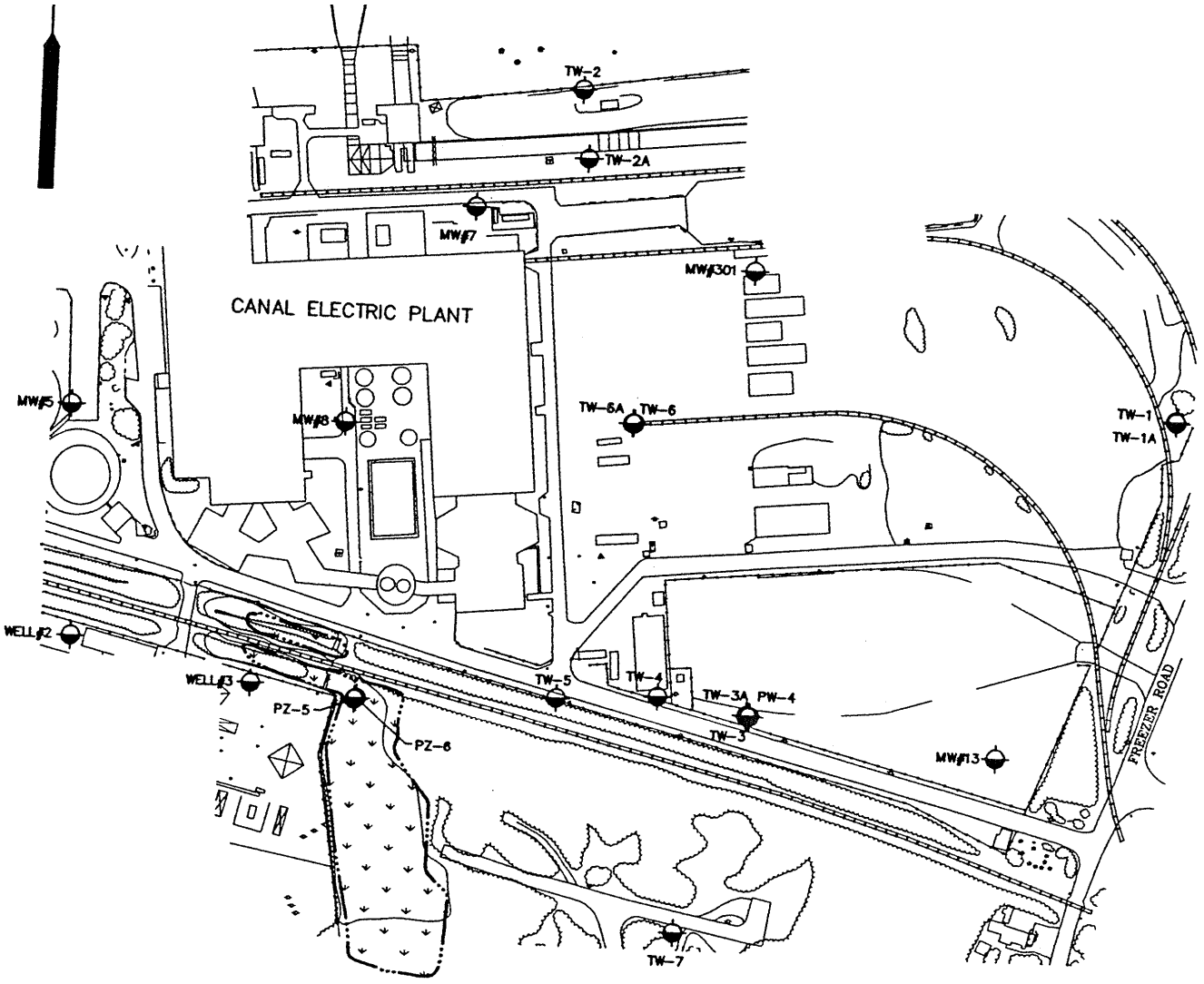
Respectfully submitted,

Warren F. Diesl
Project Manager

FIGURES

FIGURE 1. LOCATION MAP





LEGEND

WELL

WETLAND

NOTES

1. THE COORDINATES, IN FEET, ARE BASED UPON THE NORTH AMERICAN DATUM OF 1927 (NAD 27).
2. ELEVATIONS, IN FEET, ARE REFERRED TO THE CANAL ELECTRIC PLANT VERTICAL DATUM, WHICH IS THE NATIONAL GEODETIC VERTICAL DATUM (NGVD 29).
3. PLANIMETRIC MAPPING WAS COMPILED FROM SMC DRAWING No.D10916.DWG, 3 SHEETS, REVISED 6/14/95 AND IS BASED UPON AERIAL PHOTOGRAPHY OBTAINED BY SMC ON 11/22/93.

1" = 250'

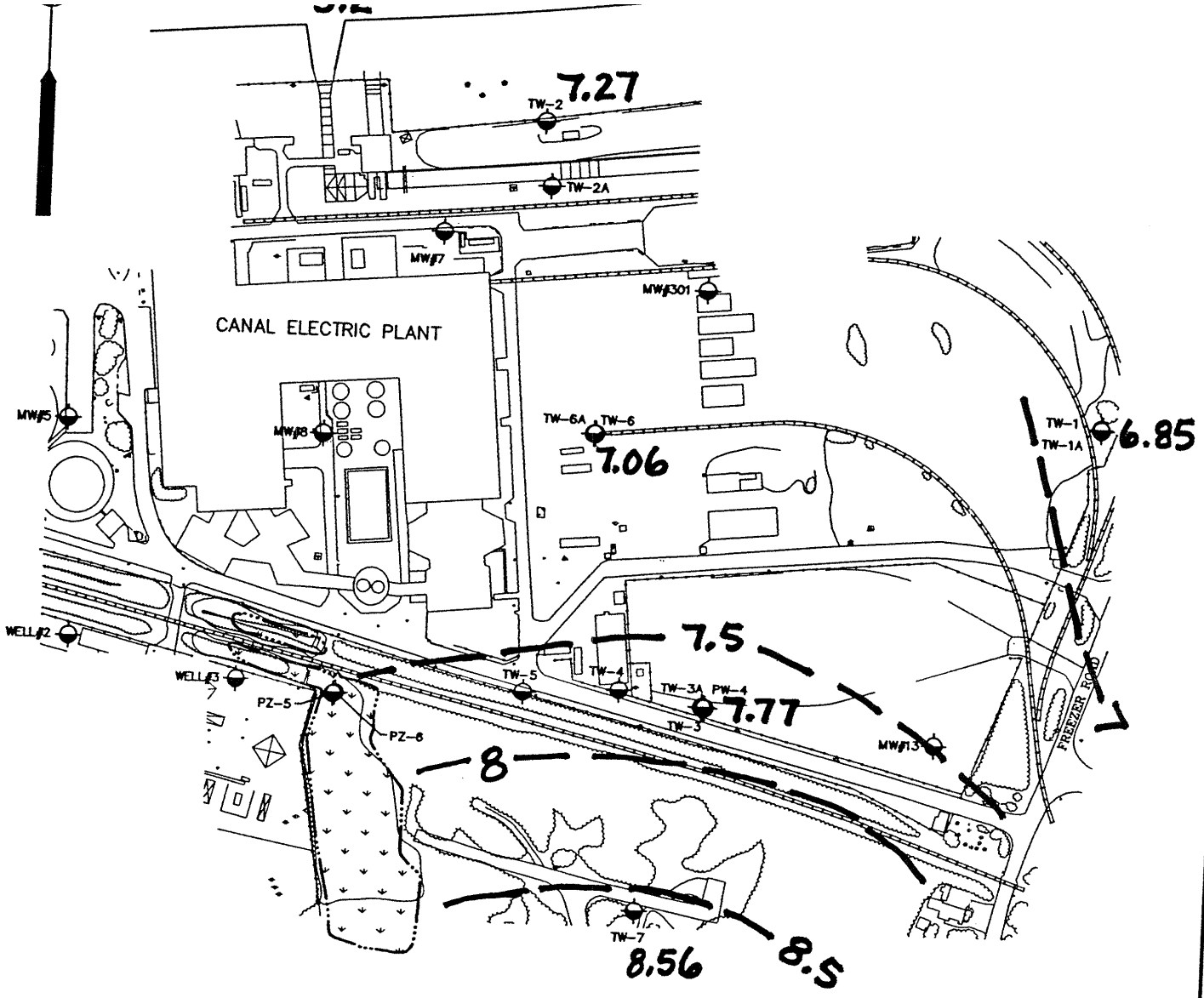
SCALE

0 250 500 750

FEET

P:\00988SND\C\CZSND002.DWG

SANDWICH, MA



LEGEND

- WELL
- WETLAND

NOTES

1. THE COORDINATES, IN FEET, ARE BASED UPON THE NORTH AMERICAN DATUM OF 1927 (NAD 27).
2. ELEVATIONS, IN FEET, ARE REFERRED TO THE CANAL ELECTRIC PLANT VERTICAL DATUM, WHICH IS THE NATIONAL GEODETIC VERTICAL DATUM (NGVD 29).
3. PLANIMETRIC MAPPING WAS COMPILED FROM SMC DRAWING No.D10916.DWG, 3 SHEETS, REVISED 6/14/95 AND IS BASED UPON AERIAL PHOTOGRAPHY OBTAINED BY SMC ON 11/22/93.

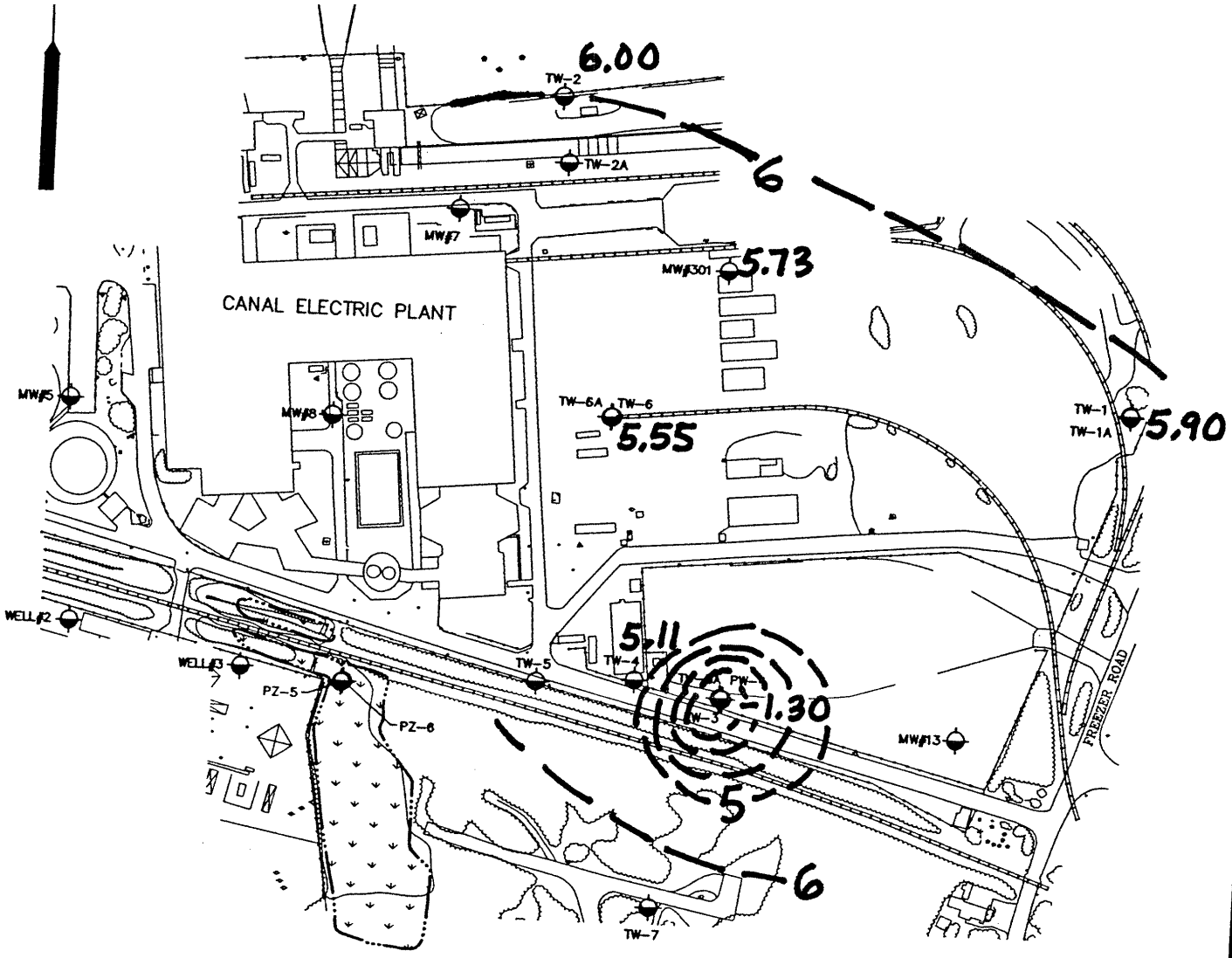
0 250 500 750

1" = 250'

SCALE

FEET

:\00988SND\C\CZSND002.DWG



LEGEND

WELL

WETLAND

NOTES

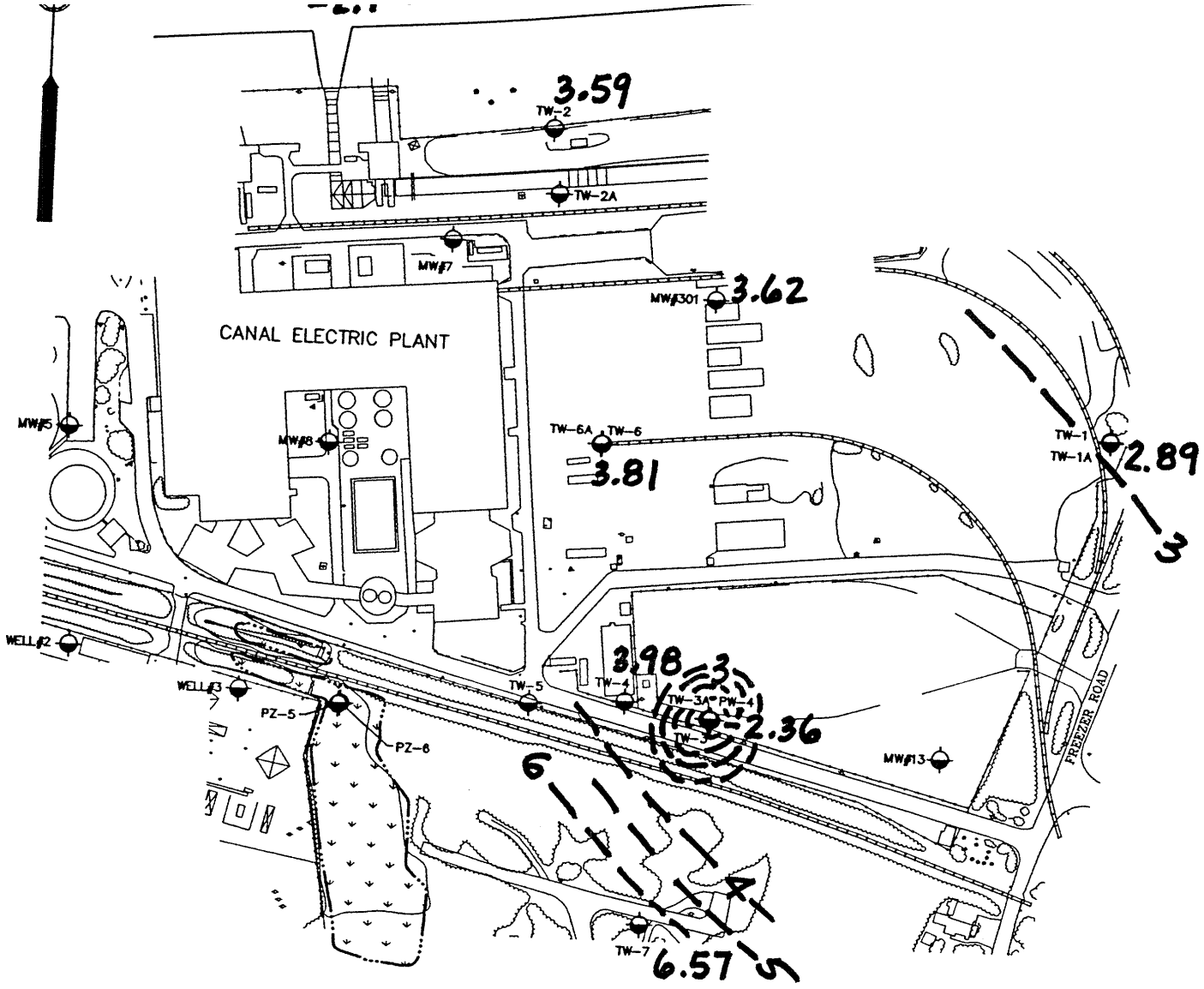
1. THE COORDINATES, IN FEET, ARE BASED UPON THE NORTH AMERICAN DATUM OF 1927 (NAD 27).
2. ELEVATIONS, IN FEET, ARE REFERRED TO THE CANAL ELECTRIC PLANT VERTICAL DATUM, WHICH IS THE NATIONAL GEODETIC VERTICAL DATUM (NGVD 29).
3. PLANIMETRIC MAPPING WAS COMPILED FROM SMC DRAWING No.D10916.DWG, 3 SHEETS, REVISED 6/14/95 AND IS BASED UPON AERIAL PHOTOGRAPHY OBTAINED BY SMC ON 11/22/93.

1" = 250'

0 250 500 750

SCALE FEET

P:\00988SND\C\CZSND002.DWG



LEGEND

WELL

WETLAND

NOTES

1. THE COORDINATES, IN FEET, ARE BASED UPON THE NORTH AMERICAN DATUM OF 1927 (NAD 27).
2. ELEVATIONS, IN FEET, ARE REFERRED TO THE CANAL ELECTRIC PLANT VERTICAL DATUM, WHICH IS THE NATIONAL GEODETIC VERTICAL DATUM (NGVD 29).
3. PLANIMETRIC MAPPING WAS COMPILED FROM SMC DRAWING No.D10916.DWG, 3 SHEETS, REVISED 6/14/95 AND IS BASED UPON AERIAL PHOTOGRAPHY OBTAINED BY SMC ON 11/22/93.

1" = 250'

0 250 500 750

SCALE

FEET

\00988SND\C\CZSND002.DWG

ATTACHMENT 1

R. E. CHAPMAN CO.

OAKDALE, MASS.

Name of Driller Stephen Turner Names of Helpers Brad Learnard

Job: Name & Location Southern Energy Canal - Sandwich, Mass

Date Started 12/27/00 Date Finished 1/09/01

Hole No. 12" AT THE SITE #3

Depth From	Depth To	Classification of Material
2	12	Brown medium sand
12	26	Brown poorly sorted tight sand & gravel with some rocks mixed in
26	41	Brown fine-medium sand & silt
41	50	Brown fine-medium sand, some silt
50	70	Fine brown sand
70	80	Brown very fine-fine sand
80	85	Brown sand & gravel, semi angular, brown till
85	101	Fine-medium brown sand
101	120	Brown medium sand, some coarse sand
120	122	Brown fine sand

Feet of Screen Exposed

Size of Screen & Slot

Screen Left in

Screen Pulled Out

Pipe Left in

Pipe Pulled Out

Remarks

Pump Test on Hole No.

Date	Time	Dr. Down	G. P. M.	Static and Other Info.

Date Started Date Finished

Hole No.

Depth From	Depth To	Classification of Material
122	132	Brown medium-coarse sand, trace of fine sand, fine gravel
132	135	Brown fine-medium sand
135	141	Brown fine-coarse sand, fine gravel
141	146	Brown fine-medium sand

Feet of Screen Exposed

Size of Screen & Slot

Screen Left in

Screen Pulled Out

Pipe Left in

Pipe Pulled Out

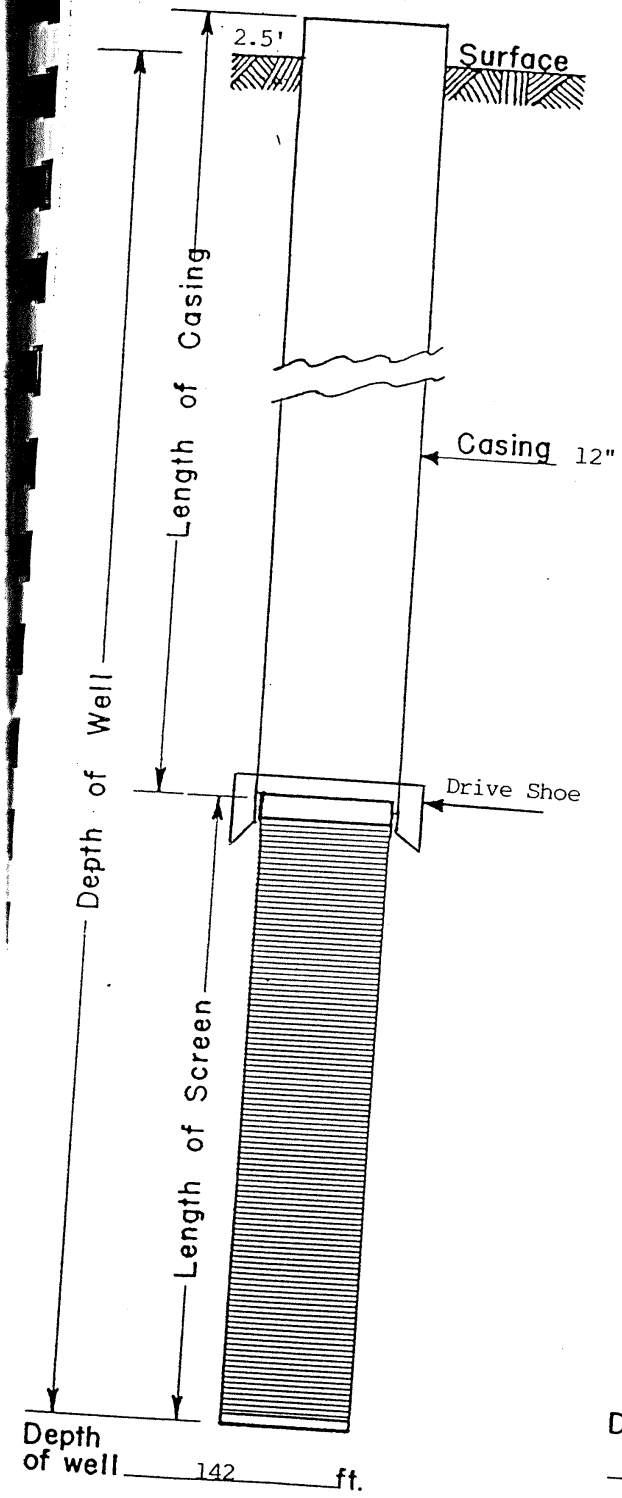
Remarks

Pump Test on Hole No.

Date	Time	Dr. Down	G. P. M.	Static and Other Info.

CHAPMAN CO.

WELL CONSTRUCTION RECORD



WELL OWNER Southern Energy Canal Electric
Sandwich, Mass.

WELL NO. 12" Well at TW #3

Date February 12, 2001

CASING DETAILS

Length 118.5 ft.

Diameter 12 in.

Kind 3/8 steel

SCREEN DETAILS

Make Johnson

Length 26.1 ft.

Diameter 8" telescope in.

Slot size Top 10' .030 Middle 5' .020 Bottom 10' .020

Metal Stainless steel

SCREEN FITTINGS

Top 12" K-packer

Bottom Threaded

PUMP TEST

See pump test logs

Static level _____ ft.

Rate _____ g.p.m.

Draw down _____ ft.

Hours pumped _____ hrs.

ARTIFICIALLY GRAVEL TREATED

Yes _____ No X

Thickness _____ in.

Size of gravel _____

DRILLER Stephen Turner

JOB LOCATION: Sandwich, Mass.

CUSTOMER: Southern Energy Canal, LLC

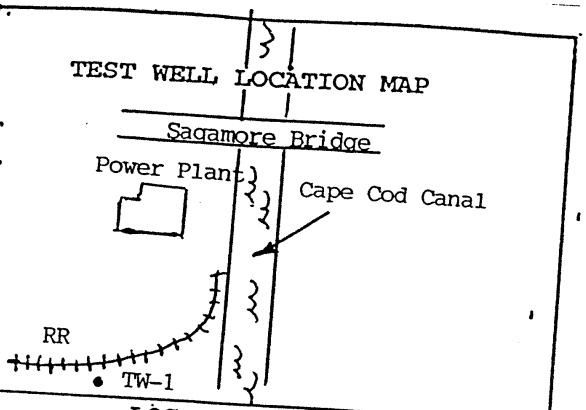
ENGINEER: Warren Diesl

TEST WELL NO: TW-1-00

DATE STARTED: 8/23/00 COMPLETED: 8/30/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 180.6 FT

WELL DEPTH: 157 FT

CASING STICK-UP: 1.2 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
157	152	.040	S.S.
160	155	.040	S.S.

DEVELOPMENT TIME: 4 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 5 FT

PUMPING TEST DETAILS

PUMPING RATE: 31 GPM

VACUUM: 20 IN

STATIC WATER LEVEL: 10.3 FT

PUMPING DURATION: 4 HRS

IRON: _____ MANG: _____ PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	2	Topsoil, organics
2	7	Medium-fine sand, some coarse gravel
7	10	Coarse-medium gravel, some fine sand, brown silty clay
10	27	Fine brown sand, silt, some medium gravel, trace of gray silty clay
27	41	Fine brown sand, silt, medium-coarse sand, medium-coarse gravel, some brown clay
41	109	Fine brown sand, silt, some medium-coarse gravel
109	164	Fine-medium brown sand,silt some medium-large gravel
164	171	Fine-medium sand, silt, some medium-large coarse gravel
171	178	Fine-medium brown sand, silt some gray sand, sharp gravel
178	180	Gray sand, sharp angular gravel
		Refusal at 180.6'

COMMENTS:
1st Screen Setting at 160'-155'
2nd Screen Setting at 157'-152'

TEST WELL RECORD

R. E. CHAPMAN COMPANY

1st Setting developed for 2 hours
Time to pull and reset screen 2 hours
Developed 2nd screen setting for 4 hrs.

JOB LOCATION: Sandwich, Mass.

CUSTOMER: Southern Energy Canal, LLC

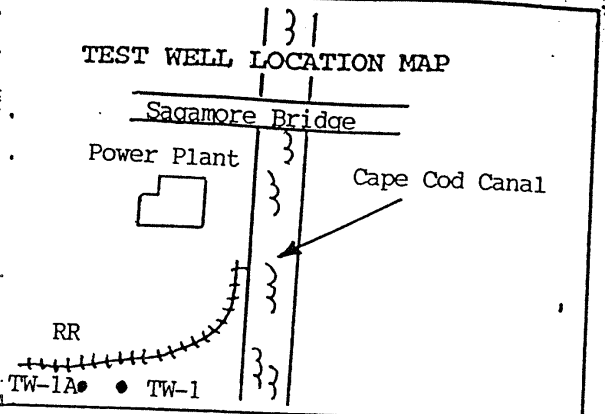
ENGINEER: Warren Diesl

TEST WELL NO: TW-1A-00

DATE STARTED: 8/30/00 COMPLETED: 8/30/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 20 FT

WELL DEPTH: 20 FT

CASING STICK-UP: 1 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
20	15	.040	S.S.

DEVELOPMENT TIME: 4 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 3 FT

PUMPING TEST DETAILS

PUMPING RATE: 5 GPM

VACUUM: 28 IN

STATIC WATER LEVEL: 10.3 FT

PUMPING DURATION: 4 HRS

IRON: _____ MANG: _____ PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	2	Topsoil, organics
2	7	Fine-medium sand, some coarse gravel
7	20	Fine brown sand, silt, coarse-medium-large gravel
		traces of brown and gray silty clay

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, Mass.

CUSTOMER: Southern Energy Canal

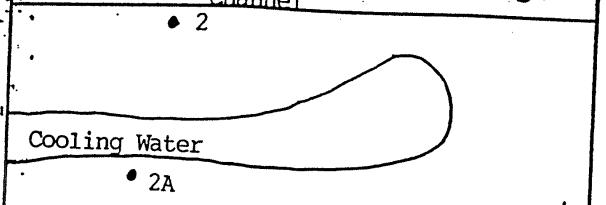
ENGINEER: Warren Diesel

TEST WELL NO: 2

DATE STARTED: 8/31/00 COMPLETED: 9/12/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 206 FT

WELL DEPTH: _____ FT

CASING STICK-UP: 2 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
173	168	.020	S.S.
177	174	.030	S.S.
169	164	.020	S.S.

DEVELOPMENT TIME: Total 8 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 5 FT

PUMPING TEST DETAILS

PUMPING RATE: 3 GPM

VACUUM: 28 IN

STATIC WATER LEVEL: 5.55 FT

PUMPING DURATION: _____ HRS

IRON: _____ MANG: _____ PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	30	Fine-medium brown sand, small-large coarse gravel
30	35	Fine sand, silt
35	49	Brown-gray silty clay
49	70	Hard gray silty clay
70	78	Gray silty clay
78	84	Gray silty clay, some small-large-coarse gravel
84	92	Fine sand, silt, some small-medium-coarse gravel
92	105	Fine brown sand, silt, some small-medium gravel
105	106	Gray clay
106	113	Fine brown-gray sand, silt
113	127	Fine brown-gray sand, silt, some medium-coarse gravel
127	155	Fine brown-gray sand, silt, some gray-brown clay
155	170	Fine brown sand, silt, small-medium gravel
170	189	Fine-medium brown sand, silt, some small gravel
189	206	Fine brown sand, silt
		Refusal at 206'

COMMENTS:
1st Screen Set 173'-168' (dev. 1 hour)
Pulled screen, and reset (3 hours)
2nd Screen Set 174'-177' (dev. 4 hours)
Pulled screen, and reset (4 hours)
3rd Screen Set 169'-164' (dev. 3 hours)

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich

CUSTOMER: Southern Energy Canal

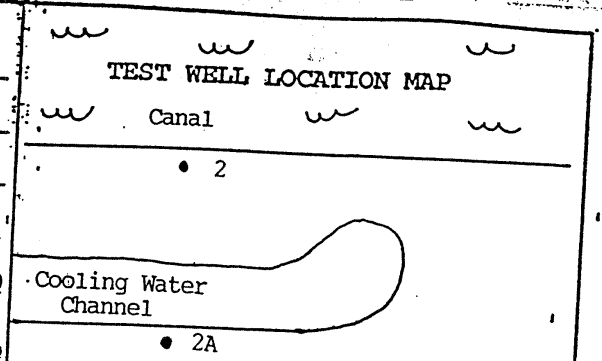
ENGINEER: Warren Diesl

TEST WELL NO: 2A

DATE STARTED: 9/13/00 COMPLETED: 9/14/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 85 FT

WELL DEPTH: 77 FT

CASING STICK-UP: 1.6 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
77	72	.020	S.S.

DEVELOPMENT TIME: 4 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 5 FT

PUMPING TEST DETAILS

PUMPING RATE: 20 GPM

VACUUM: 20.5 IN

STATIC WATER LEVEL: FT

PUMPING DURATION: HRS

IRON: MANG: PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	4	Fine brown sand
4	7	Brown sand, coarse medium-large gravel
7	14	Fine-medium brown sand
14	28	Fine-medium brown sand, some medium gravel, little gray clay
28	32	Coarse medium gravel, some brown silty clay
32	49	Fine gray sand, silt, some gray clay
49	63	Gray silty clay
63	77	Small-medium-coarse gravel, fine-medium sand, silt
77	84	Coarse angular gravel, hard silty clay

COMMENTS:
Good circulation (73'-77')

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich

CUSTOMER: Southern Energy Canal

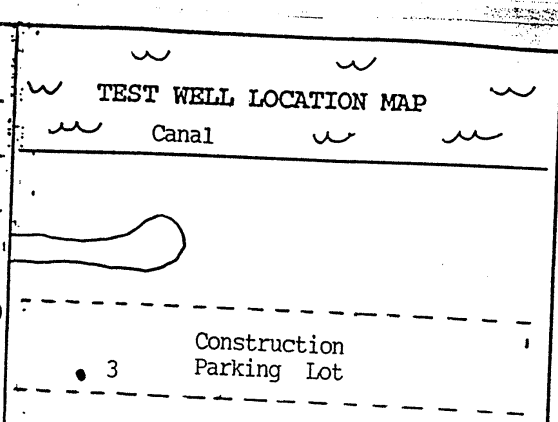
ENGINEER: Warren Diesl

TEST WELL NO: 3

DATE STARTED: 9/18/00 COMPLETED: 9/21/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 148 FT

WELL DEPTH: 145 FT

CASING STICK-UP: 1.7 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
145	140	.030	S.S.

DEVELOPMENT TIME: 6 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 5 FT

PUMPING TEST DETAILS

PUMPING RATE: 40 GPM

VACUUM: 18 IN

STATIC WATER LEVEL: 4.05 FT

PUMPING DURATION: _____ HRS

IRON: _____ MANG: _____ PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	16	Fine-medium brown sand, small-medium-coarse gravel
16	42	Fine-medium brown sand, silt, some small-medium-coarse gravel, some brown silty clay
42	99	Fine-medium brown sand, silt
99	134	Fine-medium brown sand, silt, small-large gravel
134	145	Fine-medium sand, silt, small-large gravel
145	148	Fine brown sand, silt

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, Mass.

CUSTOMER: Southern Energy Canal

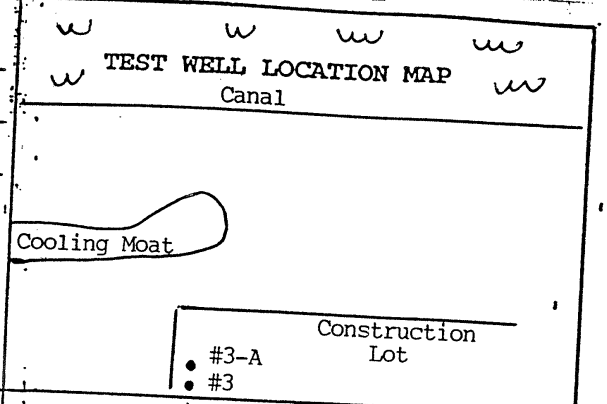
ENGINEER: Warren Diesl

TEST WELL NO: 3-A

DATE STARTED: 9/27/00 COMPLETED: 9/28/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 145.7 FT

WELL DEPTH: 145.7 FT

CASING STICK-UP: 1 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
145	140	.030	S.S.

DEVELOPMENT TIME: 4 HRS

DEVELOPMENT METHOD: centrifugal pump

SCREEN RISER: FT

PUMPING TEST DETAILS

PUMPING RATE: 35 GPM

VACUUM: 20 IN

STATIC WATER LEVEL: FT

PUMPING DURATION: HRS

IRON: MANG: PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	16	Fine-medium brown sand, small-medium-coarse gravel
16	42	Fine-medium brown sand, silt some small-medium gravel, some brown, silty clay
42	99	Fine-medium brown sand, silt
99	134	Fine-medium sand, silt small-large gravel
134	145	Fine-medium sand, silt, small-large gravel

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, Mass.

CUSTOMER: Southern Energy Canal

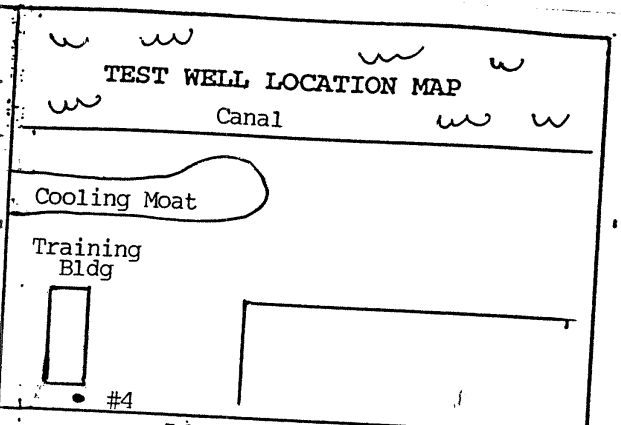
ENGINEER: Warren Diesl

TEST WELL NO: 4

DATE STARTED: 9/21/00 COMPLETED: 9/26/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 147 FT

WELL DEPTH: 144 FT

CASING STICK-UP: 1 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
144	139	.030	S.S.

DEVELOPMENT TIME: 4 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 4 FT

PUMPING TEST DETAILS

PUMPING RATE: 8 GPM

VACUUM: 27 IN

STATIC WATER LEVEL: 5.06 FT

PUMPING DURATION: HRS

IRON: MANG: PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	1	Topsoil
1	21	Fine-medium brown sand, silt, small-medium-large gravel
21	42	Fine-medium brown sand, silt some brown clay
42	51	Fine-medium brown sand, silt some small-medium-coarse gravel
51	55	Fine-medium brown sand, silt Medium-large-coarse gravel, some gray-brown clay
55	63	Fine brown sand, silt
63	92	Fine-medium brown sand, silt, small-medium gravel
92	120	Fine-medium brown sand, silt small-medium gravel, some brown-gray clay
120	143	Fine-medium brown sand, silt small-medium gravel
143	147	Fine brown sand, silt, small gravel, some brown gray clay

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, Mass.

CUSTOMER: Southern Energy Canal

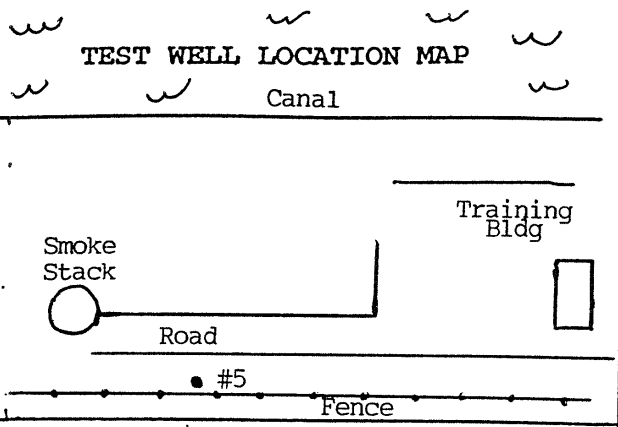
ENGINEER: Warren Diesl

TEST WELL NO: 5

DATE STARTED: 9/27/00 COMPLETED: 9/27/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 15 FT

WELL DEPTH: 15 FT

CASING STICK-UP: 1½ FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
15	10	.010	S.S.

DEVELOPMENT TIME: 1 HRS

DEVELOPMENT METHOD: 1½" centrifugal

SCREEN RISER: 3 FT

PUMPING TEST DETAILS

PUMPING RATE: 30 GPM

VACUUM: 12 IN

STATIC WATER LEVEL: FT

PUMPING DURATION: 1 HRS

IRON: MANG: PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	15	Fine-medium brown sand, silt small-large-coarse gravel

COMMENTS: Monitoring well

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, MA

CUSTOMER: Southern Energy Canal

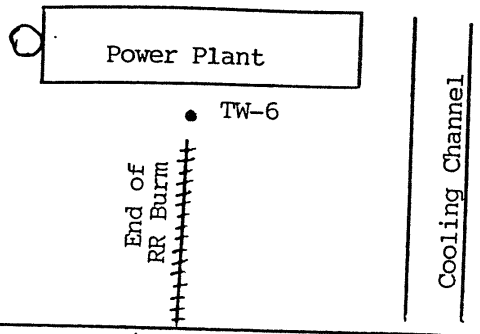
ENGINEER: Warren Diesl

TEST WELL NO: TW-6

DATE STARTED: 10/12/00 COMPLETED: 10/17/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 145 FT

WELL DEPTH: 145 FT

CASING STICK-UP: 1.3 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
145	140	.030	S.S.

DEVELOPMENT TIME: 2½ HRS

DEVELOPMENT METHOD: 1½ centrifugal

SCREEN RISER: 3 FT

PUMPING TEST DETAILS

PUMPING RATE: 30 GPM

VACUUM: 22 IN

STATIC WATER LEVEL: 8.15 FT

PUMPING DURATION: HRS

IRON: MANG: PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	7	Small-large coarse gravel, fine-medium brown sand,silt
7	37	Fine-medium brown sand,silt small-large gravel
37	39	Gray clay
39	42	Brown silty clay, small-medium gravel
42	48	Fine-medium brown sand, silt, small-medium gravel
48	112	Fine-medium brown sand, silt, brown silty clay
112	119	Fine-medium brown sand,silt, small-medium angular gravel
119	145	Fine-medium brown sand, silt small-medium gravel

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, MA

CUSTOMER: Southern Energy Canal

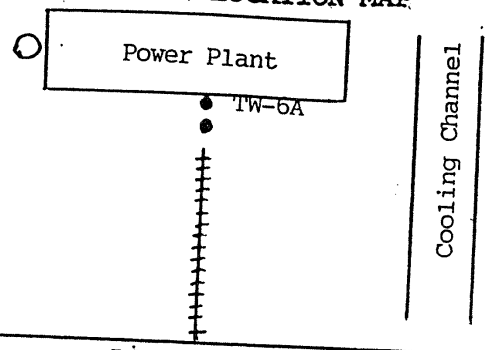
ENGINEER: Warren Diesl

TEST WELL NO: TW-6A

DATE STARTED: 10/17/00 COMPLETED: 10/17/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 15 FT

WELL DEPTH: 15 FT

CASING STICK-UP: 2 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
15	10	.010	S.S.

DEVELOPMENT TIME: 1 HRS

DEVELOPMENT METHOD: 1½ centrifugal

SCREEN RISER: 3 FT

PUMPING TEST DETAILS

PUMPING RATE: 30 GPM

VACUUM: 20 IN

STATIC WATER LEVEL: 6.23 FT

PUMPING DURATION: HRS

IRON: MANG: PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	15	Fine-medium gray-brown sand, silt, small coarse gravel

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

JOB LOCATION: Sandwich, MA

CUSTOMER: Southern Energy Canal

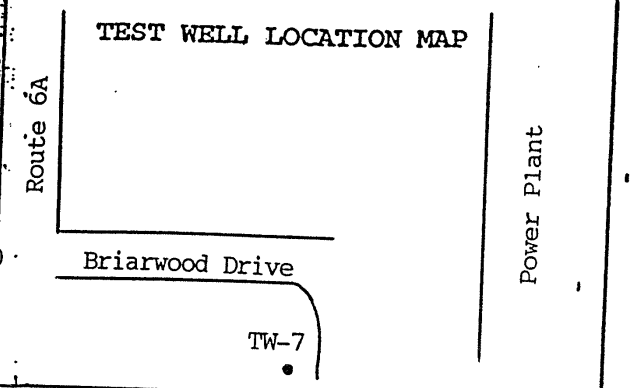
ENGINEER: Warren Diesl

TEST WELL NO: TW-7

DATE STARTED: 10/23/00 COMPLETED: 10/25/00

FOREMAN: Paul Grady

TEST WELL LOCATION MAP



TEST WELL INSTALLATION DETAILS

BOREHOLE DEPTH: 155 FT

WELL DEPTH: 155 FT

CASING STICK-UP: .6 FT

SCREEN LEFT IN PLACE: 5 FT

SCREEN SETTING DETAILS

FROM	TO	SLOT SIZE (in.)	MATERIAL
155	150	.040	S.S.

DEVELOPMENT TIME: 2 HRS

DEVELOPMENT METHOD: 1½ centrifugal

SCREEN RISER: 3 FT

PUMPING TEST DETAILS

PUMPING RATE: 15 GPM

VACUUM: 28 IN

STATIC WATER LEVEL: 15.43 FT

PUMPING DURATION: _____ HRS

IRON: _____ MANG: _____ PPM

LOG OF HOLE

DEPTH FROM	DEPTH TO	CLASSIFICATION OF MATERIALS
0	2	Topsoil, organics
2	13	Fine brown sand, silt, small coarse gravel
13	35	Fine brown sand, silt, some gray sand
35	69	Fine-medium brown sand, silt, some brown silty clay
69	70	Medium-coarse gravel
70	98	Fine-medium brown sand, silt, some small-medium gravel
98	155	Fine-medium brown sand, silt, small gravel

COMMENTS:

TEST WELL RECORD

R. E. CHAPMAN COMPANY

R. E. CHAPMAN CO.

OAKDALE, MASS.

Name of Driller Brad Learnard Names of Helpers Maynard Marin

Job: Name & Location Southern Energy Canal Electric - Piezometer for pumping test of SWD Wells

Date Started 1/18/01 Date Finished 1/18/01

Hole No. PZ-5 in brook near RR tracks at power plant

Depth From	Depth To	Classification of Material
0	.5	Water
.5	2	Black organic peat material, trace of silt
2	6.5	Tarnish gray fine sand and silt

Feet of Screen Exposed: 2'

Size of Screen & Slot: 1¼" diameter 10 slot

Screen Left in: 2'

Screen Pulled Out: N/A

Pipe Left in: see remarks

Pipe Pulled Out: N/A

Remarks: Overall well length 8.5'
Developed 30 min.
Well took water
Casing stickup: 2' above W.L.

Pump Test on Hole No.

Date	Time	Dr. Down	G. P. M.	Static and Other Info.

Date Started 1/18/01 Date Finished 1/18/01

Hole No. PZ-6 beside brook near RR tracks at power plant

Depth From	Depth To	Classification of Material
0	2.5	Black organic peat material, some silt
2.5	3.5	Tarnish gray fine sand with silt

Feet of Screen Exposed: 2'

Size of Screen & Slot: 1¼" diameter 10 slot

Screen Left in: 2'

Screen Pulled Out: N/A

Pipe Left in: see remarks

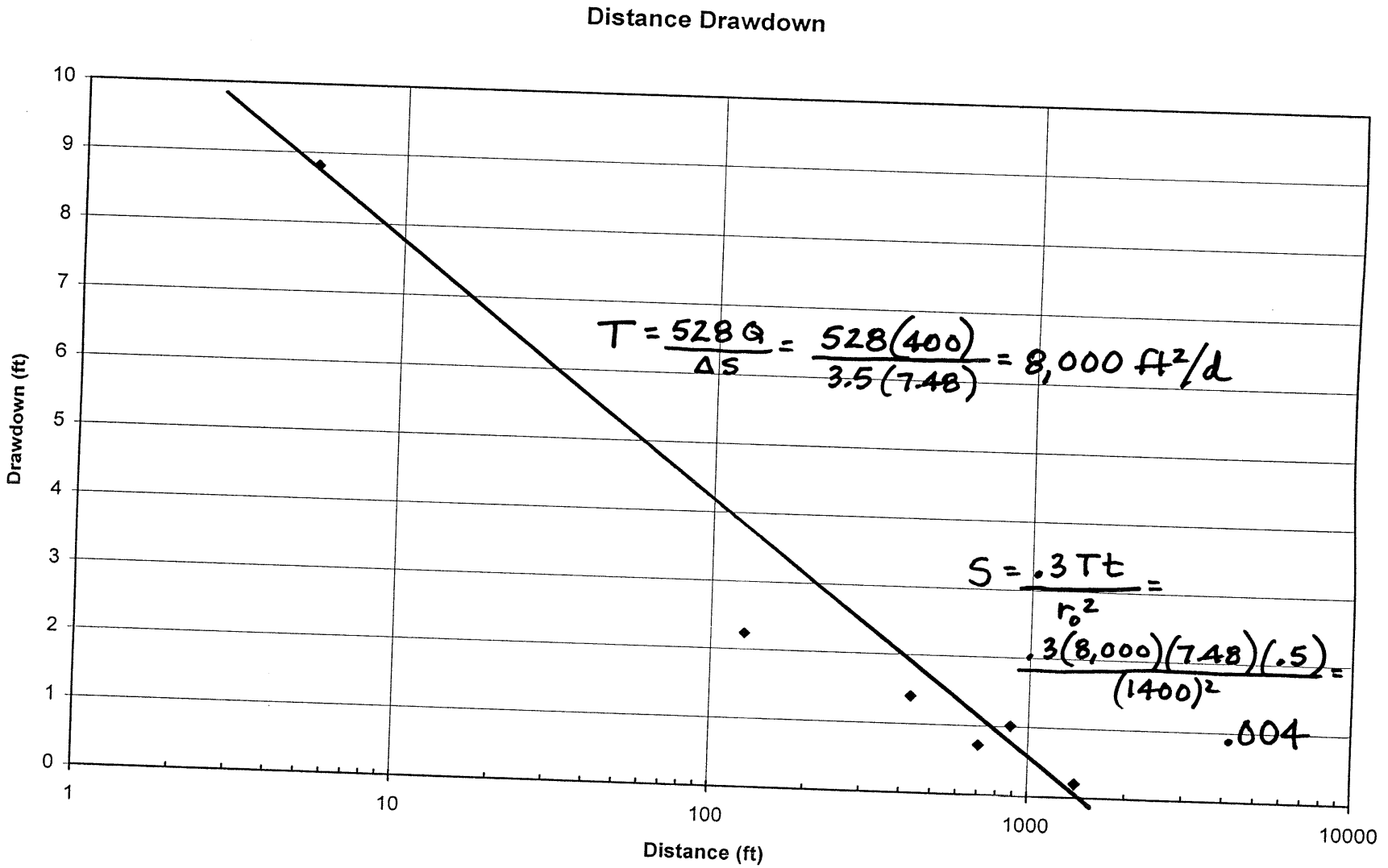
Pipe Pulled Out: N/A

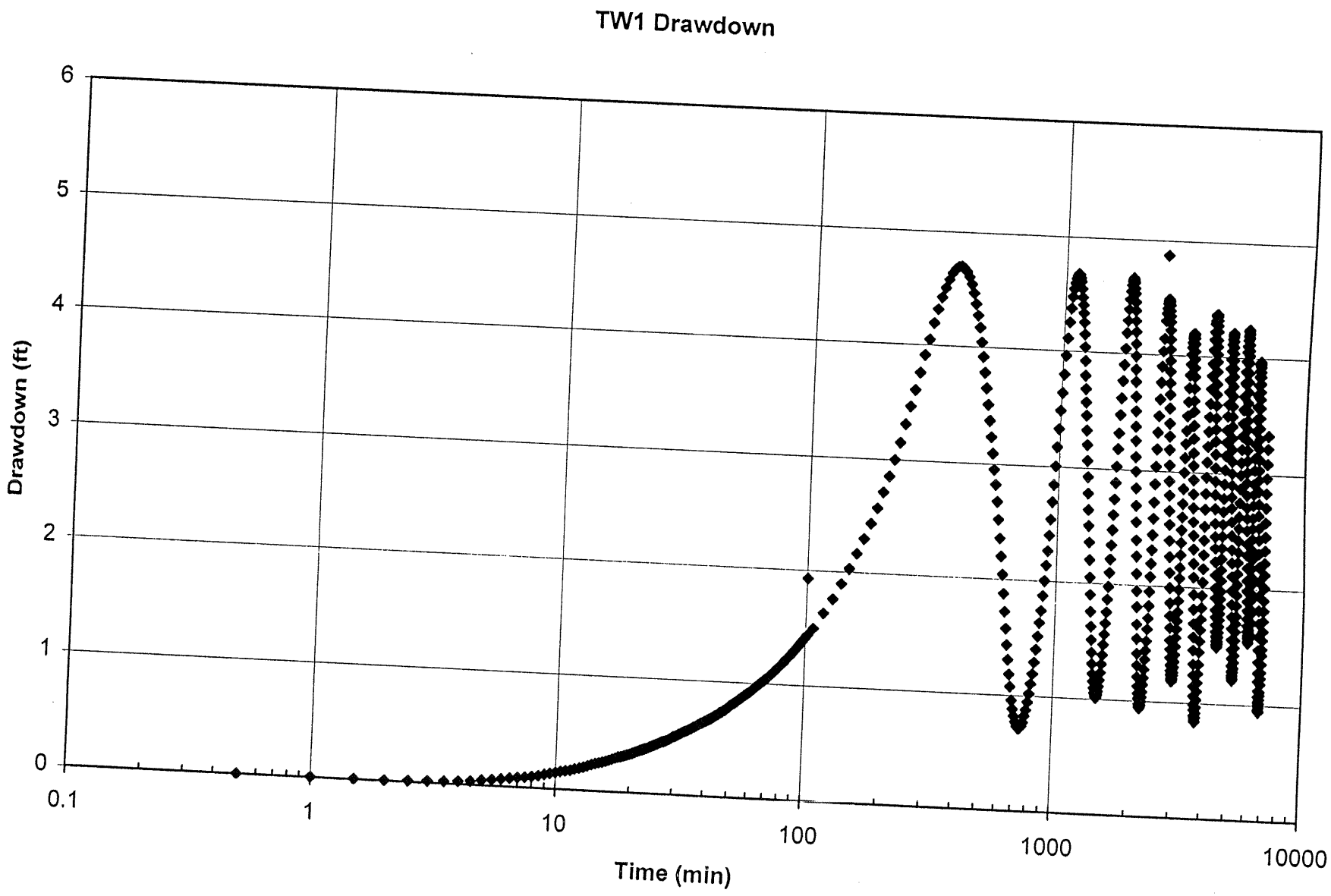
Remarks: Overall well leng 5.5'
Developed 45 min.
Well took water
Casing stickup: 1.4' above G.L.

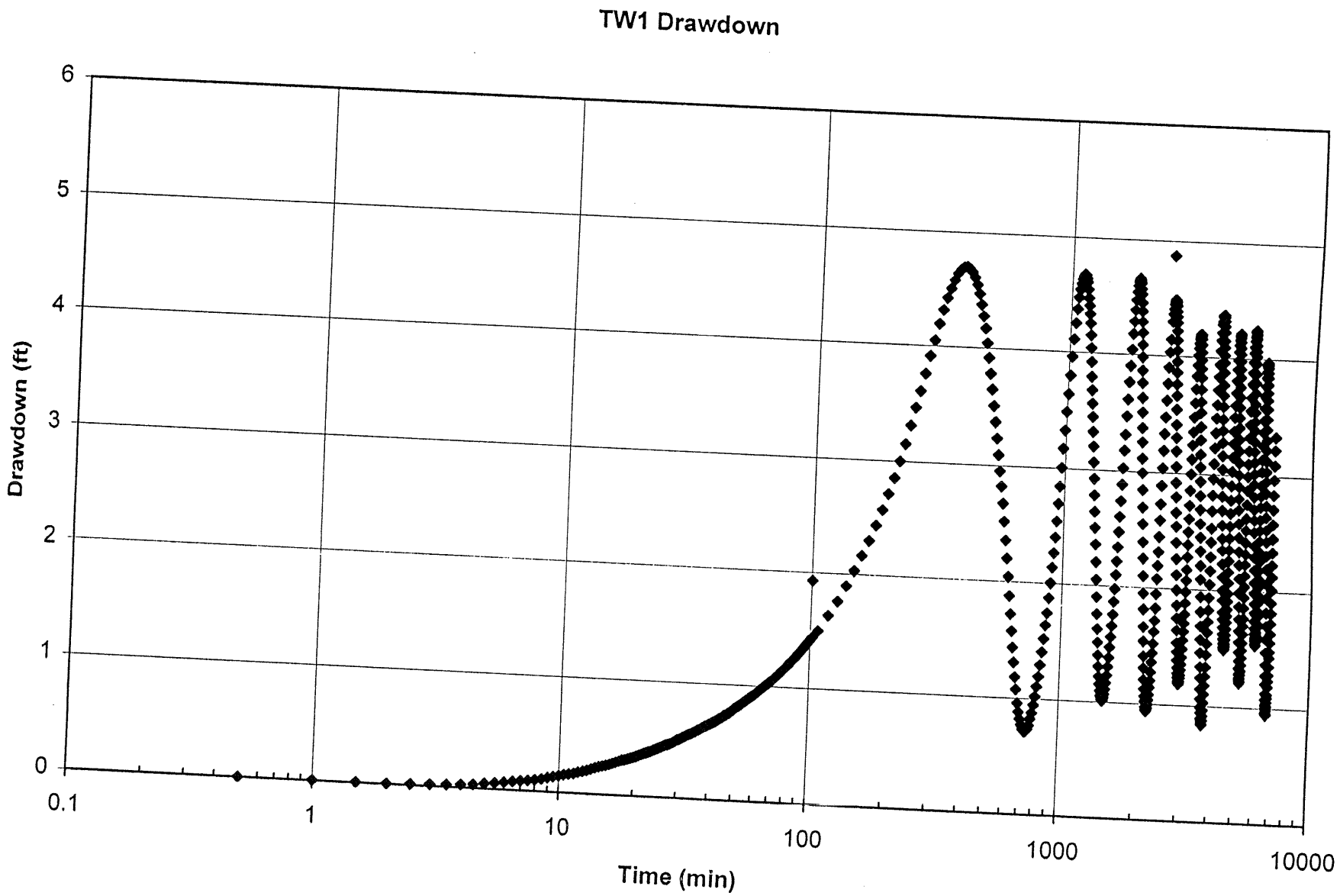
Pump Test on Hole No.

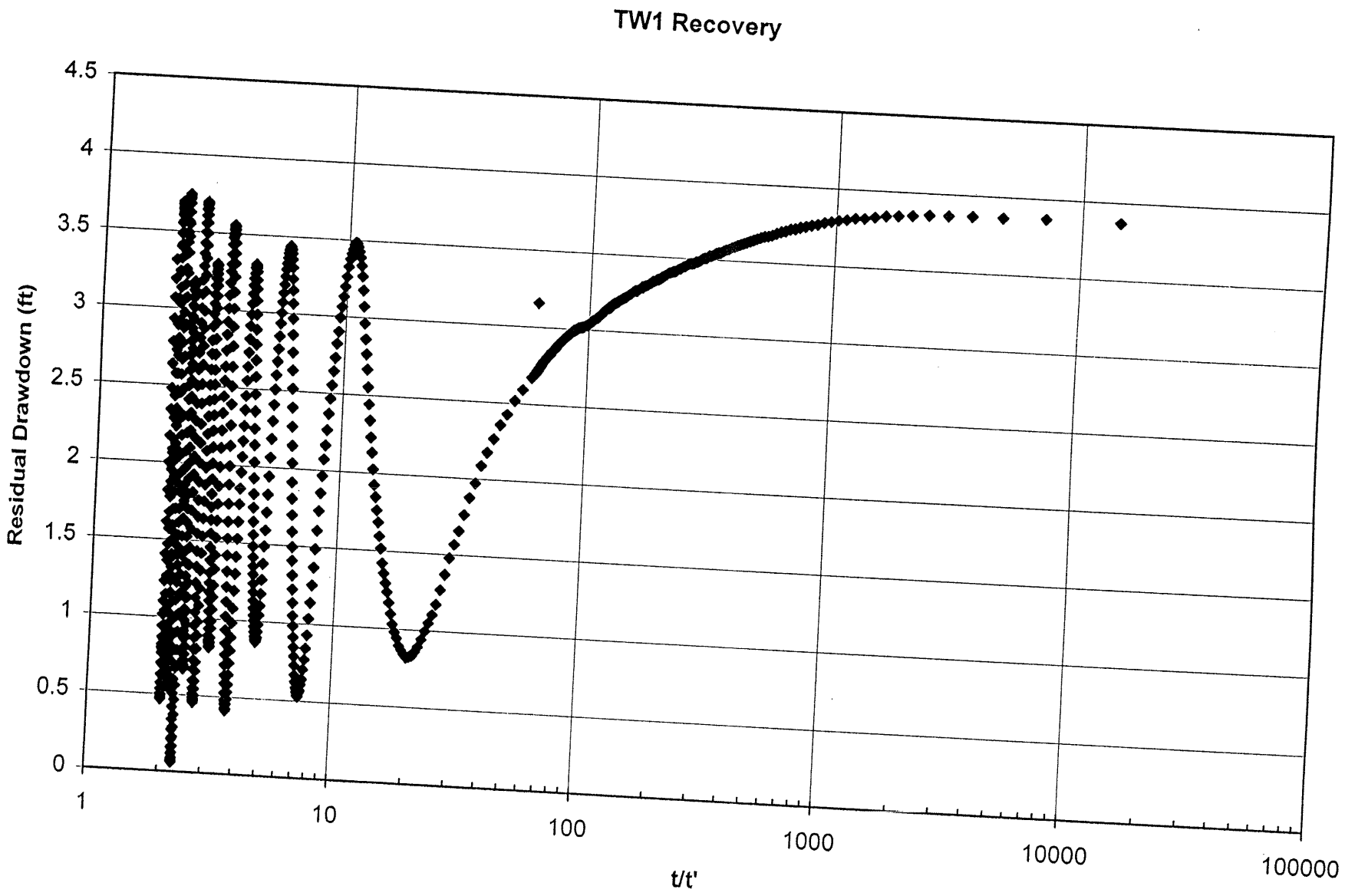
Date	Time	Dr. Down	G. P. M.	Static and Other Info.

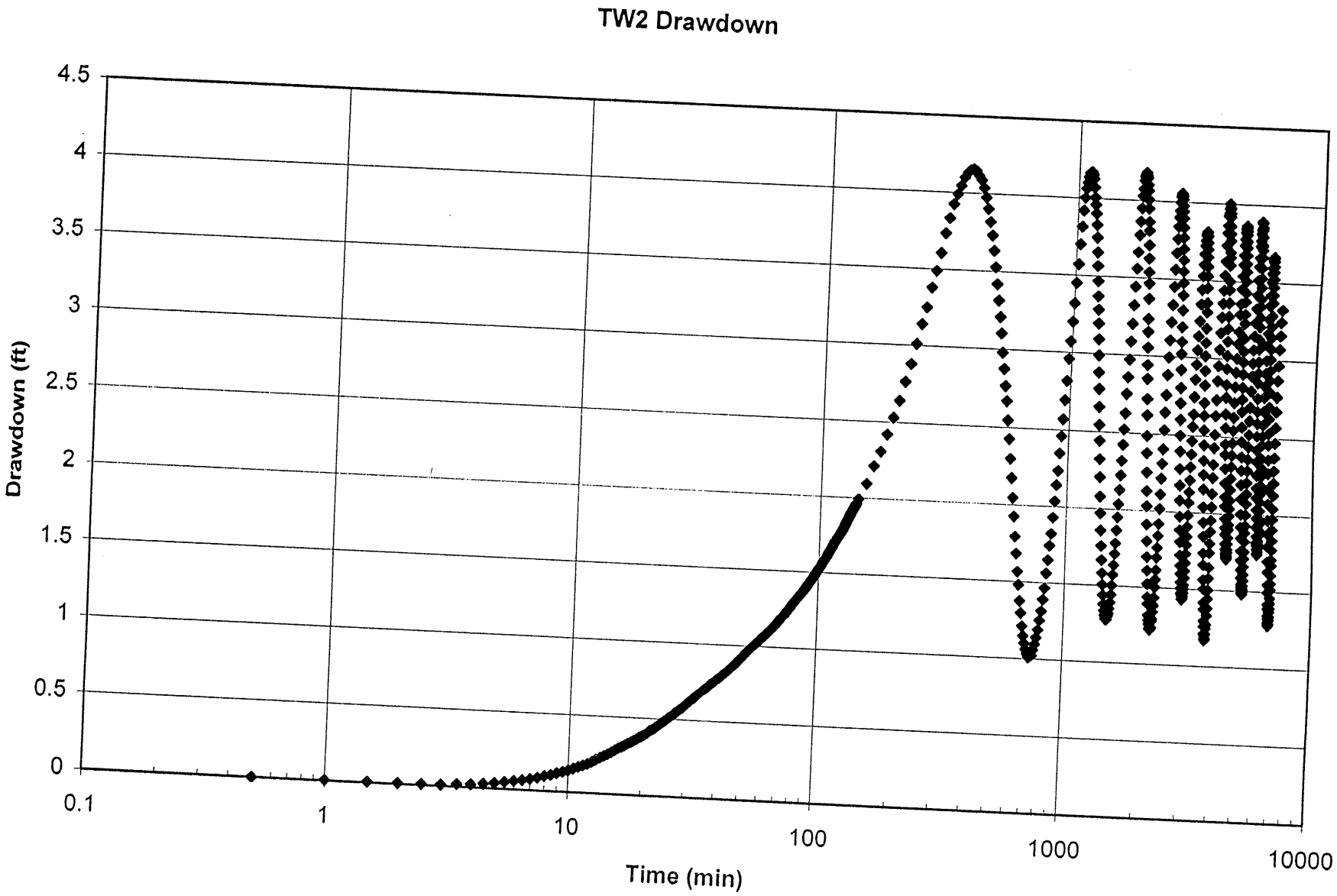
ATTACHMENT 2

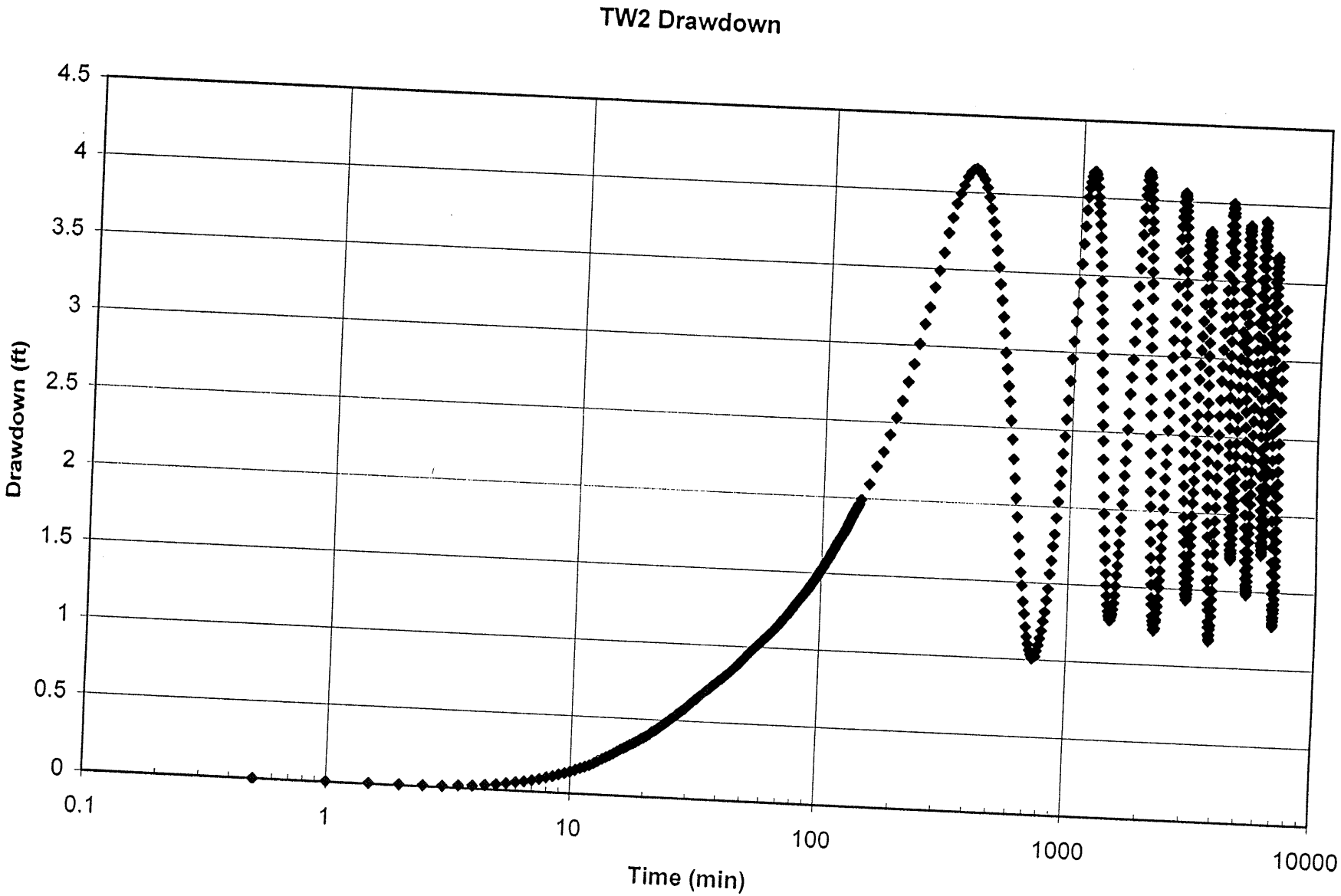

Distance Drawdown
Drawdown (ft)
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Distance (ft)
$T = \frac{528Q}{\Delta s} = \frac{528(400)}{3.5(7.48)} = 8{,}000\ ft^2/d$
$S = \frac{.3Tt}{r_o^2} = \frac{.3(8{,}000)(7.48)(.5)}{(1400)^2} = .004$

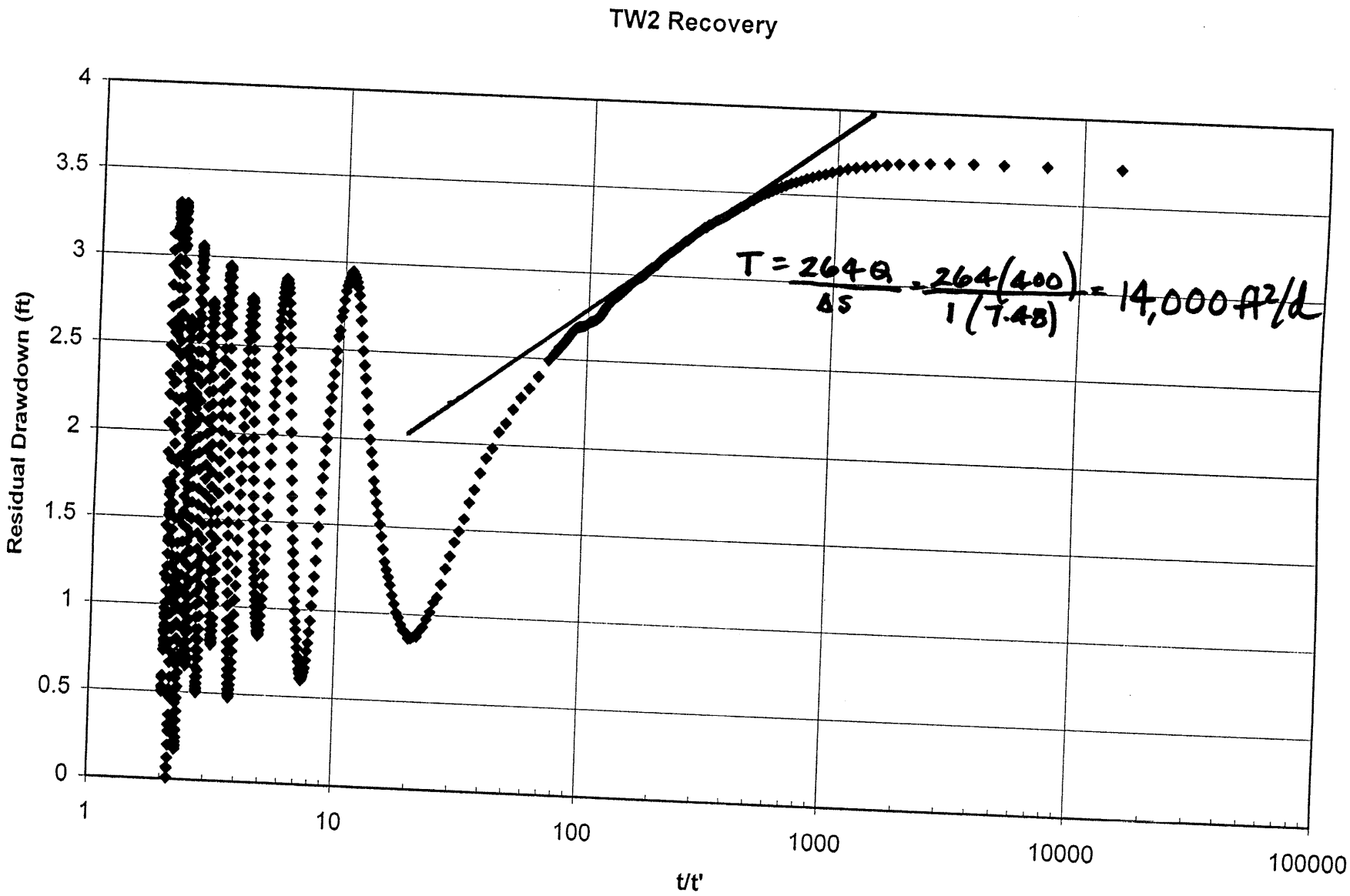

TW1 Drawdown
Drawdown (ft)
0
1
2
3
4
5
6
0.1
1
10
100
1000
10000
Time (min)

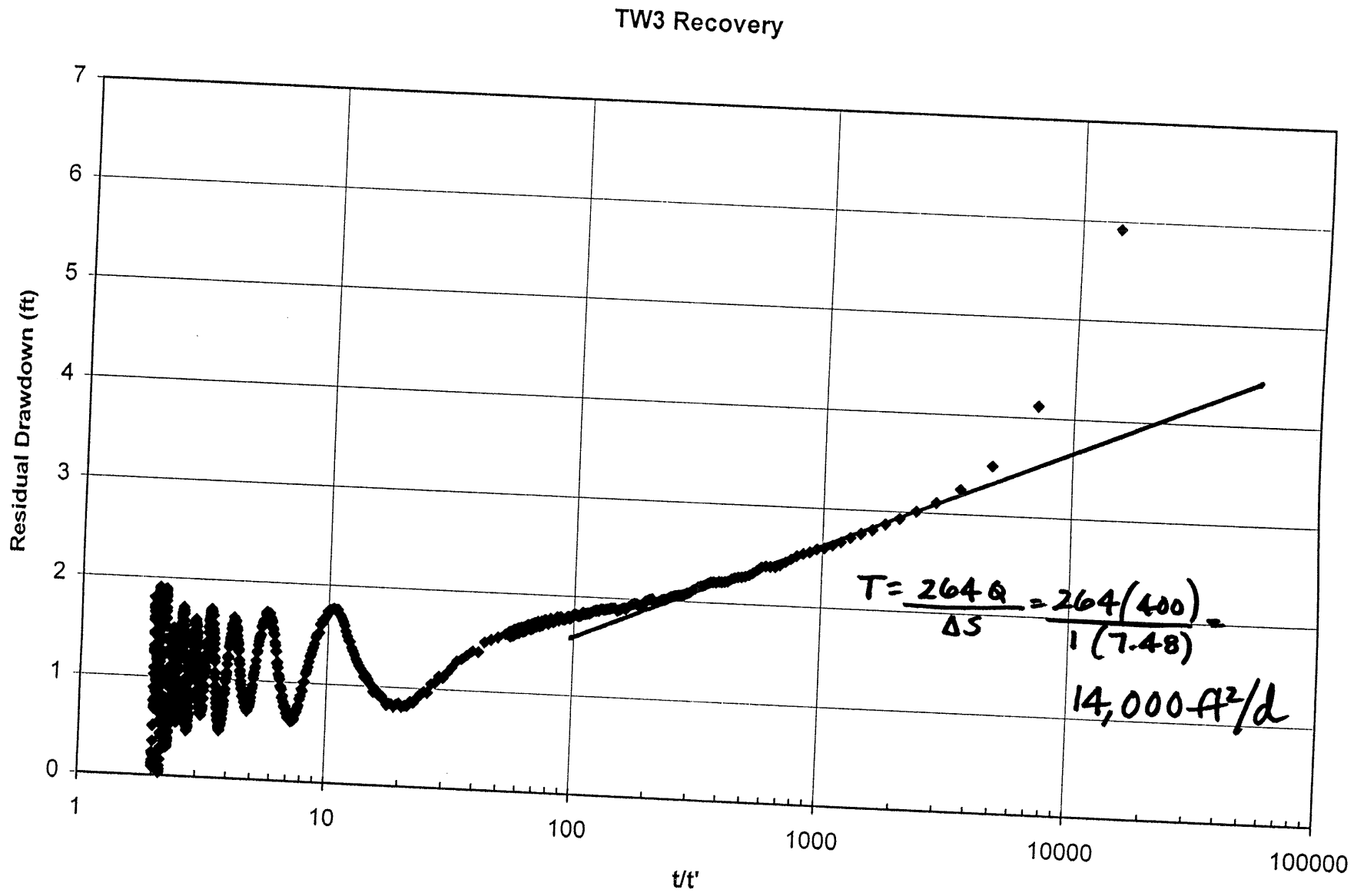

TW1 Drawdown
Drawdown (ft)
0
1
2
3
4
5
6
0.1
1
10
100
1000
10000
Time (min)

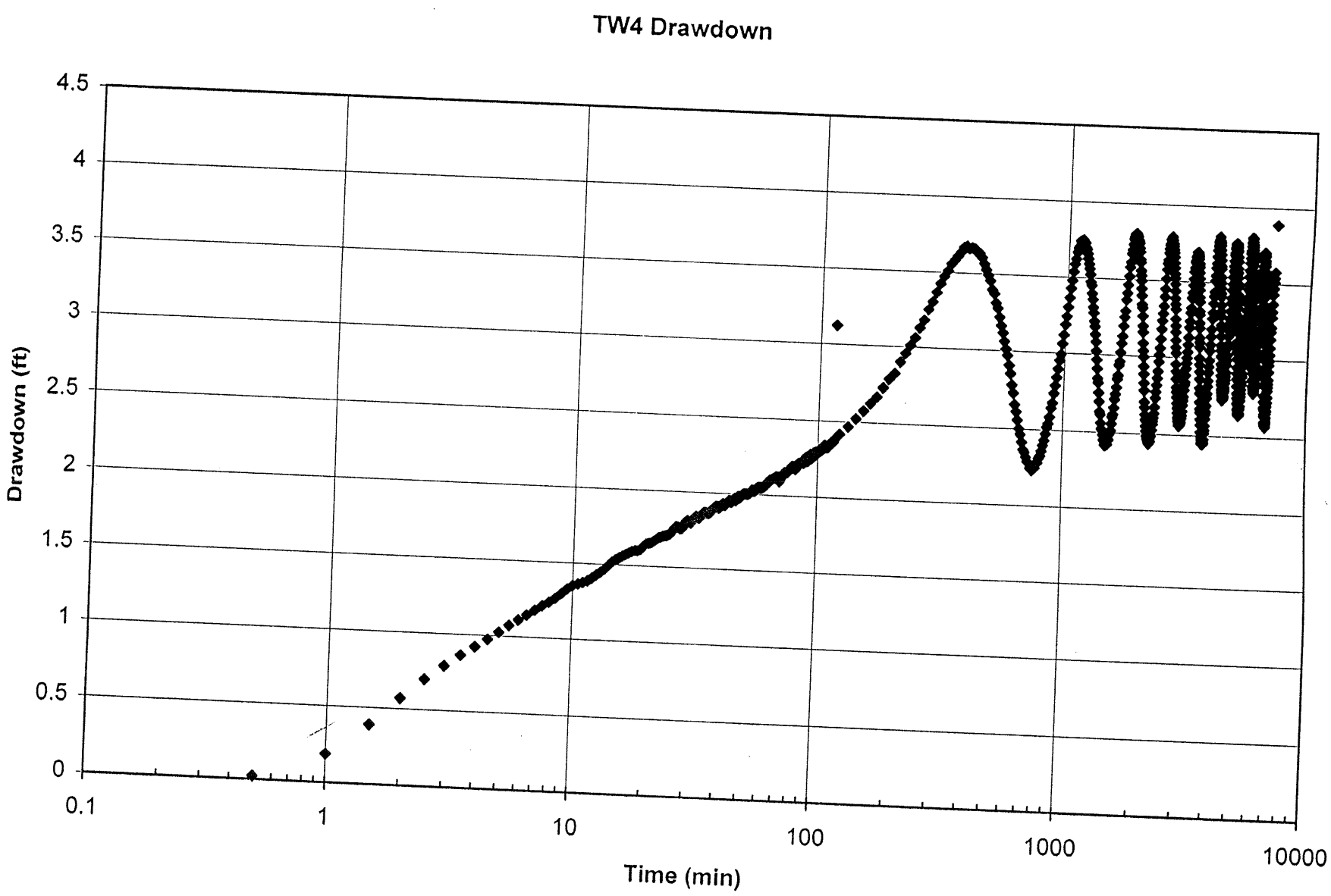

TW1 Recovery
Residual Drawdown (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
100000
t/t'

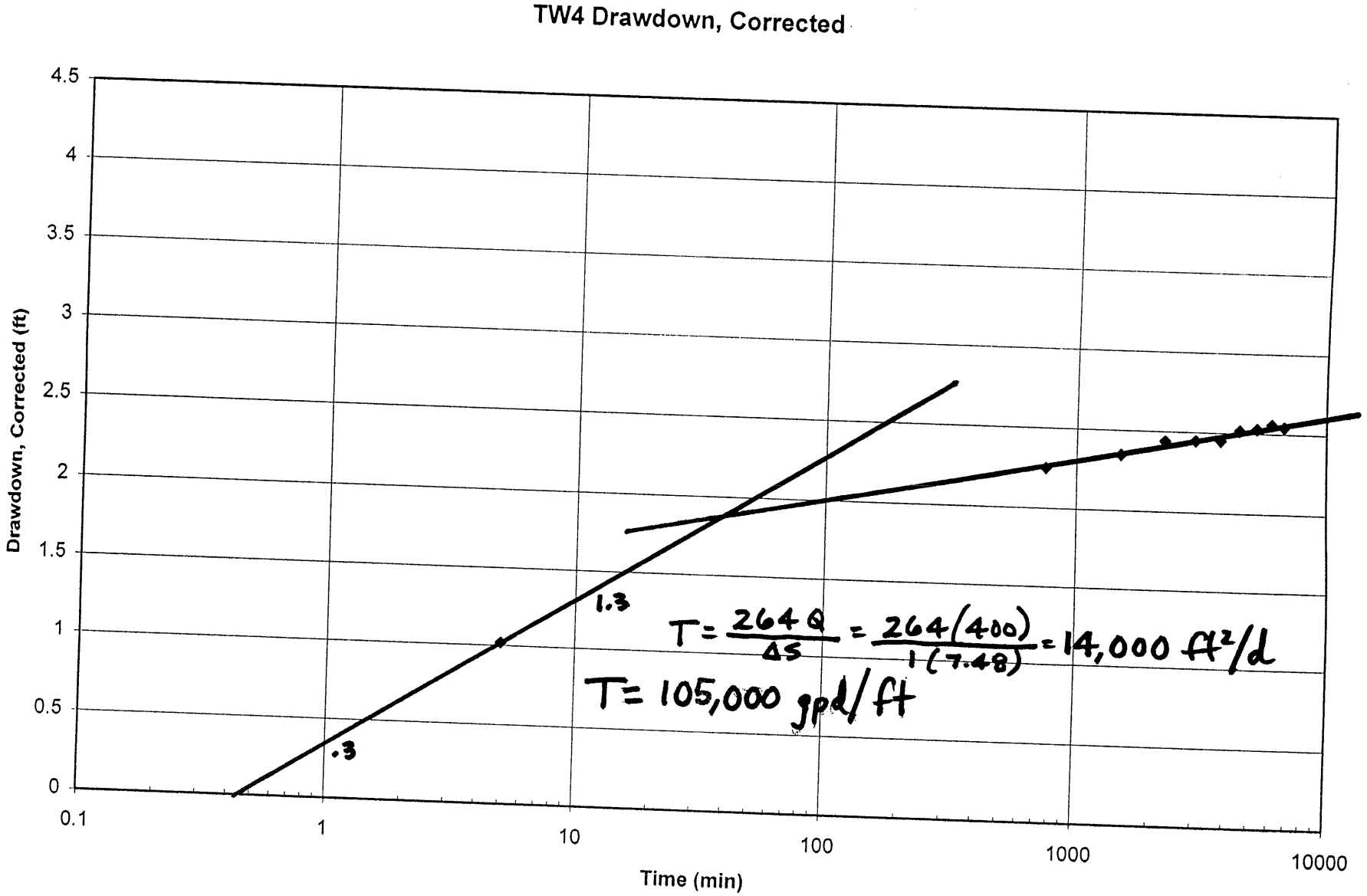

TW2 Drawdown
Drawdown (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
1000
10000
Time (min)

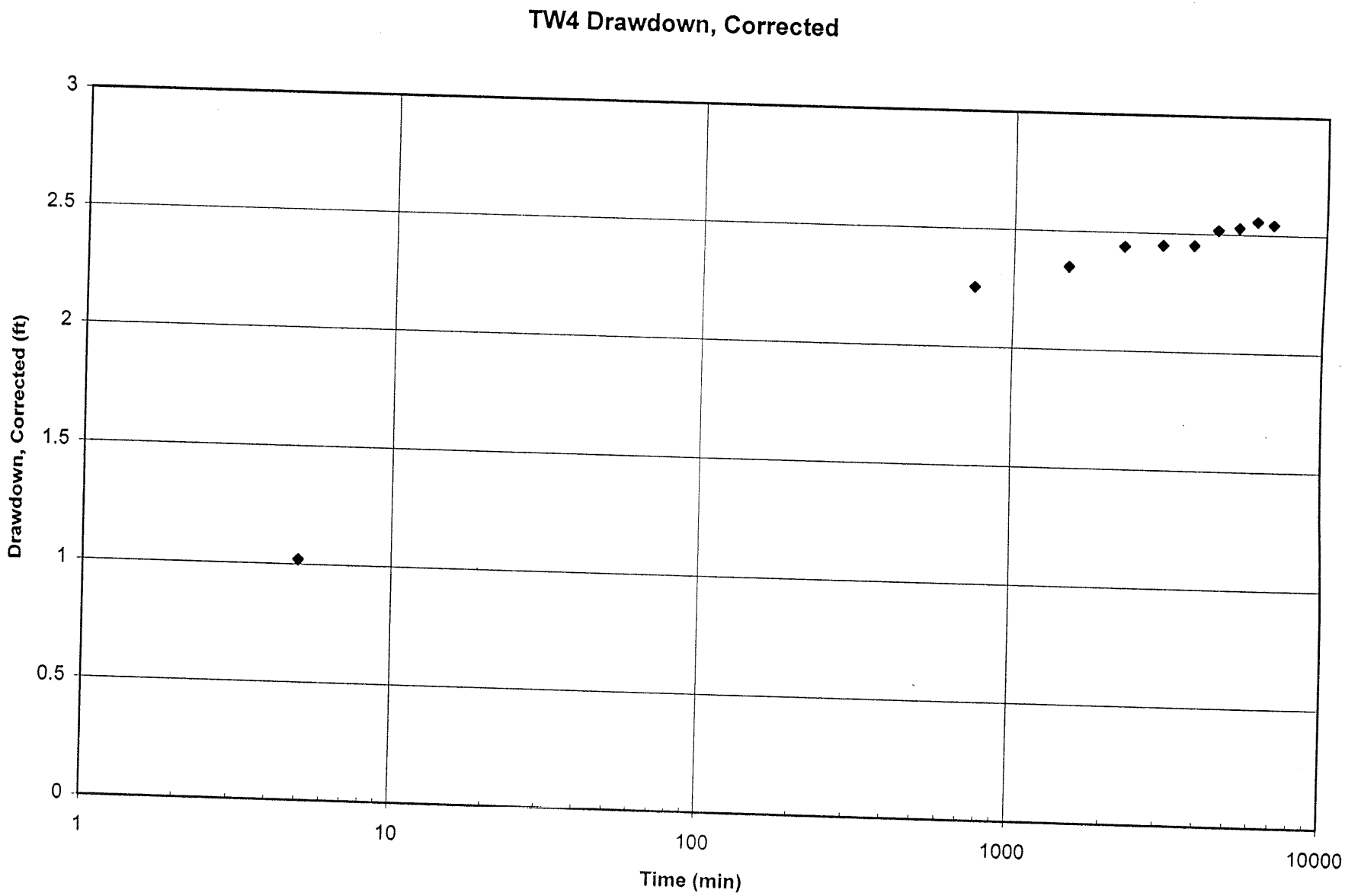

TW2 Drawdown
Drawdown (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
1000
10000
Time (min)

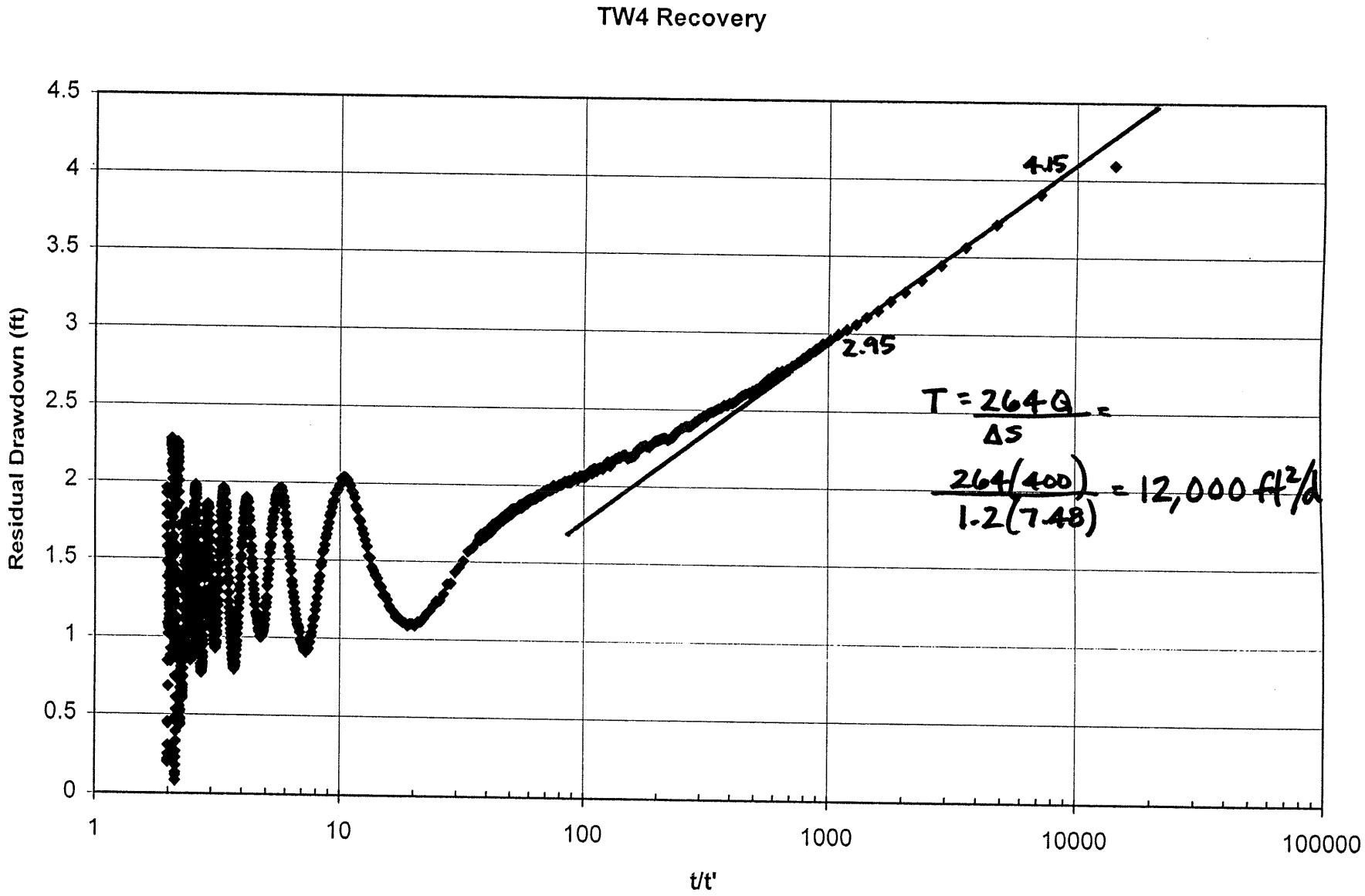

TW2 Recovery
Residual Drawdown (ft)
4
3.5
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
100000
t/t'
T = 264Q/Δs = 264(400)/1(7.48) = 14,000 ft²/d

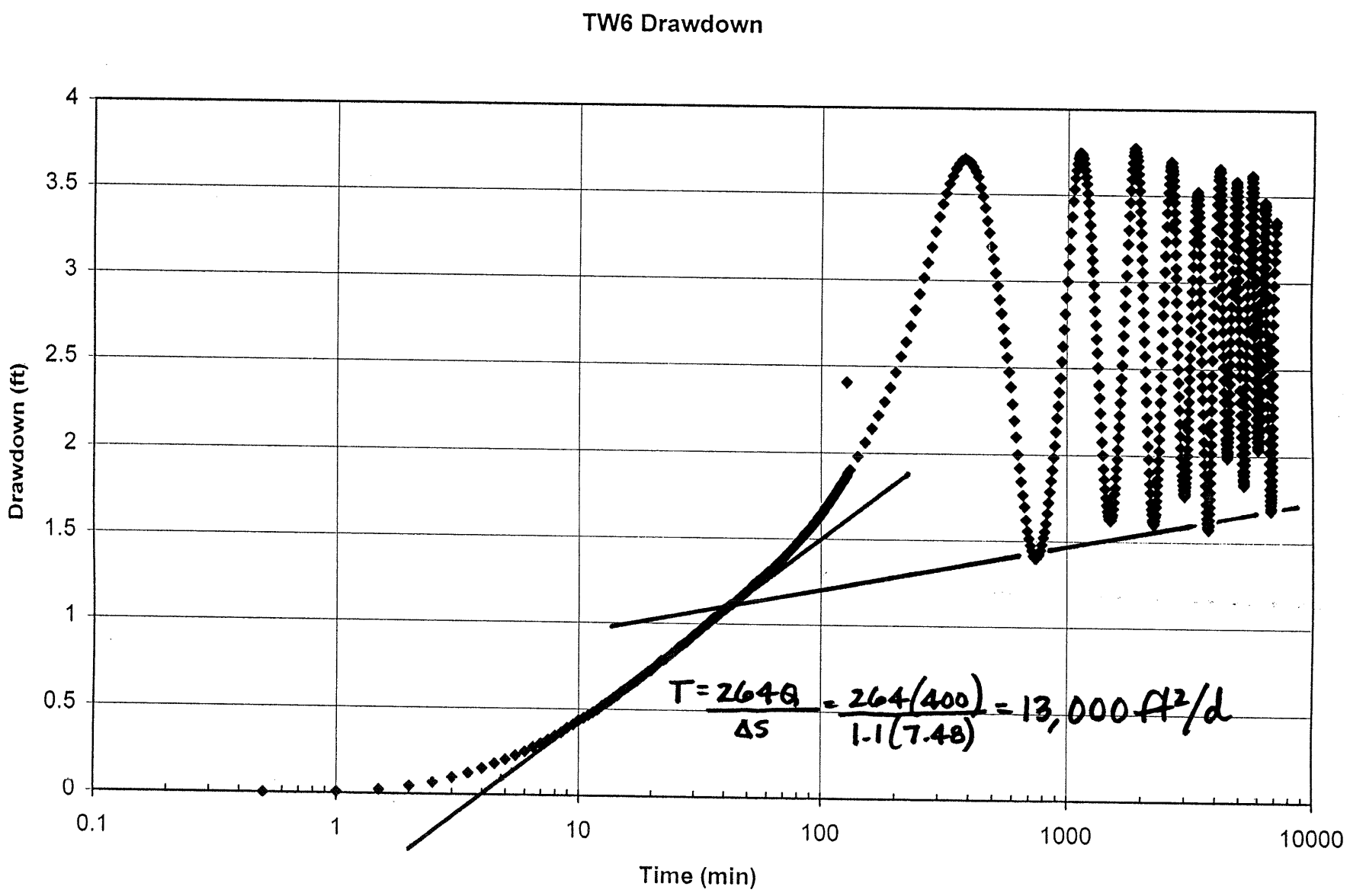

TW3 Recovery
Residual Drawdown (ft)
0
1
2
3
4
5
6
7
1
10
100
1000
10000
100000
t/t'
T = 264Q/ΔS = 264(400)/1(7.48) =
14,000 ft²/d

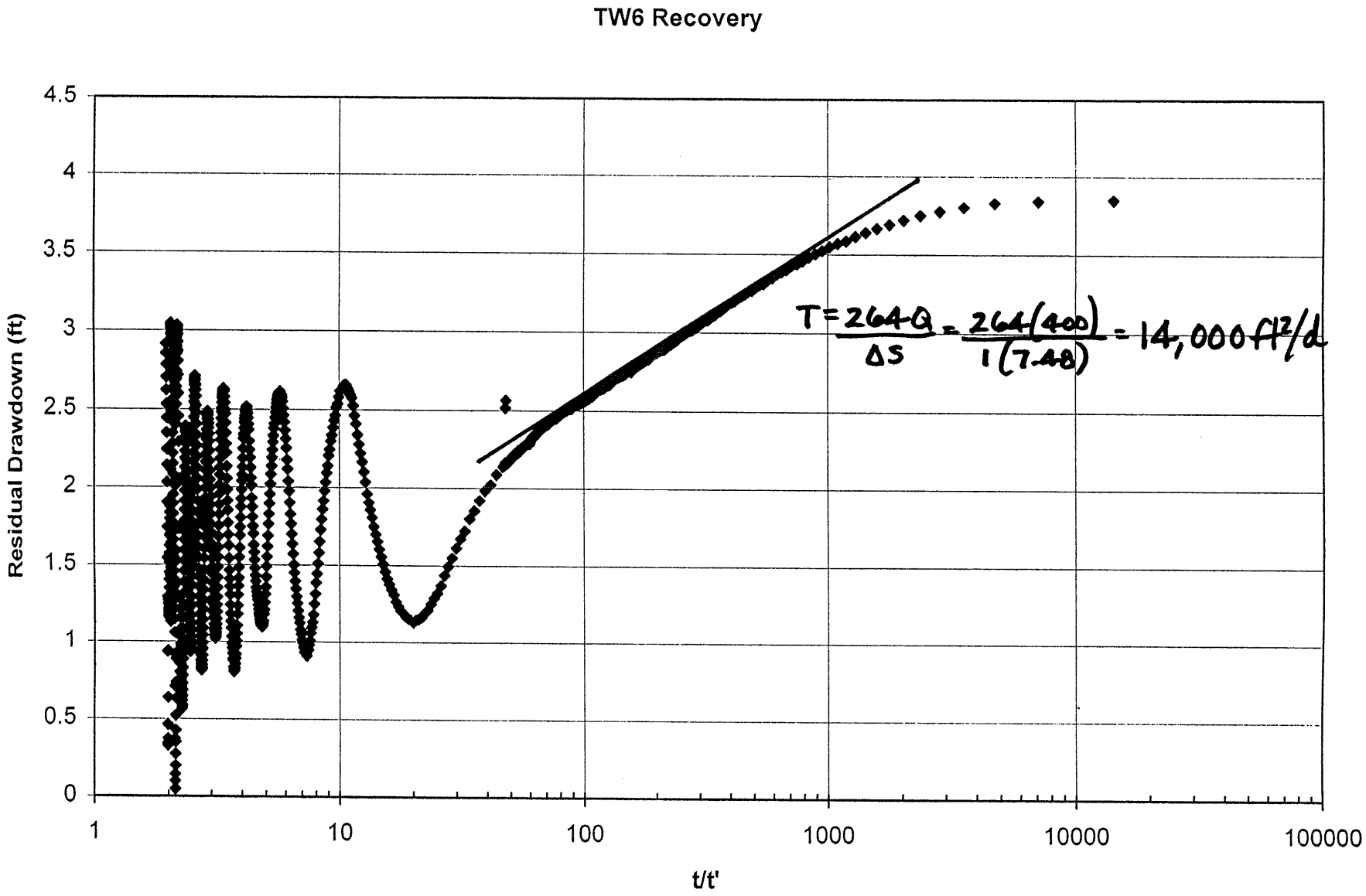

TW4 Drawdown
Drawdown (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
1000
10000
Time (min)


TW4 Drawdown, Corrected
Drawdown, Corrected (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
1000
10000
Time (min)
.3
1.3
T = 264 Q / Δs = 264(400) / 1(7.48) = 14,000 ft²/d
T = 105,000 gpd/ft

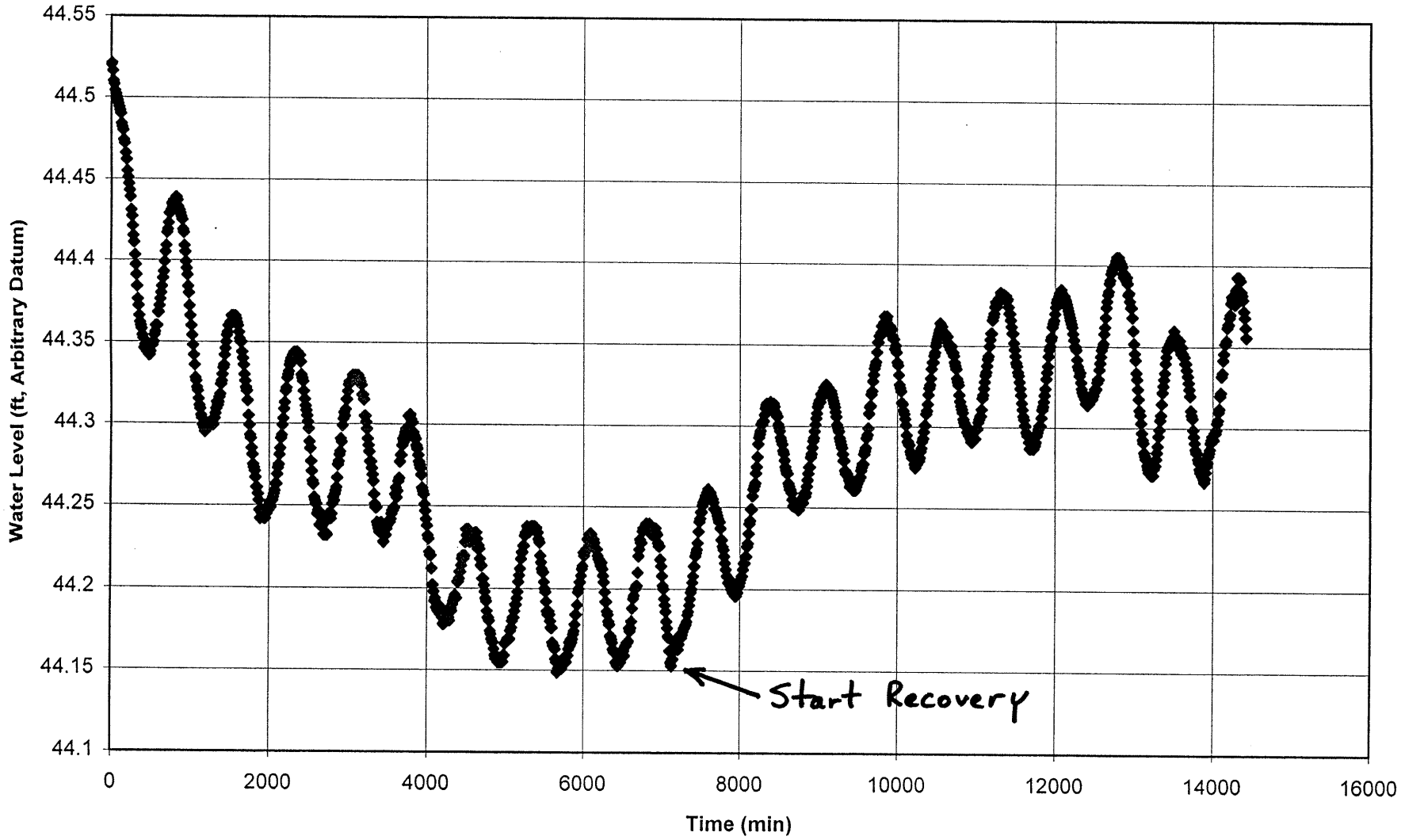

TW4 Drawdown, Corrected
Drawdown, Corrected (ft)
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
Time (min)


TW4 Recovery
Residual Drawdown (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
100000
t/t'
4.15
2.95
T = 264Q / ΔS =
264(400) / 1.2(7.48) = 12,000 ft²/d


TW6 Drawdown
Drawdown (ft)
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
1000
10000
Time (min)
T = 264Q/ΔS = 264(400)/1.1(7.48) = 13,000 ft²/d


TW6 Recovery
Residual Drawdown (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
100000
t/t'
T=264Q/ΔS = 264(400)/1(7.48) = 14,000 ft²/d

OBS4 Drawdown and Recovery



ATTACHMENT 5.A-2: STORMWATER OPERATION AND MAINTENANCE PLAN

DESIGN ENGINEERS, INC.

STORMWATER OPERATION & MAINTENANCE PLAN

CANAL UNIT 3

Sandwich, Massachusetts

September 16, 2016

GRASSED SWALES WITH CHECK DAMS: During construction, inspect immediately after each run-off producing rainfall event and at least daily during prolonged rainfall. After construction, inspect at a minimum of twice a year, or after major storm events (2" or greater). Repair eroded spots immediately after inspection. Additional inspections should be scheduled during the first few months to ensure that the vegetation in the channels is established adequately. Accumulated sediment shall be removed at least once a year or before it exceeds 6" in depth, whichever occurs first.

SEDIMENT FOREBAY: Inspect monthly at a minimum, or after major storm events (2" or greater) during construction and twice per year after construction. Check for erosion, excessive accumulation of sediment and trash. Repair eroded spots immediately after inspection. Accumulated sediment shall be removed at least once per year or before it exceeds 6" in depth, whichever occurs first.

VEGETATED INFILTRATION/RETENTION AREAS: Inspect after every major storm event (2" or greater) during construction and for the first few months after construction to ensure proper stabilization and function. Thereafter, inspect at least twice per year during wet weather to ensure the retention area is draining properly and vegetation is thriving. Check for accumulation of sediment and ponding water. If ponding water is visible for several days after a storm event, notify the engineer for possible remedial measures. Check for erosion, invasive tree growth, clogging, and trash. Remove organic matter, weeds, trash, debris and dead vegetation as necessary, particularly from any inlet/outlet pipes or outlet structures. Prune thriving vegetation and replace dead vegetation as needed. Re-seed eroded or barren spots immediately after inspection. Remove sediment as necessary during construction, while dry, and at least every five years after construction.

SUBSURFACE INFILTRATION CHAMBERS: Inspect after every major storm event (2" or greater) during construction and for the first few months after construction to ensure proper stabilization and function. Thereafter, inspect at least twice per year during wet weather

P.O. Box 1051
Sandwich, MA 02563
(508) 888-9282 · FAX 888-5859
email: ade@atlanticcompanies.com
www.atlanticcompanies.com

to ensure the system is draining properly. Check for accumulation of sediment and ponding water. If ponding water is visible inside the system for several days after a storm event, notify the engineer for possible remedial measures. Remove sediment as necessary during construction, while the system is dry, and at least every five years after construction.

DEEP SUMP HOODED CATCH BASINS: Inspect monthly at a minimum, or after major storm events (2" or greater) during construction for excessive accumulation of sediments and trash. Thereafter, inspect quarterly and clean sumps quarterly (every three months) or when sediment reaches 24" (1/2 the depth of the sump).

PROPRIETARY WATER QUALITY STRUCTURE: Inspect, operate, and maintain per manufacturer's requirements and recommendations.

VEGETATION FILTER STRIPS: During construction, inspect immediately after each run-off producing rainfall event and at least daily during prolonged rainfall. After construction, inspect every 6 months during the first year and annually thereafter. Check for sediment buildup, signs of erosion, bare spots and overall health of the vegetation. Remove sediment and repair/reseed eroded or bare spots as needed. Mow at least 2 times a year, during the growing season.

NOTES:

1. The contractor shall be responsible for the proper inspection and maintenance of all stormwater and erosion control facilities until the project construction is completed. The contractor shall clean all components of the stormwater management system at the completion of construction, immediately prior to turning over operation and maintenance responsibility to the owner.

2. Upon completion of construction, the operation and maintenance of all components of the stormwater management system will be the responsibility of the owner:

   NRG Canal 3 Development LLC
   9 Freezer Road
   Sandwich, MA 02563

3. The owner/contractor shall file an inspection report with the Town of Sandwich Department of Public Works – Engineering Department following each site inspection as recommended in the O & M schedule. Copies of the inspection reports are to be made available to the Cape Cod Commission and/or Sandwich Conservation Commission upon request. The inspection report shall identify the date of inspection, name and contact number of responsible party, specific structures inspected, specific maintenance and/or repairs required and general observations. Any deficiencies noted in the inspection report shall be corrected to the Town of Sandwich Department of Public Works – Engineering Department satisfaction.

4. Disposal of accumulated sediment and hydrocarbons to be in accordance with applicable local, state and federal guidelines and regulations.

5. There shall be no illicit discharge of any waste or waste water into the stormwater management system. The maintenance of the facility shall be undertaken in such a manner as to prevent any discharge of waste or waste water into stormwater management system. Any waste products generated during maintenance shall be properly disposed of off-site.

6. One year from completion of the stormwater system, prior to the issuance of a Final Certificate of Compliance from the Cape Cod Commission, a Professional Engineer shall inspect the system and submit a letter to Commission staff certifying that the system was installed and functions as designed, including certification to the system's compliance with the design standards contained in the Cape Cod Commission's Regional Policy plan Minimum Performance Standards 7.2 and 7.8.

ATTACHMENT 5.C-1: CONSTRUCTION TRAFFIC MANAGEMENT PLAN

Construction Traffic Overview
Canal Unit 3 Simple Cycle Construction Project

Figure 1 shows the routing of traffic from Route 6 and the Sagamore Bridge to the Canal Site. Off Cape traffic will generally come onto the Cape via the Sagamore Bridge and will exit Route 6 to Sandwich Road and the Old Kings Highway (Route 6A) towards Sandwich via the Mid Cape Connector. Traffic will then take a left onto Tupper Road and will access the site via Freezer Road. Traffic leaving the site will use the same general route in reverse using the Cranberry Highway to access the Sagamore Bridge.

During peak construction activities a total of about 152 craft people will be employed. Normal working hours will generally be from 7:00 am to 3:30 pm on an 8 hour per day 5 day per week schedule. Some spot overtime is anticipated that will delay a portion of the traffic leaving the site to later than 3:30 pm during certain periods of the construction schedule.

Craft and supervisory labor will access the parking area using a temporary gate as shown in Figure 2. The Craft parking area will support 200 spaces though with anticipated carpooling a total of 130 Craft labor cars are expected during peak construction activities. Supervisory personnel (an anticipated additional 15 – 20 cars) will use a separate parking area near the temporary construction offices. Truck deliveries of equipment and supplies will also use this route to the Canal Site accessing the site at the same general location.

OWNER	APPLICANT	PREPARER	ZONING
NRG CANAL LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	NRG CANAL 3 DEVELOPMENT LLC 9 FREEZER ROAD SANDWICH, MASSACHUSETTS 02563	CB&I 121 WEST TRADE STREET CHARLOTTE, NC 28202	INDUSTRIAL

THIS DRAWING IS FOR PERMIT APPLICATION ONLY. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION.

CANAL

#3

Figure 1
Facility Traffic Route

NO.	DATE	REVISION	BY	CHK.	APP.
A	9/21/16	ISSUED FOR CCC PERMIT	JGM	DGJ	

DRAWN:	J.G. MARTIN	DRAWING NUMBER
CHECKED	D.G. JOHNSON	FIGURE E
APPROVED		SHEET: 1 OF 1
SIZE: D 22X34		REV: A
DISCIPLINE:	SCALE: NO SCALE	FILE:

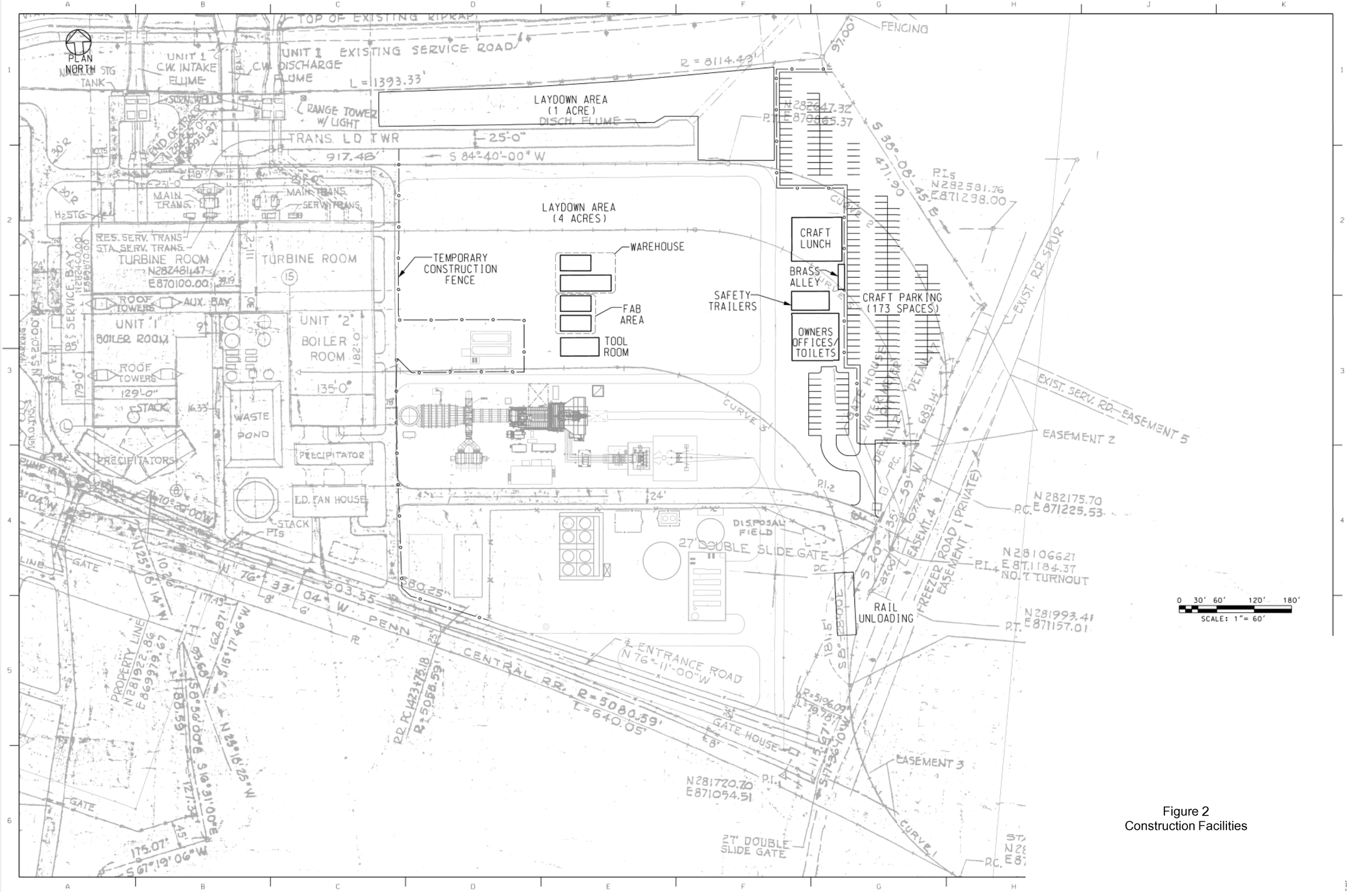


Figure 2
Construction Facilities

ATTACHMENT 5.C-2: TRAFFIC DATA

Traffic Count Data & Seasonal Adjustment Factor

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Class
Site Code: 1436763915002
Date Start: 29-Jul-15

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
07/29/1														
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
06:00	0	21	7	0	1	0	0	0	0	0	0	0	0	29
07:00	0	5	3	0	0	0	0	0	0	0	0	0	0	8
08:00	0	1	0	0	1	0	0	0	0	0	0	0	0	2
09:00	0	5	0	0	3	0	0	0	0	0	0	0	0	8
10:00	0	4	2	0	2	0	0	0	0	0	0	0	0	8
11:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
12 PM	0	7	1	0	0	0	0	0	0	0	0	0	0	8
13:00	1	10	1	0	0	0	0	0	0	0	0	0	0	12
14:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
17:00	0	7	1	0	1	0	0	0	0	0	0	0	0	9
18:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
19:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	1	1	0	0	0	0	0	0	0	0	0	0	0	2
22:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	81	20	0	8	0	0	0	0	0	0	0	0	111
Percent	1.8%	73.0%	18.0%	0.0%	7.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak		06:00	06:00		09:00									06:00
Vol.		21	7		3									29
PM Peak	13:00	13:00	12:00		17:00									13:00
Vol.	1	10	1		1									12

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Class
Site Code: 1436763915002
Date Start: 29-Jul-15

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
07/30/1														
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
06:00	0	16	8	0	0	0	0	0	0	0	0	0	0	24
07:00	0	2	3	0	0	0	0	0	0	0	0	0	0	5
08:00	0	4	5	0	0	1	0	0	0	0	0	0	0	10
09:00	0	4	2	0	1	0	0	0	0	0	0	0	0	7
10:00	0	1	1	0	1	0	0	0	0	0	0	0	0	3
11:00	0	4	1	0	0	1	0	0	0	0	0	0	0	6
12 PM	0	2	0	0	0	0	0	0	0	0	0	0	0	2
13:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
14:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	1	6	0	0	0	0	0	0	0	0	0	0	0	7
18:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
22:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	57	25	0	2	2	0	0	0	0	0	0	0	87
Percent	1.1%	65.5%	28.7%	0.0%	2.3%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak		06:00	06:00		09:00	08:00								06:00
Vol.		16	8		1	1								24
PM Peak	17:00	17:00	14:00											17:00
Vol.	1	6	2											7
Total		138	45	0	10	2	0	0	0	0	0	0	0	198

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Class
Site Code: 1436763915002
Date Start: 29-Jul-15

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
07/29/1														
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
06:00	0	5	0	0	1	0	0	0	0	0	0	0	0	6
07:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
08:00	0	1	0	0	1	0	0	0	0	0	0	0	0	2
09:00	0	3	1	0	1	0	0	0	0	0	0	0	0	5
10:00	0	2	1	0	3	0	0	0	0	0	0	0	0	6
11:00	0	8	2	0	0	0	0	0	0	0	0	0	0	10
12 PM	0	7	0	0	1	0	0	0	0	0	0	0	0	8
13:00	1	7	4	0	0	0	0	0	0	0	0	0	0	12
14:00	0	4	2	0	1	0	0	0	0	0	0	0	0	7
15:00	0	12	6	0	1	0	0	0	0	0	0	0	0	19
16:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
17:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
18:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
19:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
20:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
21:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
22:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
23:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
Total	1	82	22	0	9	0	0	0	0	0	0	0	0	114
Percent	0.9%	71.9%	19.3%	0.0%	7.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak		11:00	11:00		10:00									11:00
Vol.		8	2		3									10
PM Peak	13:00	15:00	15:00		12:00									15:00
Vol.	1	12	6		1									19

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

154575 A Class
Site Code: 1436763915002
Date Start: 29-Jul-15

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
07/30/1														
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
06:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1
07:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
08:00	0	2	4	0	1	0	0	0	0	0	0	0	0	7
09:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
10:00	0	4	2	0	1	0	0	0	0	0	0	0	0	7
11:00	1	6	2	0	0	1	0	0	0	0	0	0	0	10
12 PM	0	2	1	0	0	0	0	0	0	0	0	0	0	3
13:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
14:00	0	5	2	0	0	0	0	0	0	0	0	0	0	7
15:00	0	5	4	0	1	0	0	0	0	0	0	0	0	10
16:00	0	3	2	0	1	0	0	0	0	0	0	0	0	6
17:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
18:00	0	6	3	0	0	0	0	0	0	0	0	0	0	9
19:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
22:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
23:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	1	57	27	0	5	1	0	0	0	0	0	0	0	91
Percent	1.1%	62.6%	29.7%	0.0%	5.5%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	09:00	08:00		06:00	11:00								11:00
Vol.	1	6	4		1	1								10
PM Peak		18:00	15:00		15:00									15:00
Vol.		6	4		1									10
Total		139	49	0	14	1	0	0	0	0	0	0	0	205

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Speed
Site Code: 1436763915002
Date Start: 29-Jul-15

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
07/29/ 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	8	0	0	0	0	0	0	0	0	0	0	0	0	8	11	8
06:00	**26**	**1**	**2**	0	0	0	0	0	0	0	0	0	0	**29**	13	9
07:00	7	1	0	0	0	0	0	0	0	0	0	0	0	8	13	9
08:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
09:00	8	0	0	0	0	0	0	0	0	0	0	0	0	8	11	8
10:00	8	0	0	0	0	0	0	0	0	0	0	0	0	8	11	8
11:00	5	**1**	0	0	0	0	0	0	0	0	0	0	0	6	14	9
12 PM	5	1	2	0	0	0	0	0	0	0	0	0	0	8	21	12
13:00	**9**	0	**3**	0	0	0	0	0	0	0	0	0	0	**12**	21	11
14:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
16:00	1	**2**	0	0	0	0	0	0	0	0	0	0	0	3	17	14
17:00	**9**	0	0	0	0	0	0	0	0	0	0	0	0	**9**	11	8
18:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
19:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
21:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
22:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
Total	98	6	7	0	0	0	0	0	0	0	0	0	0	111		
%	88.3%	5.4%	6.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	06:00	06:00	06:00											06:00		
Vol.	26	1	2											29		
Midday Peak	13:00	11:00	13:00											13:00		
Vol.	9	1	3											12		
PM Peak	17:00	16:00												17:00		
Vol.	9	2												9		

% iles

15th Percentile :	2 MPH
50th Percentile :	7 MPH
85th Percentile :	13 MPH
95th Percentile :	20 MPH

Stats

10 MPH Pace Speed :	5-14 MPH
Number in Pace :	70
Percent in Pace :	63.1%
Number of Vehicles > 15 MPH :	12
Percent of Vehicles > 15 MPH :	10.6%
Mean Speed(Average) :	9 MPH

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Speed
Site Code: 1436763915002
Date Start: 29-Jul-15

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
07/30/ 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
04:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
05:00	6	0	0	0	0	0	0	0	0	0	0	0	0	6	11	7
06:00	**24**	0	0	0	0	0	0	0	0	0	0	0	0	**24**	11	7
07:00	4	**1**	0	0	0	0	0	0	0	0	0	0	0	5	15	9
08:00	10	0	0	0	0	0	0	0	0	0	0	0	0	10	11	7
09:00	7	0	0	0	0	0	0	0	0	0	0	0	0	7	11	8
10:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3	11	7
11:00	**6**	0	0	0	0	0	0	0	0	0	0	0	0	**6**	11	7
12 PM	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
13:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4	11	8
14:00	5	0	0	0	0	0	0	0	0	0	0	0	0	5	11	7
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
17:00	**6**	0	**1**	0	0	0	0	0	0	0	0	0	0	**7**	13	10
18:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3	11	7
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
21:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
22:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
Total	85	1	1	0	0	0	0	0	0	0	0	0	0	87		
%	97.7%	1.1%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	06:00	07:00												06:00		
Vol.	24	1												24		
Midday Peak	11:00													11:00		
Vol.	6													6		
PM Peak	17:00		17:00											17:00		
Vol.	6		1											7		

% iles

15th Percentile : 2 MPH
50th Percentile : 7 MPH
85th Percentile : 12 MPH
95th Percentile : 13 MPH

Stats

10 MPH Pace Speed : 1-10 MPH
Number in Pace : 61
Percent in Pace : 70.1%
Number of Vehicles > 15 MPH : 2
Percent of Vehicles > 15 MPH : 2.1%
Mean Speed(Average) : 8 MPH

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Speed
Site Code: 1436763915002
Date Start: 29-Jul-15

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
07/29/ 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
06:00	**6**	0	0	0	0	0	0	0	0	0	0	0	0	**6**	11	7
07:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4	11	8
08:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
09:00	5	0	0	0	0	0	0	0	0	0	0	0	0	5	11	7
10:00	6	0	0	0	0	0	0	0	0	0	0	0	0	6	11	7
11:00	**10**	0	0	0	0	0	0	0	0	0	0	0	0	10	11	7
12 PM	5	1	2	0	0	0	0	0	0	0	0	0	0	8	21	12
13:00	7	**2**	**3**	0	0	0	0	0	0	0	0	0	0	**12**	21	13
14:00	7	0	0	0	0	0	0	0	0	0	0	0	0	7	11	8
15:00	**17**	**2**	0	0	0	0	0	0	0	0	0	0	0	**19**	13	9
16:00	6	0	0	0	0	0	0	0	0	0	0	0	0	6	11	7
17:00	5	0	0	0	0	0	0	0	0	0	0	0	0	5	11	7
18:00	7	1	0	0	0	0	0	0	0	0	0	0	0	8	13	9
19:00	3	0	**2**	0	0	0	0	0	0	0	0	0	0	5	22	13
20:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
21:00	3	0	1	0	0	0	0	0	0	0	0	0	0	4	20	11
22:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
23:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
Total	100	6	8	0	0	0	0	0	0	0	0	0	0	114		
%	87.7%	5.3%	7.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	06:00													06:00		
Vol.	6													6		
Midday Peak	11:00	13:00	13:00											13:00		
Vol.	10	2	3											12		
PM Peak	15:00	15:00	19:00											15:00		
Vol.	17	2	2											19		

% iles

15th Percentile : 2 MPH
50th Percentile : 7 MPH
85th Percentile : 13 MPH
95th Percentile : 20 MPH

Stats

10 MPH Pace Speed : 5-14 MPH
Number in Pace : 71
Percent in Pace : 62.3%
Number of Vehicles > 15 MPH : 13
Percent of Vehicles > 15 MPH : 11.2%
Mean Speed(Average) : 9 MPH

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Speed
Site Code: 1436763915002
Date Start: 29-Jul-15

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
07/30/ 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2	11	8
06:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
07:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3	11	7
08:00	**7**	0	0	0	0	0	0	0	0	0	0	0	0	7	11	8
09:00	5	0	**3**	0	0	0	0	0	0	0	0	0	0	**8**	22	13
10:00	6	0	2	0	0	0	0	0	0	0	0	0	0	8	20	11
11:00	**8**	**2**	0	0	0	0	0	0	0	0	0	0	0	**10**	15	9
12 PM	3	0	0	0	0	0	0	0	0	0	0	0	0	3	11	7
13:00	5	0	0	0	0	0	0	0	0	0	0	0	0	5	11	7
14:00	7	0	0	0	0	0	0	0	0	0	0	0	0	7	11	8
15:00	**9**	**1**	0	0	0	0	0	0	0	0	0	0	0	**10**	13	8
16:00	6	0	0	0	0	0	0	0	0	0	0	0	0	6	11	7
17:00	1	0	**1**	0	0	0	0	0	0	0	0	0	0	2	22	15
18:00	9	0	0	0	0	0	0	0	0	0	0	0	0	9	11	8
19:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4	11	8
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
21:00	2	1	0	0	0	0	0	0	0	0	0	0	0	3	16	11
22:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3	11	7
23:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
Total	82	4	6	0	0	0	0	0	0	0	0	0	0	92		
%	89.1%	4.3%	6.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00		09:00											09:00		
Vol.	7		3											8		
Midday Peak	11:00	11:00												11:00		
Vol.	8	2												10		
PM Peak	15:00	15:00	17:00											15:00		
Vol.	9	1	1											10		

% iles	15th Percentile :	2 MPH
	50th Percentile :	7 MPH
	85th Percentile :	13 MPH
	95th Percentile :	20 MPH

Stats	10 MPH Pace Speed :	1-10 MPH
	Number in Pace :	59
	Percent in Pace :	64.1%
	Number of Vehicles > 15 MPH :	9
	Percent of Vehicles > 15 MPH :	10.0%
	Mean Speed(Average) :	9 MPH

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Volume
Site Code: 1436763915002
Date Start: 29-Jul-15

Start	WB				EB				Combined				29-Jul-15
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.		Wed
12:00	0		3		0		3		0		6		
12:15	0		2		0		1		0		3		
12:30	0		0		0		2		0		2		
12:45	0	0	3	8	0	0	2	8	0	0	5	16	
01:00	0		0		0		1		0		1		
01:15	0		3		0		2		0		5		
01:30	0		9		0		2		0		11		
01:45	0	0	0	12	0	0	7	12	0	0	7	24	
02:00	0		0		0		2		0		2		
02:15	0		0		0		0		0		0		
02:30	0		1		0		5		0		6		
02:45	0	0	1	2	0	0	0	7	0	0	1	9	
03:00	0		0		0		9		0		9		
03:15	0		0		0		3		0		3		
03:30	0		0		0		5		0		5		
03:45	0	0	0	0	0	0	2	19	0	0	2	19	
04:00	0		0		0		2		0		2		
04:15	0		2		0		0		0		2		
04:30	0		0		0		0		0		0		
04:45	0	0	1	3	0	0	4	6	0	0	5	9	
05:00	0		1		0		1		0		2		
05:15	3		0		0		2		3		2		
05:30	2		3		2		2		4		5		
05:45	3	8	5	9	0	2	0	5	3	10	5	14	
06:00	1		1		0		1		1		2		
06:15	4		0		2		2		6		2		
06:30	14		0		1		2		15		2		
06:45	10	29	1	2	3	6	3	8	13	35	4	10	
07:00	4		1		3		2		7		3		
07:15	2		0		0		1		2		1		
07:30	1		0		0		0		1		0		
07:45	1	8	1	2	1	4	2	5	2	12	3	7	
08:00	0		0		0		1		0		1		
08:15	0		0		0		0		0		0		
08:30	1		0		0		0		1		0		
08:45	1	2	0	0	2	2	0	1	3	4	0	1	
09:00	3		0		2		1		5		1		
09:15	1		2		0		1		1		3		
09:30	2		0		0		1		2		1		
09:45	2	8	0	2	3	5	1	4	5	13	1	6	
10:00	2		0		3		0		5		0		
10:15	3		0		1		0		4		0		
10:30	2		0		2		0		4		0		
10:45	1	8	2	2	0	6	2	2	1	14	4	4	
11:00	0		0		3		2		3		2		
11:15	2		0		0		0		2		0		
11:30	1		0		4		0		5		0		
11:45	3	6	0	0	3	10	0	2	6	16	0	2	
Total	69		42		35		79		104		121		
Percent	66.3%		34.7%		33.7%		65.3%						
Day Total		111				114				225			
Peak	06:15	-	00:45	-	11:00	-	03:00	-	06:15	-	01:15	-	- -
Vol.	32	-	15	-	10	-	19	-	41	-	25	-	- -
P.H.F.	0.571		0.417		0.625		0.528		0.683		0.568		

Rickeys Road
west of Freezer Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

154575 A Volume
Site Code: 1436763915002
Date Start: 29-Jul-15

Start	WB				EB				Combined				30-Jul-15
Time	A.M.		P.M.		A.M.		P.M.		A.M.		P.M.		Thu
12:00	0		1		0		0		0		1		
12:15	0		1		0		3		0		4		
12:30	0		0		0		0		0		0		
12:45	0	0	0	2	0	0	0	3	0	0	0	5	
01:00	0		0		0		2		0		2		
01:15	0		1		0		0		0		1		
01:30	0		1		0		1		0		2		
01:45	0	0	2	4	0	0	2	5	0	0	4	9	
02:00	0		1		0		4		0		5		
02:15	0		1		0		0		0		1		
02:30	0		1		0		1		0		2		
02:45	0	0	2	5	0	0	2	7	0	0	4	12	
03:00	0		0		0		8		0		8		
03:15	0		0		0		1		0		1		
03:30	0		0		0		1		0		1		
03:45	1	1	0	0	0	0	0	10	1	1	0	10	
04:00	0		0		0		0		0		0		
04:15	0		0		0		3		0		3		
04:30	1		0		0		2		1		2		
04:45	0	1	0	0	0	0	1	6	0	1	1	6	
05:00	0		1		0		0		0		1		
05:15	2		2		0		1		2		3		
05:30	3		3		2		1		5		4		
05:45	1	6	1	7	0	2	0	2	1	8	1	9	
06:00	2		0		0		1		2		1		
06:15	3		1		0		3		3		4		
06:30	8		1		1		4		9		5		
06:45	11	24	1	3	0	1	1	9	11	25	2	12	
07:00	1		0		2		2		3		2		
07:15	2		0		0		2		2		2		
07:30	1		0		0		0		1		0		
07:45	1	5	0	0	1	3	0	4	2	8	0	4	
08:00	1		0		3		0		4		0		
08:15	3		0		1		0		4		0		
08:30	1		0		2		0		3		0		
08:45	5	10	0	0	1	7	0	0	6	17	0	0	
09:00	3		0		3		0		6		0		
09:15	4		1		3		2		7		3		
09:30	0		1		2		1		2		2		
09:45	0	7	0	2	0	8	0	3	0	15	0	5	
10:00	0		0		3		0		3		0		
10:15	2		0		1		0		3		0		
10:30	0		1		2		0		2		1		
10:45	1	3	0	1	2	8	3	3	3	11	3	4	
11:00	1		0		0		1		1		1		
11:15	2		0		0		0		2		0		
11:30	1		0		3		0		4		0		
11:45	2	6	0	0	7	10	0	1	9	16	0	1	
Total	63		24		39		53		102		77		
Percent	61.8%		31.2%		38.2%		68.8%						
Day Total		87				92				179			
Peak	06:00	-	05:00	-	11:00	-	02:30	-	06:15	-	02:15	-	- -
Vol.	24	-	7	-	10	-	12	-	26	-	15	-	- -
P.H.F.	0.545		0.583		0.357		0.375		0.591		0.469		

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 A
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Freezer Road From North			Tupper Road From East			Tupper Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	7	0	0	3	9	0	5	6	0	30
06:15 AM	11	0	0	10	23	0	7	13	0	64
06:30 AM	3	3	0	14	16	0	7	12	0	55
06:45 AM	11	7	0	13	15	0	9	16	0	71
Total	32	10	0	40	63	0	28	47	0	220
07:00 AM	8	6	0	7	29	0	18	8	0	76
07:15 AM	5	11	0	15	29	0	17	12	0	89
07:30 AM	13	4	0	6	34	0	13	7	0	77
07:45 AM	10	6	0	12	39	0	16	14	0	97
Total	36	27	0	40	131	0	64	41	0	339
08:00 AM	6	14	0	12	33	0	21	7	0	93
08:15 AM	6	7	0	6	48	0	30	6	0	103
08:30 AM	12	11	0	8	44	0	30	16	0	121
08:45 AM	17	9	0	8	49	0	29	18	0	130
Total	41	41	0	34	174	0	110	47	0	447
Grand Total	109	78	0	114	368	0	202	135	0	1006
Apprch %	58.3	41.7	0	23.7	76.3	0	59.9	40.1	0	
Total %	10.8	7.8	0	11.3	36.6	0	20.1	13.4	0	
Cars	106	78	0	113	359	0	197	131	0	984
% Cars	97.2	100	0	99.1	97.6	0	97.5	97	0	97.8
Heavy Vehicles	3	0	0	1	9	0	5	4	0	22
% Heavy Vehicles	2.8	0	0	0.9	2.4	0	2.5	3	0	2.2

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:00 AM													
07:00 AM	8	6	0	14	7	29	0	36	18	8	0	26	76
07:15 AM	5	11	0	16	15	29	0	44	17	12	0	29	89
07:30 AM	13	4	0	17	6	34	0	40	13	7	0	20	77
07:45 AM	10	6	0	16	12	39	0	51	16	14	0	30	97
Total Volume	36	27	0	63	40	131	0	171	64	41	0	105	339
% App. Total	57.1	42.9	0		23.4	76.6	0		61	39	0		
PHF	.692	.614	.000	.926	.667	.840	.000	.838	.889	.732	.000	.875	.874
Cars	36	27	0	63	40	126	0	166	62	41	0	103	332
% Cars	100	100	0	100	100	96.2	0	97.1	96.9	100	0	98.1	97.9
Heavy Vehicles	0	0	0	0	0	5	0	5	2	0	0	2	7
% Heavy Vehicles	0	0	0	0	0	3.8	0	2.9	3.1	0	0	1.9	2.1

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 A
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars

	Freezer Road From North			Tupper Road From East			Tupper Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	6	0	0	3	9	0	5	6	0	29
06:15 AM	10	0	0	10	23	0	7	13	0	63
06:30 AM	3	3	0	14	16	0	6	12	0	54
06:45 AM	11	7	0	12	15	0	9	14	0	68
Total	30	10	0	39	63	0	27	45	0	214
07:00 AM	8	6	0	7	28	0	18	8	0	75
07:15 AM	5	11	0	15	29	0	16	12	0	88
07:30 AM	13	4	0	6	33	0	13	7	0	76
07:45 AM	10	6	0	12	36	0	15	14	0	93
Total	36	27	0	40	126	0	62	41	0	332
08:00 AM	6	14	0	12	31	0	19	7	0	89
08:15 AM	6	7	0	6	48	0	30	6	0	103
08:30 AM	12	11	0	8	44	0	30	15	0	120
08:45 AM	16	9	0	8	47	0	29	17	0	126
Total	40	41	0	34	170	0	108	45	0	438
Grand Total	106	78	0	113	359	0	197	131	0	984
Apprch %	57.6	42.4	0	23.9	76.1	0	60.1	39.9	0	
Total %	10.8	7.9	0	11.5	36.5	0	20	13.3	0	

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:00 AM													
07:00 AM	8	6	0	14	7	28	0	35	18	8	0	26	75
07:15 AM	5	11	0	16	15	29	0	44	16	12	0	28	88
07:30 AM	13	4	0	17	6	33	0	39	13	7	0	20	76
07:45 AM	10	6	0	16	12	36	0	48	15	14	0	29	93
Total Volume	36	27	0	63	40	126	0	166	62	41	0	103	332
% App. Total	57.1	42.9	0		24.1	75.9	0		60.2	39.8	0		
PHF	.692	.614	.000	.926	.667	.875	.000	.865	.861	.732	.000	.888	.892

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 A
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Heavy Vehicles

	Freezer Road From North			Tupper Road From East			Tupper Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	1	0	0	0	0	0	0	0	0	1
06:15 AM	1	0	0	0	0	0	0	0	0	1
06:30 AM	0	0	0	0	0	0	1	0	0	1
06:45 AM	0	0	0	1	0	0	0	2	0	3
Total	2	0	0	1	0	0	1	2	0	6
07:00 AM	0	0	0	0	1	0	0	0	0	1
07:15 AM	0	0	0	0	0	0	1	0	0	1
07:30 AM	0	0	0	0	1	0	0	0	0	1
07:45 AM	0	0	0	0	3	0	1	0	0	4
Total	0	0	0	0	5	0	2	0	0	7
08:00 AM	0	0	0	0	2	0	2	0	0	4
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	1	0	1
08:45 AM	1	0	0	0	2	0	0	1	0	4
Total	1	0	0	0	4	0	2	2	0	9
Grand Total	3	0	0	1	9	0	5	4	0	22
Apprch %	100	0	0	10	90	0	55.6	44.4	0	
Total %	13.6	0	0	4.5	40.9	0	22.7	18.2	0	

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:00 AM													
07:00 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
07:15 AM	0	0	0	0	0	0	0	0	1	0	0	1	1
07:30 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
07:45 AM	0	0	0	0	0	3	0	3	1	0	0	1	4
Total Volume	0	0	0	0	0	5	0	5	2	0	0	2	7
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.417	.000	.417	.500	.000	.000	.500	.438

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 A
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Peds and Bikes

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	Peds EB	Peds WB	Right	Thru	Peds SB	Peds NB	Thru	Left	Peds NB	Peds SB	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	1	0	0	0	0	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	0	0	0	0	0	1
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	3	0	0	3
07:30 AM	0	0	2	0	0	0	0	0	0	0	0	0	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	2	0	0	0	0	0	0	3	0	0	5
08:00 AM	0	0	0	0	1	0	0	0	0	0	0	0	1
08:15 AM	0	0	0	2	0	0	0	0	0	0	0	0	2
08:30 AM	2	0	0	0	1	0	0	0	0	0	0	0	3
08:45 AM	0	0	0	0	0	0	0	0	0	0	1	0	1
Total	2	0	0	2	2	0	0	0	0	0	1	0	7
Grand Total	2	1	2	2	2	0	0	0	0	3	1	0	13
Apprch %	28.6	14.3	28.6	28.6	100	0	0	0	0	75	25	0	
Total %	15.4	7.7	15.4	15.4	15.4	0	0	0	0	23.1	7.7	0	

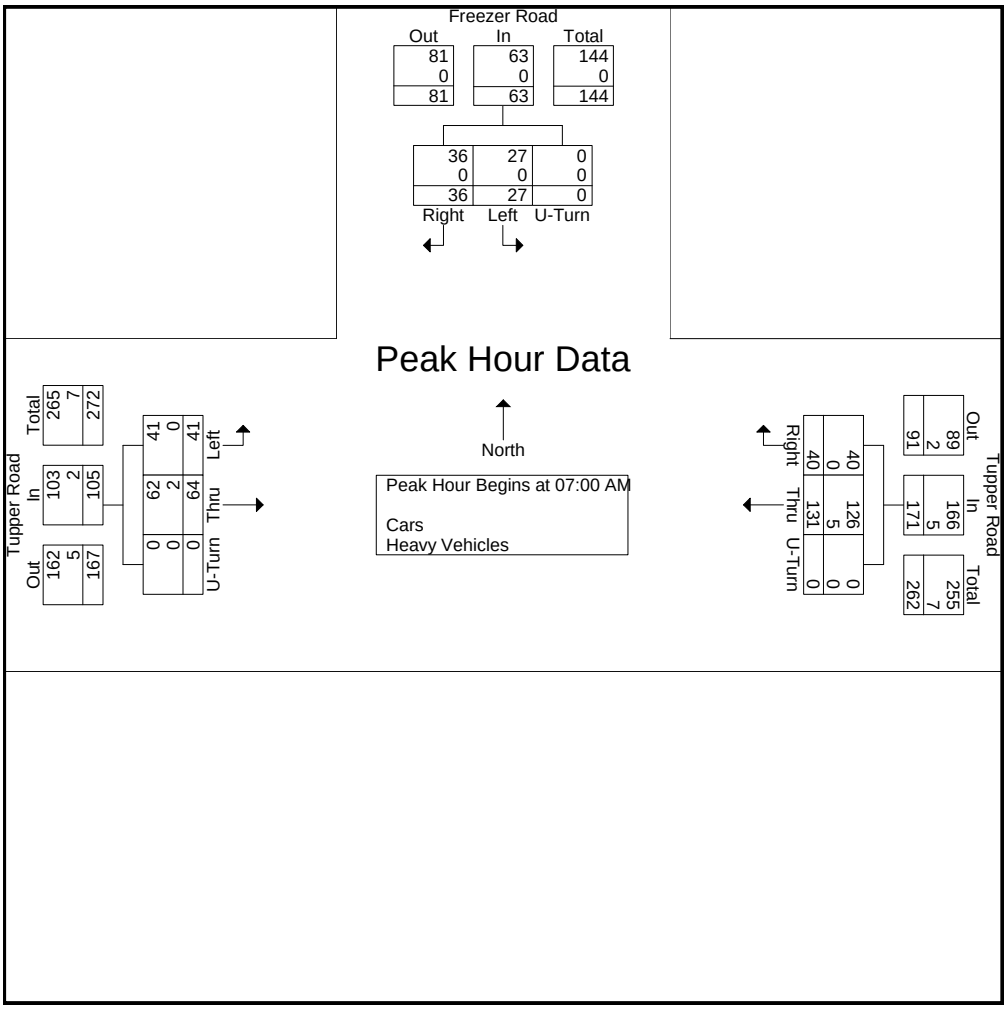
	Freezer Road From North					Tupper Road From East					Tupper Road From West					
Start Time	Right	Left	Peds EB	Peds WB	App. Total	Right	Thru	Peds SB	Peds NB	App. Total	Thru	Left	Peds NB	Peds SB	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																
Peak Hour for Entire Intersection Begins at 06:45 AM																
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	3
07:30 AM	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	2
Total Volume	0	0	2	0	2	0	0	0	0	0	0	3	0	0	3	5
% App. Total	0	0	100	0		0	0	0	0		0	100	0	0		
PHF	.000	.000	.250	.000	.250	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.417

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 A
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:00 AM													
07:00 AM	8	6	0	14	7	29	0	36	18	8	0	26	76
07:15 AM	5	11	0	16	15	29	0	44	17	12	0	29	89
07:30 AM	13	4	0	17	6	34	0	40	13	7	0	20	77
07:45 AM	10	6	0	16	12	39	0	51	16	14	0	30	97
Total Volume	36	27	0	63	40	131	0	171	64	41	0	105	339
% App. Total	57.1	42.9	0		23.4	76.6	0		61	39	0		
PHF	.692	.614	.000	.926	.667	.840	.000	.838	.889	.732	.000	.875	.874
Cars	36	27	0	63	40	126	0	166	62	41	0	103	332
% Cars	100	100	0	100	100	96.2	0	97.1	96.9	100	0	98.1	97.9
Heavy Vehicles	0	0	0	0	0	5	0	5	2	0	0	2	7
% Heavy Vehicles	0	0	0	0	0	3.8	0	2.9	3.1	0	0	1.9	2.1



N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 AA
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Freezer Road From North			Tupper Road From East			Tupper Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	28	7	0	7	63	0	41	17	0	163
03:15 PM	20	14	0	7	72	0	35	18	0	166
03:30 PM	28	9	0	11	47	0	35	14	0	144
03:45 PM	22	9	0	6	73	0	42	12	0	164
Total	98	39	0	31	255	0	153	61	0	637
04:00 PM	16	16	0	14	55	0	34	13	0	148
04:15 PM	19	15	0	7	64	0	35	16	0	156
04:30 PM	18	13	0	14	70	0	39	20	0	174
04:45 PM	26	12	0	13	70	0	44	17	0	182
Total	79	56	0	48	259	0	152	66	0	660
05:00 PM	24	8	0	9	58	0	38	16	0	153
05:15 PM	25	6	0	11	63	0	41	16	0	162
05:30 PM	21	18	0	8	59	0	64	29	0	199
05:45 PM	17	14	0	16	50	0	49	26	0	172
Total	87	46	0	44	230	0	192	87	0	686
Grand Total	264	141	0	123	744	0	497	214	0	1983
Apprch %	65.2	34.8	0	14.2	85.8	0	69.9	30.1	0	
Total %	13.3	7.1	0	6.2	37.5	0	25.1	10.8	0	
Cars	261	139	0	120	733	0	490	213	0	1956
% Cars	98.9	98.6	0	97.6	98.5	0	98.6	99.5	0	98.6
Heavy Vehicles	3	2	0	3	11	0	7	1	0	27
% Heavy Vehicles	1.1	1.4	0	2.4	1.5	0	1.4	0.5	0	1.4

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	16	16	0	32	14	55	0	69	34	13	0	47	148
04:15 PM	19	15	0	34	7	64	0	71	35	16	0	51	156
04:30 PM	18	13	0	31	14	70	0	84	39	20	0	59	174
04:45 PM	26	12	0	38	13	70	0	83	44	17	0	61	182
Total Volume	79	56	0	135	48	259	0	307	152	66	0	218	660
% App. Total	58.5	41.5	0		15.6	84.4	0		69.7	30.3	0		
PHF	.760	.875	.000	.888	.857	.925	.000	.914	.864	.825	.000	.893	.907
Cars	79	54	0	133	46	255	0	301	150	66	0	216	650
% Cars	100	96.4	0	98.5	95.8	98.5	0	98.0	98.7	100	0	99.1	98.5
Heavy Vehicles	0	2	0	2	2	4	0	6	2	0	0	2	10
% Heavy Vehicles	0	3.6	0	1.5	4.2	1.5	0	2.0	1.3	0	0	0.9	1.5

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 AA
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars

	Freezer Road From North			Tupper Road From East			Tupper Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	28	7	0	7	60	0	39	17	0	158
03:15 PM	19	14	0	7	72	0	35	18	0	165
03:30 PM	27	9	0	11	47	0	35	13	0	142
03:45 PM	21	9	0	5	71	0	41	12	0	159
Total	95	39	0	30	250	0	150	60	0	624
04:00 PM	16	14	0	14	54	0	33	13	0	144
04:15 PM	19	15	0	7	63	0	35	16	0	155
04:30 PM	18	13	0	12	70	0	39	20	0	172
04:45 PM	26	12	0	13	68	0	43	17	0	179
Total	79	54	0	46	255	0	150	66	0	650
05:00 PM	24	8	0	9	57	0	38	16	0	152
05:15 PM	25	6	0	11	63	0	39	16	0	160
05:30 PM	21	18	0	8	59	0	64	29	0	199
05:45 PM	17	14	0	16	49	0	49	26	0	171
Total	87	46	0	44	228	0	190	87	0	682
Grand Total	261	139	0	120	733	0	490	213	0	1956
Apprch %	65.2	34.8	0	14.1	85.9	0	69.7	30.3	0	
Total %	13.3	7.1	0	6.1	37.5	0	25.1	10.9	0	

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	16	14	0	30	14	54	0	68	33	13	0	46	144
04:15 PM	19	15	0	34	7	63	0	70	35	16	0	51	155
04:30 PM	18	13	0	31	12	70	0	82	39	20	0	59	172
04:45 PM	26	12	0	38	13	68	0	81	43	17	0	60	179
Total Volume	79	54	0	133	46	255	0	301	150	66	0	216	650
% App. Total	59.4	40.6	0		15.3	84.7	0		69.4	30.6	0		
PHF	.760	.900	.000	.875	.821	.911	.000	.918	.872	.825	.000	.900	.908

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 AA
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Heavy Vehicles

	Freezer Road From North			Tupper Road From East			Tupper Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	0	0	0	0	3	0	2	0	0	5
03:15 PM	1	0	0	0	0	0	0	0	0	1
03:30 PM	1	0	0	0	0	0	0	1	0	2
03:45 PM	1	0	0	1	2	0	1	0	0	5
Total	3	0	0	1	5	0	3	1	0	13
04:00 PM	0	2	0	0	1	0	1	0	0	4
04:15 PM	0	0	0	0	1	0	0	0	0	1
04:30 PM	0	0	0	2	0	0	0	0	0	2
04:45 PM	0	0	0	0	2	0	1	0	0	3
Total	0	2	0	2	4	0	2	0	0	10
05:00 PM	0	0	0	0	1	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	2	0	0	2
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	1	0	0	0	0	1
Total	0	0	0	0	2	0	2	0	0	4
Grand Total	3	2	0	3	11	0	7	1	0	27
Apprch %	60	40	0	21.4	78.6	0	87.5	12.5	0	
Total %	11.1	7.4	0	11.1	40.7	0	25.9	3.7	0	

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	0	0	0	0	0	3	0	3	2	0	0	2	5
03:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
03:30 PM	1	0	0	1	0	0	0	0	0	1	0	1	2
03:45 PM	1	0	0	1	1	2	0	3	1	0	0	1	5
Total Volume	3	0	0	3	1	5	0	6	3	1	0	4	13
% App. Total	100	0	0		16.7	83.3	0		75	25	0		
PHF	.750	.000	.000	.750	.250	.417	.000	.500	.375	.250	.000	.500	.650

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION
D A T A
INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 AA
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Peds and Bikes

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	Peds EB	Peds WB	Right	Thru	Peds SB	Peds NB	Thru	Left	Peds NB	Peds SB	Int. Total
03:00 PM	0	0	0	0	1	2	0	0	0	0	0	0	3
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	4	0	1	5
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	2	0	0	0	4	0	1	8
04:00 PM	0	0	0	0	0	0	0	0	0	2	0	0	2
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	1	0	0	0	0	0	0	1
04:45 PM	0	0	1	0	1	0	0	0	0	0	0	0	2
Total	0	0	1	0	1	1	0	0	0	2	0	0	5
05:00 PM	1	1	0	0	1	1	0	0	0	0	0	0	4
05:15 PM	0	2	0	0	0	0	0	0	0	1	0	0	3
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	1	0	0	0	1	0	0	0	0	0	0	2
Total	1	4	0	0	1	2	0	0	0	1	0	0	9
Grand Total	1	4	1	0	3	5	0	0	0	7	0	1	22
Apprch %	16.7	66.7	16.7	0	37.5	62.5	0	0	0	87.5	0	12.5	
Total %	4.5	18.2	4.5	0	13.6	22.7	0	0	0	31.8	0	4.5	

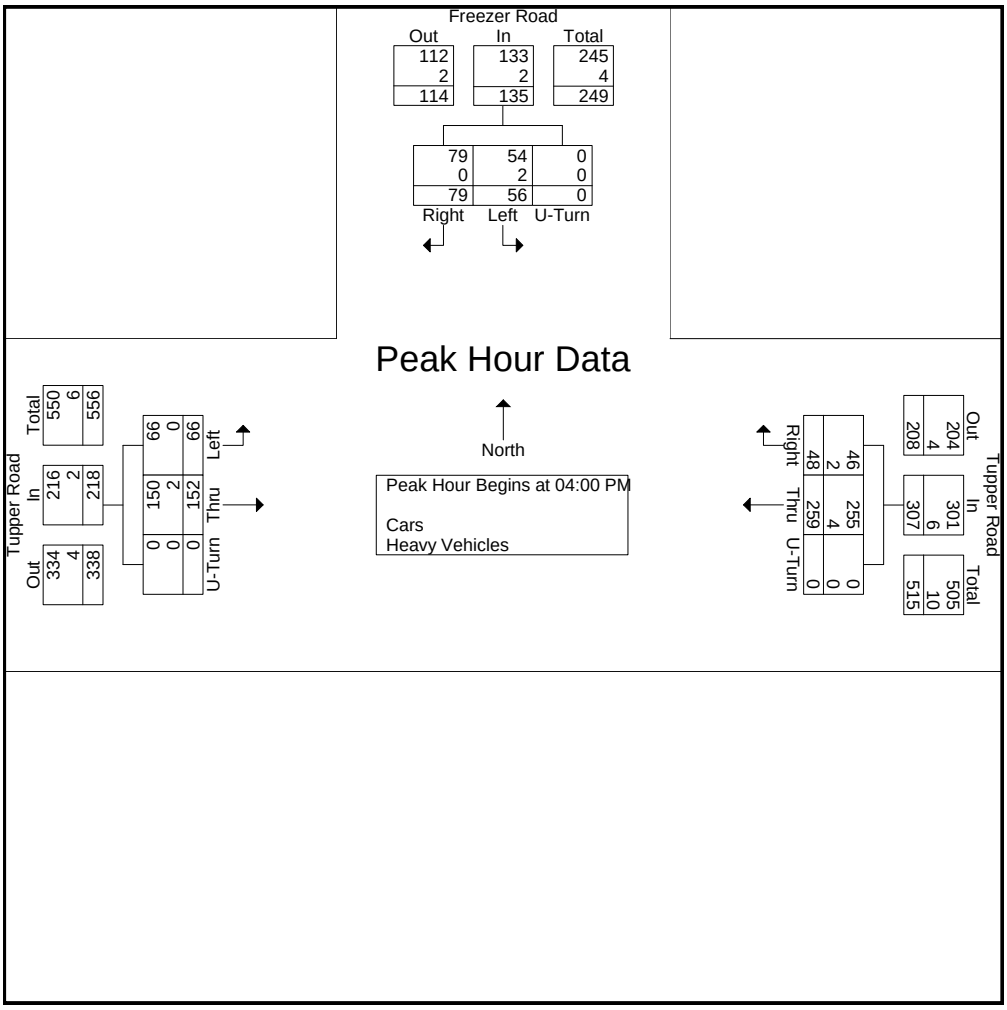
	Freezer Road From North					Tupper Road From East					Tupper Road From West					
Start Time	Right	Left	Peds EB	Peds WB	App. Total	Right	Thru	Peds SB	Peds NB	App. Total	Thru	Left	Peds NB	Peds SB	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																
Peak Hour for Entire Intersection Begins at 03:00 PM																
03:00 PM	0	0	0	0	0	1	2	0	0	3	0	0	0	0	0	3
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	4	0	1	5	5
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	1	2	0	0	3	0	4	0	1	5	8
% App. Total	0	0	0	0		33.3	66.7	0	0		0	80	0	20		
PHF	.000	.000	.000	.000	.000	.250	.250	.000	.000	.250	.000	.250	.000	.250	.250	.400

N: Freezer Road
E/W: Tupper Road
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 AA
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

	Freezer Road From North				Tupper Road From East				Tupper Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	16	16	0	32	14	55	0	69	34	13	0	47	148
04:15 PM	19	15	0	34	7	64	0	71	35	16	0	51	156
04:30 PM	18	13	0	31	14	70	0	84	39	20	0	59	174
04:45 PM	26	12	0	38	13	70	0	83	44	17	0	61	182
Total Volume	79	56	0	135	48	259	0	307	152	66	0	218	660
% App. Total	58.5	41.5	0		15.6	84.4	0		69.7	30.3	0		
PHF	.760	.875	.000	.888	.857	.925	.000	.914	.864	.825	.000	.893	.907
Cars	79	54	0	133	46	255	0	301	150	66	0	216	650
% Cars	100	96.4	0	98.5	95.8	98.5	0	98.0	98.7	100	0	99.1	98.5
Heavy Vehicles	0	2	0	2	2	4	0	6	2	0	0	2	10
% Heavy Vehicles	0	3.6	0	1.5	4.2	1.5	0	2.0	1.3	0	0	0.9	1.5



N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 B
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Tupper Road From North				Old Kings Highway (Route 6A) From East				Tupper Road From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	1	1	11	0	7	13	2	0	5	7	6	0	1	4	0	0	58
06:15 AM	0	1	7	0	16	24	2	0	6	14	6	0	4	10	0	0	90
06:30 AM	1	9	7	0	13	32	2	0	2	12	5	0	4	11	0	0	98
06:45 AM	0	9	14	0	19	32	6	0	8	24	4	0	3	24	0	0	143
Total	2	20	39	0	55	101	12	0	21	57	21	0	12	49	0	0	389
07:00 AM	0	12	18	0	32	43	4	0	10	13	13	0	2	18	0	0	165
07:15 AM	0	12	18	0	24	48	4	0	6	17	10	0	2	29	0	0	170
07:30 AM	2	15	14	0	25	49	6	0	5	18	14	0	7	38	0	0	193
07:45 AM	0	13	23	0	29	41	9	0	13	18	24	0	9	29	0	0	208
Total	2	52	73	0	110	181	23	0	34	66	61	0	20	114	0	0	736
08:00 AM	0	19	19	0	27	57	10	0	7	30	16	0	11	39	1	0	236
08:15 AM	1	18	21	0	35	55	7	0	11	21	23	0	9	46	0	0	247
08:30 AM	0	26	33	0	47	44	9	0	11	30	26	0	10	42	1	0	279
08:45 AM	1	25	30	0	40	59	5	0	13	32	25	0	17	44	3	0	294
Total	2	88	103	0	149	215	31	0	42	113	90	0	47	171	5	0	1056
Grand Total	6	160	215	0	314	497	66	0	97	236	172	0	79	334	5	0	2181
Apprch %	1.6	42	56.4	0	35.8	56.7	7.5	0	19.2	46.7	34.1	0	18.9	79.9	1.2	0	
Total %	0.3	7.3	9.9	0	14.4	22.8	3	0	4.4	10.8	7.9	0	3.6	15.3	0.2	0	
Cars	6	156	210	0	309	485	64	0	94	225	166	0	76	309	5	0	2105
% Cars	100	97.5	97.7	0	98.4	97.6	97	0	96.9	95.3	96.5	0	96.2	92.5	100	0	96.5
Heavy Vehicles	0	4	5	0	5	12	2	0	3	11	6	0	3	25	0	0	76
% Heavy Vehicles	0	2.5	2.3	0	1.6	2.4	3	0	3.1	4.7	3.5	0	3.8	7.5	0	0	3.5

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	0	12	18	0	30	32	43	4	0	79	10	13	13	0	36	2	18	0	0	20	165
07:15 AM	0	12	18	0	30	24	48	4	0	76	6	17	10	0	33	2	29	0	0	31	170
07:30 AM	2	15	14	0	31	25	49	6	0	80	5	18	14	0	37	7	38	0	0	45	193
07:45 AM	0	13	23	0	36	29	41	9	0	79	13	18	24	0	55	9	29	0	0	38	208
Total Volume	2	52	73	0	127	110	181	23	0	314	34	66	61	0	161	20	114	0	0	134	736
% App. Total	1.6	40.9	57.5	0		35	57.6	7.3	0		21.1	41	37.9	0		14.9	85.1	0	0		
PHF	.250	.867	.793	.000	.882	.859	.923	.639	.000	.981	.654	.917	.635	.000	.732	.556	.750	.000	.000	.744	.885
Cars	2	50	72	0	124	109	176	23	0	308	34	60	59	0	153	18	104	0	0	122	707
% Cars	100	96.2	98.6	0	97.6	99.1	97.2	100	0	98.1	100	90.9	96.7	0	95.0	90.0	91.2	0	0	91.0	96.1
Heavy Vehicles	0	2	1	0	3	1	5	0	0	6	0	6	2	0	8	2	10	0	0	12	29
% Heavy Vehicles	0	3.8	1.4	0	2.4	0.9	2.8	0	0	1.9	0	9.1	3.3	0	5.0	10.0	8.8	0	0	9.0	3.9

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 B
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars

	Tupper Road From North				Old Kings Highway (Route 6A) From East				Tupper Road From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	1	1	10	0	7	13	2	0	5	6	6	0	1	3	0	0	55
06:15 AM	0	1	7	0	16	24	2	0	6	13	5	0	4	10	0	0	88
06:30 AM	1	9	6	0	13	32	1	0	2	12	5	0	4	10	0	0	95
06:45 AM	0	9	14	0	18	32	5	0	7	24	4	0	3	20	0	0	136
Total	2	20	37	0	54	101	10	0	20	55	20	0	12	43	0	0	374
07:00 AM	0	12	18	0	32	42	4	0	10	12	12	0	1	18	0	0	161
07:15 AM	0	12	18	0	24	46	4	0	6	16	10	0	2	25	0	0	163
07:30 AM	2	14	13	0	25	47	6	0	5	17	13	0	7	34	0	0	183
07:45 AM	0	12	23	0	28	41	9	0	13	15	24	0	8	27	0	0	200
Total	2	50	72	0	109	176	23	0	34	60	59	0	18	104	0	0	707
08:00 AM	0	19	19	0	26	55	10	0	7	28	15	0	11	36	1	0	227
08:15 AM	1	17	19	0	35	52	7	0	11	20	22	0	9	45	0	0	238
08:30 AM	0	26	33	0	47	44	9	0	10	30	26	0	9	40	1	0	275
08:45 AM	1	24	30	0	38	57	5	0	12	32	24	0	17	41	3	0	284
Total	2	86	101	0	146	208	31	0	40	110	87	0	46	162	5	0	1024
Grand Total	6	156	210	0	309	485	64	0	94	225	166	0	76	309	5	0	2105
Apprch %	1.6	41.9	56.5	0	36	56.5	7.5	0	19.4	46.4	34.2	0	19.5	79.2	1.3	0	
Total %	0.3	7.4	10	0	14.7	23	3	0	4.5	10.7	7.9	0	3.6	14.7	0.2	0	

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	0	12	18	0	30	32	42	4	0	78	10	12	12	0	34	1	18	0	0	19	161
07:15 AM	0	12	18	0	30	24	46	4	0	74	6	16	10	0	32	2	25	0	0	27	163
07:30 AM	2	14	13	0	29	25	47	6	0	78	5	17	13	0	35	7	34	0	0	41	183
07:45 AM	0	12	23	0	35	28	41	9	0	78	13	15	24	0	52	8	27	0	0	35	200
Total Volume	2	50	72	0	124	109	176	23	0	308	34	60	59	0	153	18	104	0	0	122	707
% App. Total	1.6	40.3	58.1	0		35.4	57.1	7.5	0		22.2	39.2	38.6	0		14.8	85.2	0	0		
PHF	.250	.893	.783	.000	.886	.852	.936	.639	.000	.987	.654	.882	.615	.000	.736	.563	.765	.000	.000	.744	.884

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 B
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Heavy Vehicles

	Tupper Road From North				Old Kings Highway (Route 6A) From East				Tupper Road From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	3
06:15 AM	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
06:30 AM	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	3
06:45 AM	0	0	0	0	1	0	1	0	1	0	0	0	0	4	0	0	7
Total	0	0	2	0	1	0	2	0	1	2	1	0	0	6	0	0	15
07:00 AM	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	4
07:15 AM	0	0	0	0	0	2	0	0	0	1	0	0	0	4	0	0	7
07:30 AM	0	1	1	0	0	2	0	0	0	1	1	0	0	4	0	0	10
07:45 AM	0	1	0	0	1	0	0	0	0	3	0	0	1	2	0	0	8
Total	0	2	1	0	1	5	0	0	0	6	2	0	2	10	0	0	29
08:00 AM	0	0	0	0	1	2	0	0	0	2	1	0	0	3	0	0	9
08:15 AM	0	1	2	0	0	3	0	0	0	1	1	0	0	1	0	0	9
08:30 AM	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	4
08:45 AM	0	1	0	0	2	2	0	0	1	0	1	0	0	3	0	0	10
Total	0	2	2	0	3	7	0	0	2	3	3	0	1	9	0	0	32
Grand Total	0	4	5	0	5	12	2	0	3	11	6	0	3	25	0	0	76
Apprch %	0	44.4	55.6	0	26.3	63.2	10.5	0	15	55	30	0	10.7	89.3	0	0	
Total %	0	5.3	6.6	0	6.6	15.8	2.6	0	3.9	14.5	7.9	0	3.9	32.9	0	0	

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	0	0	0	0	0	0	1	0	0	1	0	1	1	0	2	1	0	0	0	1	4
07:15 AM	0	0	0	0	0	0	2	0	0	2	0	1	0	0	1	0	4	0	0	4	7
07:30 AM	0	1	1	0	2	0	2	0	0	2	0	1	1	0	2	0	4	0	0	4	10
07:45 AM	0	1	0	0	1	1	0	0	0	1	0	3	0	0	3	1	2	0	0	3	8
Total Volume	0	2	1	0	3	1	5	0	0	6	0	6	2	0	8	2	10	0	0	12	29
% App. Total	0	66.7	33.3	0		16.7	83.3	0	0		0	75	25	0		16.7	83.3	0	0		
PHF	.000	.500	.250	.000	.375	.250	.625	.000	.000	.750	.000	.500	.500	.000	.667	.500	.625	.000	.000	.750	.725

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 B
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Peds and Bikes

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	Peds EB	Peds WB	Right	Thru	Left	Peds SB	Peds NB	Right	Thru	Left	Peds WB	Peds EB	Right	Thru	Left	Peds NB	Peds SB	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4
07:00 AM	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
07:15 AM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
07:30 AM	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	1	0	0	1	2	0	0	0	0	0	0	1	0	0	0	6
08:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
08:15 AM	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
08:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	0	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	0	5
Grand Total	0	1	1	0	0	3	0	0	2	4	0	0	0	0	3	0	1	0	0	0	15
Apprch %	0	50	50	0	0	33.3	0	0	22.2	44.4	0	0	0	0	100	0	100	0	0	0	
Total %	0	6.7	6.7	0	0	20	0	0	13.3	26.7	0	0	0	0	20	0	6.7	0	0	0	

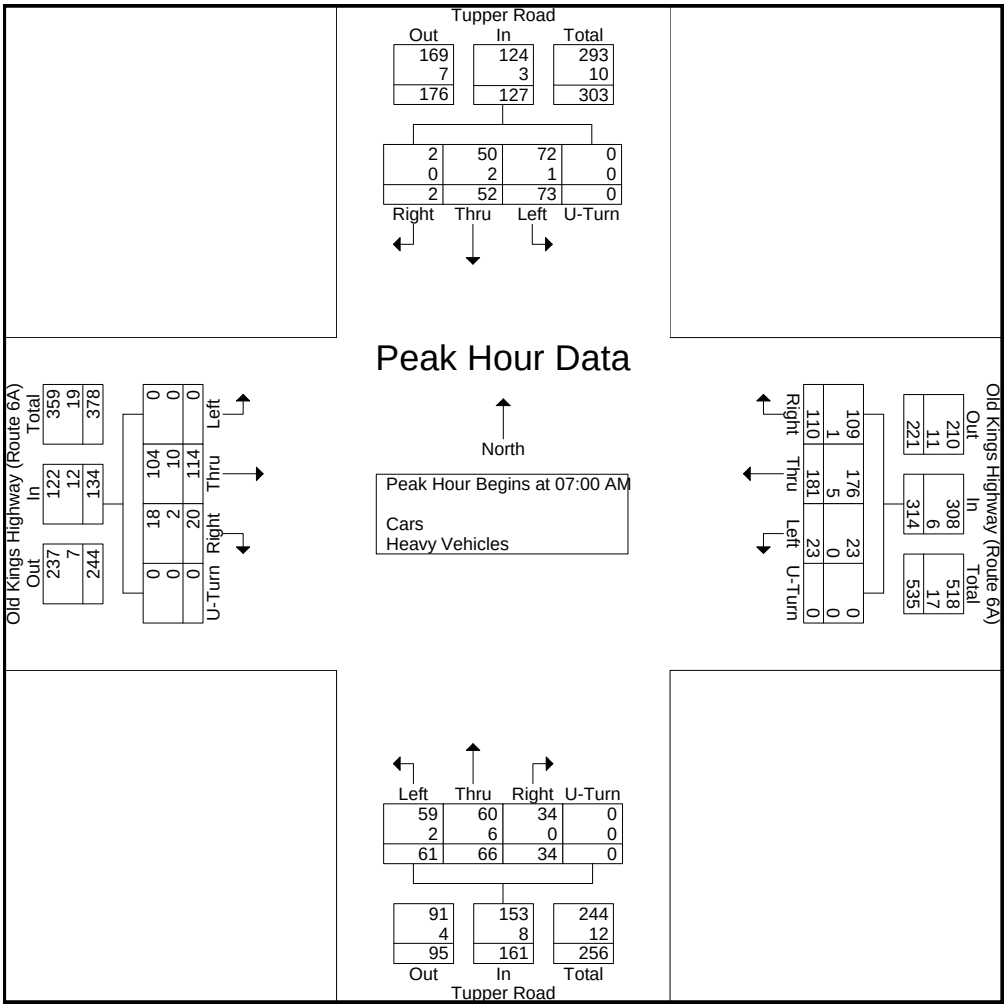
	Tupper Road From North						Old Kings Highway (Route 6A) From East						Tupper Road From South						Old Kings Highway (Route 6A) From West						
Start Time	Right	Thru	Left	Peds EB	Peds WB	App. Total	Right	Thru	Left	Peds SB	Peds NB	App. Total	Right	Thru	Left	Peds WB	Peds EB	App. Total	Right	Thru	Left	Peds NB	Peds SB	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																									
Peak Hour for Entire Intersection Begins at 06:45 AM																									
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
07:15 AM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
07:30 AM	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Total Volume	0	1	0	0	0	1	1	0	0	1	2	4	0	0	0	0	0	0	0	1	0	0	0	1	6
% App. Total	0	100	0	0	0		25	0	0	25	50		0	0	0	0	0		0	100	0	0	0		
PHF	.000	.250	.000	.000	.000	.250	.250	.000	.000	.250	.250	.500	.000	.000	.000	.000	.000	.000	.000	.250	.000	.000	.000	.250	.750

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 B
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	0	12	18	0	30	32	43	4	0	79	10	13	13	0	36	2	18	0	0	20	165
07:15 AM	0	12	18	0	30	24	48	4	0	76	6	17	10	0	33	2	29	0	0	31	170
07:30 AM	2	15	14	0	31	25	49	6	0	80	5	18	14	0	37	7	38	0	0	45	193
07:45 AM	0	13	23	0	36	29	41	9	0	79	13	18	24	0	55	9	29	0	0	38	208
Total Volume	2	52	73	0	127	110	181	23	0	314	34	66	61	0	161	20	114	0	0	134	736
% App. Total	1.6	40.9	57.5	0		35	57.6	7.3	0		21.1	41	37.9	0		14.9	85.1	0	0		
PHF	.250	.867	.793	.000	.882	.859	.923	.639	.000	.981	.654	.917	.635	.000	.732	.556	.750	.000	.000	.744	.885
Cars	2	50	72	0	124	109	176	23	0	308	34	60	59	0	153	18	104	0	0	122	707
% Cars	100	96.2	98.6	0	97.6	99.1	97.2	100	0	98.1	100	90.9	96.7	0	95.0	90.0	91.2	0	0	91.0	96.1
Heavy Vehicles	0	2	1	0	3	1	5	0	0	6	0	6	2	0	8	2	10	0	0	12	29
% Heavy Vehicles	0	3.8	1.4	0	2.4	0.9	2.8	0	0	1.9	0	9.1	3.3	0	5.0	10.0	8.8	0	0	9.0	3.9



N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 BB
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Tupper Road From North				Old Kings Highway (Route 6A) From East				Tupper Road From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
03:00 PM	5	36	46	0	51	65	6	0	12	27	32	0	20	62	2	0	364
03:15 PM	8	26	56	0	38	64	8	0	15	38	29	0	24	53	0	0	359
03:30 PM	2	35	42	0	42	64	8	0	12	36	22	0	29	49	1	0	342
03:45 PM	3	23	39	0	57	61	8	0	12	28	36	0	25	58	1	0	351
Total	18	120	183	0	188	254	30	0	51	129	119	0	98	222	4	0	1416
04:00 PM	3	34	39	1	50	62	10	0	8	32	16	0	22	83	1	0	361
04:15 PM	3	29	42	0	57	63	10	0	13	36	24	0	22	75	1	0	375
04:30 PM	4	41	50	0	56	64	6	0	10	51	24	0	25	59	3	0	393
04:45 PM	5	35	39	0	55	67	8	0	9	42	20	0	31	57	2	0	370
Total	15	139	170	1	218	256	34	0	40	161	84	0	100	274	7	0	1499
05:00 PM	2	26	43	0	41	57	6	0	6	45	28	0	31	57	0	0	342
05:15 PM	2	17	36	0	63	68	8	0	11	43	24	0	25	73	0	0	370
05:30 PM	4	26	58	0	51	56	2	0	5	46	25	0	18	44	2	0	337
05:45 PM	1	30	38	0	50	54	6	0	8	36	14	0	13	68	4	0	322
Total	9	99	175	0	205	235	22	0	30	170	91	0	87	242	6	0	1371
Grand Total	42	358	528	1	611	745	86	0	121	460	294	0	285	738	17	0	4286
Apprch %	4.5	38.5	56.8	0.1	42.4	51.7	6	0	13.8	52.6	33.6	0	27.4	71	1.6	0	
Total %	1	8.4	12.3	0	14.3	17.4	2	0	2.8	10.7	6.9	0	6.6	17.2	0.4	0	
Cars	42	355	524	1	602	727	84	0	121	456	288	0	282	730	17	0	4229
% Cars	100	99.2	99.2	100	98.5	97.6	97.7	0	100	99.1	98	0	98.9	98.9	100	0	98.7
Heavy Vehicles	0	3	4	0	9	18	2	0	0	4	6	0	3	8	0	0	57
% Heavy Vehicles	0	0.8	0.8	0	1.5	2.4	2.3	0	0	0.9	2	0	1.1	1.1	0	0	1.3

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	3	34	39	1	77	50	62	10	0	122	8	32	16	0	56	22	83	1	0	106	361
04:15 PM	3	29	42	0	74	57	63	10	0	130	13	36	24	0	73	22	75	1	0	98	375
04:30 PM	4	41	50	0	95	56	64	6	0	126	10	51	24	0	85	25	59	3	0	87	393
04:45 PM	5	35	39	0	79	55	67	8	0	130	9	42	20	0	71	31	57	2	0	90	370
Total Volume	15	139	170	1	325	218	256	34	0	508	40	161	84	0	285	100	274	7	0	381	1499
% App. Total	4.6	42.8	52.3	0.3		42.9	50.4	6.7	0		14	56.5	29.5	0		26.2	71.9	1.8	0		
PHF	.750	.848	.850	.250	.855	.956	.955	.850	.000	.977	.769	.789	.875	.000	.838	.806	.825	.583	.000	.899	.954
Cars	15	139	168	1	323	213	251	34	0	498	40	161	81	0	282	98	271	7	0	376	1479
% Cars	100	100	98.8	100	99.4	97.7	98.0	100	0	98.0	100	100	96.4	0	98.9	98.0	98.9	100	0	98.7	98.7
Heavy Vehicles	0	0	2	0	2	5	5	0	0	10	0	0	3	0	3	2	3	0	0	5	20
% Heavy Vehicles	0	0	1.2	0	0.6	2.3	2.0	0	0	2.0	0	0	3.6	0	1.1	2.0	1.1	0	0	1.3	1.3

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 BB
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars

	Tupper Road From North				Old Kings Highway (Route 6A) From East				Tupper Road From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
03:00 PM	5	35	45	0	50	62	6	0	12	27	31	0	20	61	2	0	356
03:15 PM	8	24	56	0	38	61	8	0	15	36	29	0	24	53	0	0	352
03:30 PM	2	35	42	0	41	62	8	0	12	36	21	0	29	49	1	0	338
03:45 PM	3	23	39	0	56	59	7	0	12	27	36	0	25	57	1	0	345
Total	18	117	182	0	185	244	29	0	51	126	117	0	98	220	4	0	1391
04:00 PM	3	34	38	1	49	61	10	0	8	32	15	0	21	81	1	0	354
04:15 PM	3	29	42	0	55	61	10	0	13	36	23	0	21	74	1	0	368
04:30 PM	4	41	50	0	55	63	6	0	10	51	23	0	25	59	3	0	390
04:45 PM	5	35	38	0	54	66	8	0	9	42	20	0	31	57	2	0	367
Total	15	139	168	1	213	251	34	0	40	161	81	0	98	271	7	0	1479
05:00 PM	2	26	43	0	41	56	6	0	6	44	27	0	31	56	0	0	338
05:15 PM	2	17	35	0	63	68	7	0	11	43	24	0	24	73	0	0	367
05:30 PM	4	26	58	0	51	56	2	0	5	46	25	0	18	44	2	0	337
05:45 PM	1	30	38	0	49	52	6	0	8	36	14	0	13	66	4	0	317
Total	9	99	174	0	204	232	21	0	30	169	90	0	86	239	6	0	1359
Grand Total	42	355	524	1	602	727	84	0	121	456	288	0	282	730	17	0	4229
Apprch %	4.6	38.5	56.8	0.1	42.6	51.5	5.9	0	14	52.7	33.3	0	27.4	70.9	1.7	0	
Total %	1	8.4	12.4	0	14.2	17.2	2	0	2.9	10.8	6.8	0	6.7	17.3	0.4	0	

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	3	34	38	1	76	49	61	10	0	120	8	32	15	0	55	21	81	1	0	103	354
04:15 PM	3	29	42	0	74	55	61	10	0	126	13	36	23	0	72	21	74	1	0	96	368
04:30 PM	4	41	50	0	95	55	63	6	0	124	10	51	23	0	84	25	59	3	0	87	390
04:45 PM	5	35	38	0	78	54	66	8	0	128	9	42	20	0	71	31	57	2	0	90	367
Total Volume	15	139	168	1	323	213	251	34	0	498	40	161	81	0	282	98	271	7	0	376	1479
% App. Total	4.6	43	52	0.3		42.8	50.4	6.8	0		14.2	57.1	28.7	0		26.1	72.1	1.9	0		
PHF	.750	.848	.840	.250	.850	.968	.951	.850	.000	.973	.769	.789	.880	.000	.839	.790	.836	.583	.000	.913	.948

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 BB
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Heavy Vehicles

	Tupper Road From North				Old Kings Highway (Route 6A) From East				Tupper Road From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
03:00 PM	0	1	1	0	1	3	0	0	0	0	1	0	0	1	0	0	8
03:15 PM	0	2	0	0	0	3	0	0	0	2	0	0	0	0	0	0	7
03:30 PM	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	4
03:45 PM	0	0	0	0	1	2	1	0	0	1	0	0	0	1	0	0	6
Total	0	3	1	0	3	10	1	0	0	3	2	0	0	2	0	0	25
04:00 PM	0	0	1	0	1	1	0	0	0	0	1	0	1	2	0	0	7
04:15 PM	0	0	0	0	2	2	0	0	0	0	1	0	1	1	0	0	7
04:30 PM	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	3
04:45 PM	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	3
Total	0	0	2	0	5	5	0	0	0	0	3	0	2	3	0	0	20
05:00 PM	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	4
05:15 PM	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	3
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	1	2	0	0	0	0	0	0	0	2	0	0	5
Total	0	0	1	0	1	3	1	0	0	1	1	0	1	3	0	0	12
Grand Total	0	3	4	0	9	18	2	0	0	4	6	0	3	8	0	0	57
Apprch %	0	42.9	57.1	0	31	62.1	6.9	0	0	40	60	0	27.3	72.7	0	0	
Total %	0	5.3	7	0	15.8	31.6	3.5	0	0	7	10.5	0	5.3	14	0	0	

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	0	1	1	0	2	1	3	0	0	4	0	0	1	0	1	0	1	0	0	1	8
03:15 PM	0	2	0	0	2	0	3	0	0	3	0	2	0	0	2	0	0	0	0	0	7
03:30 PM	0	0	0	0	0	1	2	0	0	3	0	0	1	0	1	0	0	0	0	0	4
03:45 PM	0	0	0	0	0	1	2	1	0	4	0	1	0	0	1	0	1	0	0	1	6
Total Volume	0	3	1	0	4	3	10	1	0	14	0	3	2	0	5	0	2	0	0	2	25
% App. Total	0	75	25	0		21.4	71.4	7.1	0		0	60	40	0		0	100	0	0		
PHF	.000	.375	.250	.000	.500	.750	.833	.250	.000	.875	.000	.375	.500	.000	.625	.000	.500	.000	.000	.500	.781

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 BB
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Peds and Bikes

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	Peds EB	Peds WB	Right	Thru	Left	Peds SB	Peds NB	Right	Thru	Left	Peds WB	Peds EB	Right	Thru	Left	Peds NB	Peds SB	Int. Total
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:30 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	3
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	4
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Total	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	4
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
05:15 PM	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	3
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	0	3	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	6
Grand Total	0	3	0	0	0	1	0	0	3	2	0	2	0	1	1	0	0	0	0	1	14
Apprch %	0	100	0	0	0	16.7	0	0	50	33.3	0	50	0	25	25	0	0	0	0	100	
Total %	0	21.4	0	0	0	7.1	0	0	21.4	14.3	0	14.3	0	7.1	7.1	0	0	0	0	7.1	

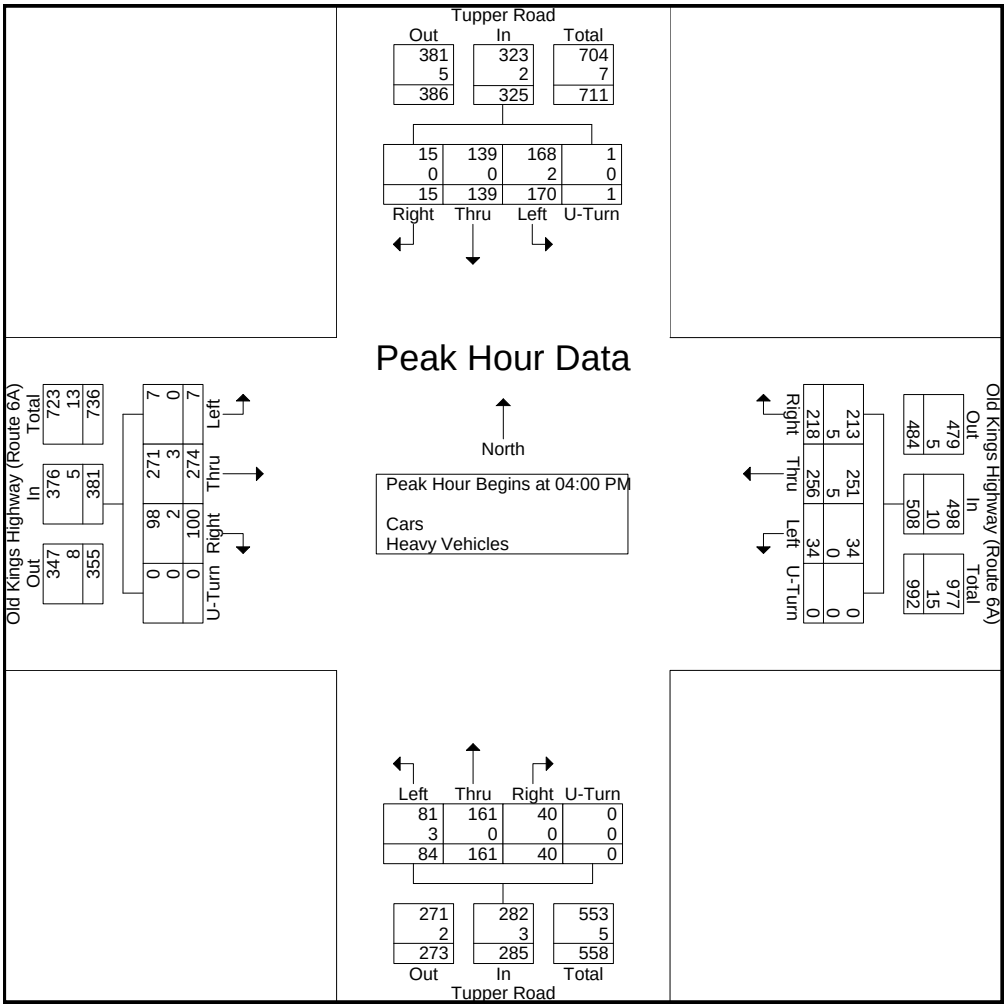
	Tupper Road From North						Old Kings Highway (Route 6A) From East						Tupper Road From South						Old Kings Highway (Route 6A) From West						
Start Time	Right	Thru	Left	Peds EB	Peds WB	App. Total	Right	Thru	Left	Peds SB	Peds NB	App. Total	Right	Thru	Left	Peds WB	Peds EB	App. Total	Right	Thru	Left	Peds NB	Peds SB	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																									
Peak Hour for Entire Intersection Begins at 03:00 PM																									
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
03:30 PM	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	1	1	3
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	1	1	4
% App. Total	0	0	0	0	0		0	0	0	100	0		0	0	0	0	0		0	0	0	0	100		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.375	.000	.375	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250	.250	.333

N/S: Tupper Road
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 BB
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

	Tupper Road From North					Old Kings Highway (Route 6A) From East					Tupper Road From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	3	34	39	1	77	50	62	10	0	122	8	32	16	0	56	22	83	1	0	106	361
04:15 PM	3	29	42	0	74	57	63	10	0	130	13	36	24	0	73	22	75	1	0	98	375
04:30 PM	4	41	50	0	95	56	64	6	0	126	10	51	24	0	85	25	59	3	0	87	393
04:45 PM	5	35	39	0	79	55	67	8	0	130	9	42	20	0	71	31	57	2	0	90	370
Total Volume	15	139	170	1	325	218	256	34	0	508	40	161	84	0	285	100	274	7	0	381	1499
% App. Total	4.6	42.8	52.3	0.3		42.9	50.4	6.7	0		14	56.5	29.5	0		26.2	71.9	1.8	0		
PHF	.750	.848	.850	.250	.855	.956	.955	.850	.000	.977	.769	.789	.875	.000	.838	.806	.825	.583	.000	.899	.954
Cars	15	139	168	1	323	213	251	34	0	498	40	161	81	0	282	98	271	7	0	376	1479
% Cars	100	100	98.8	100	99.4	97.7	98.0	100	0	98.0	100	100	96.4	0	98.9	98.0	98.9	100	0	98.7	98.7
Heavy Vehicles	0	0	2	0	2	5	5	0	0	10	0	0	3	0	3	2	3	0	0	5	20
% Heavy Vehicles	0	0	1.2	0	0.6	2.3	2.0	0	0	2.0	0	0	3.6	0	1.1	2.0	1.1	0	0	1.3	1.3



N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 C
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Tupper Road (West) From North				Old Kings Highway (Route 6A) From East				Route 130 From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	12	0	0	0	0	19	0	0	0	0	14	0	6	11	4	0	66
06:15 AM	21	0	0	0	0	32	1	0	1	0	19	0	7	10	16	0	107
06:30 AM	14	0	0	0	0	32	0	0	0	0	23	0	5	19	16	0	109
06:45 AM	15	1	0	0	0	40	1	0	1	1	19	0	13	33	22	0	146
Total	62	1	0	0	0	123	2	0	2	1	75	0	31	73	58	0	428
07:00 AM	22	1	0	0	0	54	1	0	0	0	18	0	12	22	19	0	149
07:15 AM	24	0	0	0	0	61	0	0	2	0	20	0	4	45	17	0	173
07:30 AM	27	1	1	0	0	54	1	0	0	1	29	0	7	49	10	0	180
07:45 AM	20	0	0	0	0	53	2	0	3	0	32	0	19	36	17	0	182
Total	93	2	1	0	0	222	4	0	5	1	99	0	42	152	63	0	684
08:00 AM	19	0	0	0	0	56	1	0	0	3	32	0	23	52	20	0	206
08:15 AM	28	1	0	0	0	66	0	0	2	1	24	0	8	58	33	0	221
08:30 AM	34	0	1	0	0	47	0	0	2	2	27	0	20	51	22	0	206
08:45 AM	26	1	1	0	0	56	1	0	1	0	44	0	17	60	25	0	232
Total	107	2	2	0	0	225	2	0	5	6	127	0	68	221	100	0	865
Grand Total	262	5	3	0	0	570	8	0	12	8	301	0	141	446	221	0	1977
Apprch %	97	1.9	1.1	0	0	98.6	1.4	0	3.7	2.5	93.8	0	17.5	55.2	27.4	0	
Total %	13.3	0.3	0.2	0	0	28.8	0.4	0	0.6	0.4	15.2	0	7.1	22.6	11.2	0	
Cars	252	5	3	0	0	550	8	0	11	7	291	0	135	415	214	0	1891
% Cars	96.2	100	100	0	0	96.5	100	0	91.7	87.5	96.7	0	95.7	93	96.8	0	95.6
Heavy Vehicles	10	0	0	0	0	20	0	0	1	1	10	0	6	31	7	0	86
% Heavy Vehicles	3.8	0	0	0	0	3.5	0	0	8.3	12.5	3.3	0	4.3	7	3.2	0	4.4

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	22	1	0	0	23	0	54	1	0	55	0	0	18	0	18	12	22	19	0	53	149
07:15 AM	24	0	0	0	24	0	61	0	0	61	2	0	20	0	22	4	45	17	0	66	173
07:30 AM	27	1	1	0	29	0	54	1	0	55	0	1	29	0	30	7	49	10	0	66	180
07:45 AM	20	0	0	0	20	0	53	2	0	55	3	0	32	0	35	19	36	17	0	72	182
Total Volume	93	2	1	0	96	0	222	4	0	226	5	1	99	0	105	42	152	63	0	257	684
% App. Total	96.9	2.1	1	0		0	98.2	1.8	0		4.8	1	94.3	0		16.3	59.1	24.5	0		
PHF	.861	.500	.250	.000	.828	.000	.910	.500	.000	.926	.417	.250	.773	.000	.750	.553	.776	.829	.000	.892	.940
Cars	88	2	1	0	91	0	215	4	0	219	4	1	97	0	102	40	139	62	0	241	653
% Cars	94.6	100	100	0	94.8	0	96.8	100	0	96.9	80.0	100	98.0	0	97.1	95.2	91.4	98.4	0	93.8	95.5
Heavy Vehicles	5	0	0	0	5	0	7	0	0	7	1	0	2	0	3	2	13	1	0	16	31
% Heavy Vehicles	5.4	0	0	0	5.2	0	3.2	0	0	3.1	20.0	0	2.0	0	2.9	4.8	8.6	1.6	0	6.2	4.5

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 C
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars

	Tupper Road (West) From North				Old Kings Highway (Route 6A) From East				Route 130 From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	11	0	0	0	0	19	0	0	0	0	13	0	4	10	4	0	61
06:15 AM	21	0	0	0	0	28	1	0	1	0	18	0	6	9	15	0	99
06:30 AM	14	0	0	0	0	32	0	0	0	0	23	0	5	19	16	0	109
06:45 AM	15	1	0	0	0	40	1	0	1	1	19	0	12	29	22	0	141
Total	61	1	0	0	0	119	2	0	2	1	73	0	27	67	57	0	410
07:00 AM	21	1	0	0	0	53	1	0	0	0	18	0	11	20	19	0	144
07:15 AM	24	0	0	0	0	58	0	0	2	0	18	0	4	42	16	0	164
07:30 AM	27	1	1	0	0	51	1	0	0	1	29	0	6	45	10	0	172
07:45 AM	16	0	0	0	0	53	2	0	2	0	32	0	19	32	17	0	173
Total	88	2	1	0	0	215	4	0	4	1	97	0	40	139	62	0	653
08:00 AM	18	0	0	0	0	53	1	0	0	2	31	0	23	49	18	0	195
08:15 AM	28	1	0	0	0	64	0	0	2	1	24	0	8	54	33	0	215
08:30 AM	32	0	1	0	0	46	0	0	2	2	24	0	20	48	22	0	197
08:45 AM	25	1	1	0	0	53	1	0	1	0	42	0	17	58	22	0	221
Total	103	2	2	0	0	216	2	0	5	5	121	0	68	209	95	0	828
Grand Total	252	5	3	0	0	550	8	0	11	7	291	0	135	415	214	0	1891
Apprch %	96.9	1.9	1.2	0	0	98.6	1.4	0	3.6	2.3	94.2	0	17.7	54.3	28	0	
Total %	13.3	0.3	0.2	0	0	29.1	0.4	0	0.6	0.4	15.4	0	7.1	21.9	11.3	0	

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	21	1	0	0	22	0	53	1	0	54	0	0	18	0	18	11	20	19	0	50	144
07:15 AM	24	0	0	0	24	0	58	0	0	58	2	0	18	0	20	4	42	16	0	62	164
07:30 AM	27	1	1	0	29	0	51	1	0	52	0	1	29	0	30	6	45	10	0	61	172
07:45 AM	16	0	0	0	16	0	53	2	0	55	2	0	32	0	34	19	32	17	0	68	173
Total Volume	88	2	1	0	91	0	215	4	0	219	4	1	97	0	102	40	139	62	0	241	653
% App. Total	96.7	2.2	1.1	0		0	98.2	1.8	0		3.9	1	95.1	0		16.6	57.7	25.7	0		
PHF	.815	.500	.250	.000	.784	.000	.927	.500	.000	.944	.500	.250	.758	.000	.750	.526	.772	.816	.000	.886	.944

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 C
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Heavy Vehicles

	Tupper Road (West) From North				Old Kings Highway (Route 6A) From East				Route 130 From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	1	0	0	0	0	0	0	0	0	0	1	0	2	1	0	0	5
06:15 AM	0	0	0	0	0	4	0	0	0	0	1	0	1	1	1	0	8
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	5
Total	1	0	0	0	0	4	0	0	0	0	2	0	4	6	1	0	18
07:00 AM	1	0	0	0	0	1	0	0	0	0	0	0	1	2	0	0	5
07:15 AM	0	0	0	0	0	3	0	0	0	0	2	0	0	3	1	0	9
07:30 AM	0	0	0	0	0	3	0	0	0	0	0	0	1	4	0	0	8
07:45 AM	4	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0	9
Total	5	0	0	0	0	7	0	0	1	0	2	0	2	13	1	0	31
08:00 AM	1	0	0	0	0	3	0	0	0	1	1	0	0	3	2	0	11
08:15 AM	0	0	0	0	0	2	0	0	0	0	0	0	0	4	0	0	6
08:30 AM	2	0	0	0	0	1	0	0	0	0	3	0	0	3	0	0	9
08:45 AM	1	0	0	0	0	3	0	0	0	0	2	0	0	2	3	0	11
Total	4	0	0	0	0	9	0	0	0	1	6	0	0	12	5	0	37
Grand Total	10	0	0	0	0	20	0	0	1	1	10	0	6	31	7	0	86
Apprch %	100	0	0	0	0	100	0	0	8.3	8.3	83.3	0	13.6	70.5	15.9	0	
Total %	11.6	0	0	0	0	23.3	0	0	1.2	1.2	11.6	0	7	36	8.1	0	

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	2	0	0	3	5
07:15 AM	0	0	0	0	0	0	3	0	0	3	0	0	2	0	2	0	3	1	0	4	9
07:30 AM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	1	4	0	0	5	8
07:45 AM	4	0	0	0	4	0	0	0	0	0	1	0	0	0	1	0	4	0	0	4	9
Total Volume	5	0	0	0	5	0	7	0	0	7	1	0	2	0	3	2	13	1	0	16	31
% App. Total	100	0	0	0		0	100	0	0		33.3	0	66.7	0		12.5	81.2	6.2	0		
PHF	.313	.000	.000	.000	.313	.000	.583	.000	.000	.583	.250	.000	.250	.000	.375	.500	.813	.250	.000	.800	.861

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 C
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Peds and Bikes

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	Peds EB	Peds WB	Right	Thru	Left	Peds SB	Peds NB	Right	Thru	Left	Peds WB	Peds EB	Right	Thru	Left	Peds NB	Peds SB	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	1	0	0	0	5
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	1	0	0	0	5
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Grand Total	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	2	1	0	0	0	8
Apprch %	0	100	0	0	0	0	0	0	0	0	0	100	0	0	0	66.7	33.3	0	0	0	
Total %	0	25	0	0	0	0	0	0	0	0	0	37.5	0	0	0	25	12.5	0	0	0	

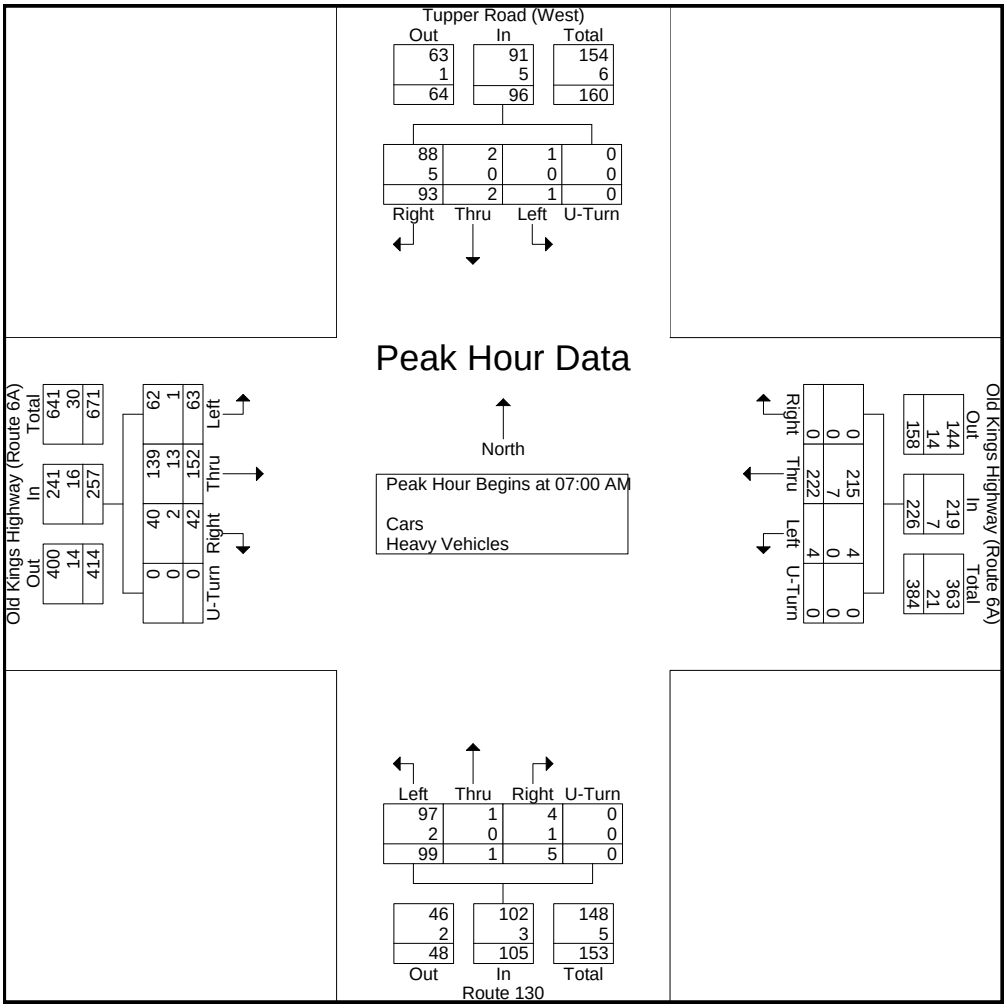
	Tupper Road (West) From North						Old Kings Highway (Route 6A) From East						Route 130 From South						Old Kings Highway (Route 6A) From West						
Start Time	Right	Thru	Left	Peds EB	Peds WB	App. Total	Right	Thru	Left	Peds SB	Peds NB	App. Total	Right	Thru	Left	Peds WB	Peds EB	App. Total	Right	Thru	Left	Peds NB	Peds SB	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																									
Peak Hour for Entire Intersection Begins at 06:30 AM																									
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	1	0	0	0	3	5
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	1	0	0	0	3	5
% App. Total	0	0	0	0	0		0	0	0	0	0		0	100	0	0	0		66.7	33.3	0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250	.000	.000	.000	.250	.250	.250	.000	.000	.000	.250	.250

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 C
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 07:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	22	1	0	0	23	0	54	1	0	55	0	0	18	0	18	12	22	19	0	53	149
07:15 AM	24	0	0	0	24	0	61	0	0	61	2	0	20	0	22	4	45	17	0	66	173
07:30 AM	27	1	1	0	29	0	54	1	0	55	0	1	29	0	30	7	49	10	0	66	180
07:45 AM	20	0	0	0	20	0	53	2	0	55	3	0	32	0	35	19	36	17	0	72	182
Total Volume	93	2	1	0	96	0	222	4	0	226	5	1	99	0	105	42	152	63	0	257	684
% App. Total	96.9	2.1	1	0		0	98.2	1.8	0		4.8	1	94.3	0		16.3	59.1	24.5	0		
PHF	.861	.500	.250	.000	.828	.000	.910	.500	.000	.926	.417	.250	.773	.000	.750	.553	.776	.829	.000	.892	.940
Cars	88	2	1	0	91	0	215	4	0	219	4	1	97	0	102	40	139	62	0	241	653
% Cars	94.6	100	100	0	94.8	0	96.8	100	0	96.9	80.0	100	98.0	0	97.1	95.2	91.4	98.4	0	93.8	95.5
Heavy Vehicles	5	0	0	0	5	0	7	0	0	7	1	0	2	0	3	2	13	1	0	16	31
% Heavy Vehicles	5.4	0	0	0	5.2	0	3.2	0	0	3.1	20.0	0	2.0	0	2.9	4.8	8.6	1.6	0	6.2	4.5



N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 CC
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Tupper Road (West) From North				Old Kings Highway (Route 6A) From East				Route 130 From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
03:00 PM	59	1	3	0	0	101	4	0	4	3	32	0	20	63	23	0	313
03:15 PM	34	2	1	0	0	76	3	0	4	2	31	0	22	47	18	0	240
03:30 PM	45	0	1	0	0	95	4	0	3	2	27	0	28	66	21	0	292
03:45 PM	57	2	1	1	0	79	2	0	11	0	30	0	23	76	22	0	304
Total	195	5	6	1	0	351	13	0	22	7	120	0	93	252	84	0	1149
04:00 PM	34	1	0	0	0	85	1	0	0	3	31	0	25	90	21	0	291
04:15 PM	46	2	1	0	0	84	1	0	3	0	39	0	38	67	24	0	305
04:30 PM	46	2	3	0	0	92	1	0	5	4	46	0	37	63	32	0	331
04:45 PM	39	2	2	0	0	95	2	0	4	0	42	0	33	76	32	0	327
Total	165	7	6	0	0	356	5	0	12	7	158	0	133	296	109	0	1254
05:00 PM	50	3	0	0	0	78	1	0	2	3	28	0	28	54	24	0	271
05:15 PM	43	4	0	0	0	74	4	0	5	0	35	0	29	68	28	0	290
05:30 PM	37	2	2	0	0	102	1	0	2	7	25	0	27	53	43	0	301
05:45 PM	25	3	0	0	0	68	2	0	2	4	32	0	35	72	41	0	284
Total	155	12	2	0	0	322	8	0	11	14	120	0	119	247	136	0	1146
Grand Total	515	24	14	1	0	1029	26	0	45	28	398	0	345	795	329	0	3549
Apprch %	93	4.3	2.5	0.2	0	97.5	2.5	0	9.6	5.9	84.5	0	23.5	54.1	22.4	0	
Total %	14.5	0.7	0.4	0	0	29	0.7	0	1.3	0.8	11.2	0	9.7	22.4	9.3	0	
Cars	505	24	14	1	0	1005	26	0	44	28	391	0	343	782	326	0	3489
% Cars	98.1	100	100	100	0	97.7	100	0	97.8	100	98.2	0	99.4	98.4	99.1	0	98.3
Heavy Vehicles	10	0	0	0	0	24	0	0	1	0	7	0	2	13	3	0	60
% Heavy Vehicles	1.9	0	0	0	0	2.3	0	0	2.2	0	1.8	0	0.6	1.6	0.9	0	1.7

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	34	1	0	0	35	0	85	1	0	86	0	3	31	0	34	25	90	21	0	136	291
04:15 PM	46	2	1	0	49	0	84	1	0	85	3	0	39	0	42	38	67	24	0	129	305
04:30 PM	46	2	3	0	51	0	92	1	0	93	5	4	46	0	55	37	63	32	0	132	331
04:45 PM	39	2	2	0	43	0	95	2	0	97	4	0	42	0	46	33	76	32	0	141	327
Total Volume	165	7	6	0	178	0	356	5	0	361	12	7	158	0	177	133	296	109	0	538	1254
% App. Total	92.7	3.9	3.4	0		0	98.6	1.4	0		6.8	4	89.3	0		24.7	55	20.3	0		
PHF	.897	.875	.500	.000	.873	.000	.937	.625	.000	.930	.600	.438	.859	.000	.805	.875	.822	.852	.000	.954	.947
Cars	165	7	6	0	178	0	348	5	0	353	12	7	157	0	176	133	289	107	0	529	1236
% Cars	100	100	100	0	100	0	97.8	100	0	97.8	100	100	99.4	0	99.4	100	97.6	98.2	0	98.3	98.6
Heavy Vehicles	0	0	0	0	0	0	8	0	0	8	0	0	1	0	1	0	7	2	0	9	18
% Heavy Vehicles	0	0	0	0	0	0	2.2	0	0	2.2	0	0	0.6	0	0.6	0	2.4	1.8	0	1.7	1.4

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 CC
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Cars

	Tupper Road (West) From North				Old Kings Highway (Route 6A) From East				Route 130 From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
03:00 PM	55	1	3	0	0	99	4	0	4	3	29	0	20	62	22	0	302
03:15 PM	34	2	1	0	0	70	3	0	4	2	30	0	22	47	18	0	233
03:30 PM	44	0	1	0	0	90	4	0	3	2	25	0	27	66	21	0	283
03:45 PM	55	2	1	1	0	77	2	0	11	0	30	0	23	75	22	0	299
Total	188	5	6	1	0	336	13	0	22	7	114	0	92	250	83	0	1117
04:00 PM	34	1	0	0	0	83	1	0	0	3	30	0	25	86	21	0	284
04:15 PM	46	2	1	0	0	83	1	0	3	0	39	0	38	66	24	0	303
04:30 PM	46	2	3	0	0	89	1	0	5	4	46	0	37	62	32	0	327
04:45 PM	39	2	2	0	0	93	2	0	4	0	42	0	33	75	30	0	322
Total	165	7	6	0	0	348	5	0	12	7	157	0	133	289	107	0	1236
05:00 PM	49	3	0	0	0	78	1	0	2	3	28	0	28	52	24	0	268
05:15 PM	42	4	0	0	0	74	4	0	5	0	35	0	28	68	28	0	288
05:30 PM	37	2	2	0	0	102	1	0	2	7	25	0	27	53	43	0	301
05:45 PM	24	3	0	0	0	67	2	0	1	4	32	0	35	70	41	0	279
Total	152	12	2	0	0	321	8	0	10	14	120	0	118	243	136	0	1136
Grand Total	505	24	14	1	0	1005	26	0	44	28	391	0	343	782	326	0	3489
Apprch %	92.8	4.4	2.6	0.2	0	97.5	2.5	0	9.5	6	84.4	0	23.6	53.9	22.5	0	
Total %	14.5	0.7	0.4	0	0	28.8	0.7	0	1.3	0.8	11.2	0	9.8	22.4	9.3	0	

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	34	1	0	0	35	0	83	1	0	84	0	3	30	0	33	25	86	21	0	132	284
04:15 PM	46	2	1	0	49	0	83	1	0	84	3	0	39	0	42	38	66	24	0	128	303
04:30 PM	46	2	3	0	51	0	89	1	0	90	5	4	46	0	55	37	62	32	0	131	327
04:45 PM	39	2	2	0	43	0	93	2	0	95	4	0	42	0	46	33	75	30	0	138	322
Total Volume	165	7	6	0	178	0	348	5	0	353	12	7	157	0	176	133	289	107	0	529	1236
% App. Total	92.7	3.9	3.4	0		0	98.6	1.4	0		6.8	4	89.2	0		25.1	54.6	20.2	0		
PHF	.897	.875	.500	.000	.873	.000	.935	.625	.000	.929	.600	.438	.853	.000	.800	.875	.840	.836	.000	.958	.945

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 CC
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Heavy Vehicles

	Tupper Road (West) From North				Old Kings Highway (Route 6A) From East				Route 130 From South				Old Kings Highway (Route 6A) From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
03:00 PM	4	0	0	0	0	2	0	0	0	0	3	0	0	1	1	0	11
03:15 PM	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	7
03:30 PM	1	0	0	0	0	5	0	0	0	0	2	0	1	0	0	0	9
03:45 PM	2	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	5
Total	7	0	0	0	0	15	0	0	0	0	6	0	1	2	1	0	32
04:00 PM	0	0	0	0	0	2	0	0	0	0	1	0	0	4	0	0	7
04:15 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2
04:30 PM	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	4
04:45 PM	0	0	0	0	0	2	0	0	0	0	0	0	0	1	2	0	5
Total	0	0	0	0	0	8	0	0	0	0	1	0	0	7	2	0	18
05:00 PM	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3
05:15 PM	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	1	0	0	0	0	1	0	0	1	0	0	0	0	2	0	0	5
Total	3	0	0	0	0	1	0	0	1	0	0	0	1	4	0	0	10
Grand Total	10	0	0	0	0	24	0	0	1	0	7	0	2	13	3	0	60
Apprch %	100	0	0	0	0	100	0	0	12.5	0	87.5	0	11.1	72.2	16.7	0	
Total %	16.7	0	0	0	0	40	0	0	1.7	0	11.7	0	3.3	21.7	5	0	

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	4	0	0	0	4	0	2	0	0	2	0	0	3	0	3	0	1	1	0	2	11
03:15 PM	0	0	0	0	0	0	6	0	0	6	0	0	1	0	1	0	0	0	0	0	7
03:30 PM	1	0	0	0	1	0	5	0	0	5	0	0	2	0	2	1	0	0	0	1	9
03:45 PM	2	0	0	0	2	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	5
Total Volume	7	0	0	0	7	0	15	0	0	15	0	0	6	0	6	1	2	1	0	4	32
% App. Total	100	0	0	0		0	100	0	0		0	0	100	0		25	50	25	0		
PHF	.438	.000	.000	.000	.438	.000	.625	.000	.000	.625	.000	.000	.500	.000	.500	.250	.500	.250	.000	.500	.727

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 CC
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

Groups Printed- Peds and Bikes

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	Peds EB	Peds WB	Right	Thru	Left	Peds SB	Peds NB	Right	Thru	Left	Peds WB	Peds EB	Right	Thru	Left	Peds NB	Peds SB	Int. Total
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	4
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
03:45 PM	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	0	0	0	2	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	7
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
04:45 PM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Total	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	5
Grand Total	1	0	0	2	3	0	2	0	0	2	0	0	0	0	0	0	3	0	0	1	14
Apprch %	16.7	0	0	33.3	50	0	50	0	0	50	0	0	0	0	0	0	75	0	0	25	
Total %	7.1	0	0	14.3	21.4	0	14.3	0	0	14.3	0	0	0	0	0	0	21.4	0	0	7.1	

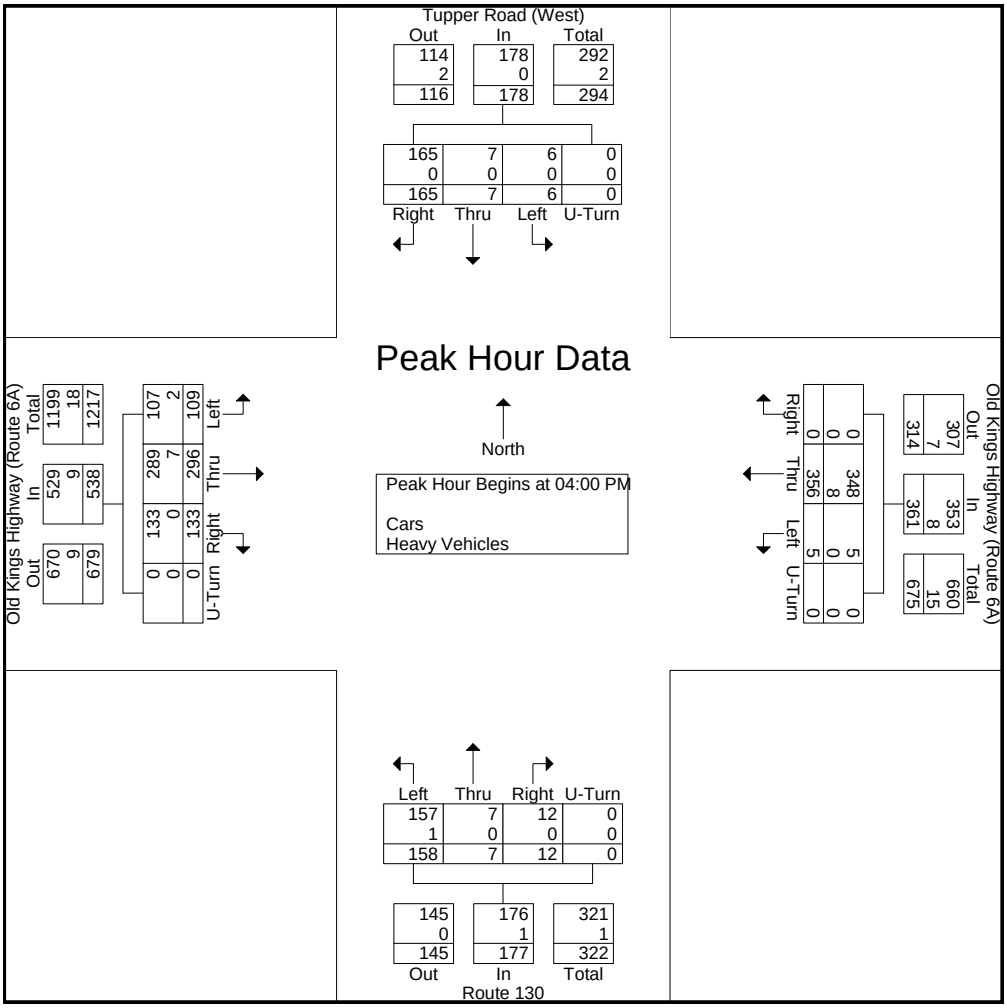
	Tupper Road (West) From North						Old Kings Highway (Route 6A) From East						Route 130 From South						Old Kings Highway (Route 6A) From West						
Start Time	Right	Thru	Left	Peds EB	Peds WB	App. Total	Right	Thru	Left	Peds SB	Peds NB	App. Total	Right	Thru	Left	Peds WB	Peds EB	App. Total	Right	Thru	Left	Peds NB	Peds SB	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																									
Peak Hour for Entire Intersection Begins at 03:00 PM																									
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	1	1	0	1	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	4
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
03:45 PM	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total Volume	0	0	0	2	1	3	0	1	0	0	2	3	0	0	0	0	0	0	0	0	0	0	1	1	7
% App. Total	0	0	0	66.7	33.3		0	33.3	0	0	66.7		0	0	0	0	0		0	0	0	0	100		
PHF	.000	.000	.000	.250	.250	.375	.000	.250	.000	.000	.250	.250	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250	.250	.438

N/S: Tupper Road (West)/ Route 130
E/W: Old Kings Highway (Route 6A)
City, State: Sandwich, MA
Client: Tetra Tech/ M. Hall

PRECISION DATA INDUSTRIES, LLC
P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

File Name : 154575 CC
Site Code : 14367639
Start Date : 7/29/2015
Page No : 1

	Tupper Road (West) From North					Old Kings Highway (Route 6A) From East					Route 130 From South					Old Kings Highway (Route 6A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 04:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	34	1	0	0	35	0	85	1	0	86	0	3	31	0	34	25	90	21	0	136	291
04:15 PM	46	2	1	0	49	0	84	1	0	85	3	0	39	0	42	38	67	24	0	129	305
04:30 PM	46	2	3	0	51	0	92	1	0	93	5	4	46	0	55	37	63	32	0	132	331
04:45 PM	39	2	2	0	43	0	95	2	0	97	4	0	42	0	46	33	76	32	0	141	327
Total Volume	165	7	6	0	178	0	356	5	0	361	12	7	158	0	177	133	296	109	0	538	1254
% App. Total	92.7	3.9	3.4	0		0	98.6	1.4	0		6.8	4	89.3	0		24.7	55	20.3	0		
PHF	.897	.875	.500	.000	.873	.000	.937	.625	.000	.930	.600	.438	.859	.000	.805	.875	.822	.852	.000	.954	.947
Cars	165	7	6	0	178	0	348	5	0	353	12	7	157	0	176	133	289	107	0	529	1236
% Cars	100	100	100	0	100	0	97.8	100	0	97.8	100	100	99.4	0	99.4	100	97.6	98.2	0	98.3	98.6
Heavy Vehicles	0	0	0	0	0	0	8	0	0	8	0	0	1	0	1	0	7	2	0	9	18
% Heavy Vehicles	0	0	0	0	0	0	2.2	0	0	2.2	0	0	0.6	0	0.6	0	2.4	1.8	0	1.7	1.4



Massachusetts Highway Department

20: Monthly Hourly Volume for July 2013

Location ID:	20	Seasonal Factor Group:	U2
County:	PLYMOUTH	Daily Factor Group:	
Funcationl Class	2	Axle Factor Group:	U2
Location:	PILGRIM HIGHWAY	Growth Factor Group:	

	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	TOTAL
1	221	135	106	143	497	1283	2210	2672	2694	2700	2835	3201	3035	2750	2934	3146	3052	3124	2405	1951	1614	1237	760	418	45123
2	208	130	97	116	350	945	1788	2523	2602	2582	2724	2847	2740	2846	3231	3304	3370	3324	2734	2341	2308	1868	1220	830	47028
3	410	183	116	125	355	887	1882	2531	2742	2846	3221	3168	2861	2802	2860	2898	3070	2946	2846	2576	2502	2040	1886	1866	49619
4	954	408	239	132	205	470	1056	2123	2890	2677	2328	2589	2601	2345	2058	1947	1900	1846	1923	1810	925	701	757	619	35503
5	1833	306	160	152	360	880	1699	2334	2703	3301	3566	3486	3302	3396	3411	3304	3173	3052	2934	2525	2415	2208	1566	908	52974
6	449	261	177	174	251	493	1092	2121	3082	3594	3421	3569	3556	3585	3626	3496	3312	3133	3074	2805	2540	2444	1997	1187	53439
7	525	319	168	164	206	474	884	1604	2473	2894	3118	3224	3122	3094	3100	2945	3026	2868	2756	2789	2894	2631	2487	1537	49302
8	291	150	115	184	696	1645	2400	2813	2738	2523	3279	3314	3230	3097	3227	3149	3057	3116	2516	2146	1760	1299	842	411	47998
9																									
10	377	169	107	127	356	973	1890	2622	2749	2829	2810	2975	2932	2850	2980	3175	3221	3328	2490	2075	1934	1334	855	511	45669
11	242	149	111	168	366	928	1936	2586	2785	2545	2680	3070	3043	2992	3184	3304	3491	3207	2771	2160	2023	1556	1036	625	46958
12	291	183	113	124	363	784	1763	2408	2586	2621	3147	3519	3311	3503	3500	2948	3556	2932	2864	2536	2462	2170	1339	956	49979
13	527	361	177	169	261	556	1175	2132	3049	3512	3742	3494	3253	3077	3288	3038	3169	3220	2665	2005	1832	1572	1189	822	48285
14	518	308	189	145	200	364	696	1140	1906	2767	3442	3600	3427	3266	2992	2878	2870	2906	2817	2755	2857	2597	1300	607	46547
15	241	156	106	195	572	1400	2259	2959	3043	2943	3138	3293	3021	2802	2998	3093	3113	3134	2655	2167	1853	1463	810	479	47893
16	233	137	85	130	416	985	1975	2658	2683	2566	3002	2871	2886	2662	2914	3065	3178	3085	2550	2114	1958	1427	916	527	45023
17																									
18	301	201	109	147	379	958	1985	2679	2808	2881	3069	3146	3173	3118	3269	3296	3563	3246	2838	2445	2426	1932	1268	667	49904
19	376	212	137	141	397	833	1818	2505	2791	3028	3450	3445	3254	3191	3216	3181	3186	3012	3067	2599	2606	2249	1608	1013	51315
20	541	308	163	158	216	509	1217	2366	3444	3029	3197	3178	3339	3145	3026	3049	2782	3050	2437	2181	2039	1873	1392	887	47526
21	462	308	189	150	173	436	766	1377	2051	3225	3590	3725	3654	3543	3400	3266	2823	3089	2842	2969	2794	2734	1970	649	50185
22	270	195	154	173	578	1375	2308	2839	2894	2871	3318	3488	3248	2991	3136	2940	3611	3426	2730	2192	1827	1356	841	500	49261
23	249	138	99	149	430	966	1883	2596	2617	2597	2752	3060	3003	2744	2728	3032	3312	3071	2344	1984	1904	1426	862	608	44554
24	370	176	114	169	427	968	1894	2704	2751	2793	3076	3162	3048	2766	3016	3348	3367	3215	2541	2156	2052	1502	975	660	47250
25	383	144	103	149	378	946	1905	2666	2824	2729	2963	3493	3267	3129	3319	3410	3577	3375	2802	2185	2079	1918	1269	610	49623
26	333	195	99	154	350	739	1542	2243	2470	2439	3008	3411	3370	3362	3192	3099	3032	2940	2728	2605	2238	2446	1921	799	48715
27	449	310	142	126	236	526	1140	2484	3440	3279	2960	3307	2911	2695	2853	2966	3064	3307	2811	2368	2329	2088	1535	972	48298
28	543	384	180	122	175	336	650	1174	1890	2966	2925	3513	3524	3376	3410	3278	2964	2878	2854	2979	2785	1980	1166	532	46584
29	222	129	107	173	575	1339	2194	2796	2855	2883	2978	3020	3301	2958	3009	3170	3034	3025	2546	2134	1750	1302	895	505	46900
30	306	126	105	150	402	1010	1875	2676	2832	2909	3031	3121	2906	2727	2954	3149	3434	3241	2644	2165	1894	1485	933	652	46727
31	307	145	77	129	410	951	1897	2617	2849	2903	3202	3247	2984	2825	2981	3376	3476	3425	2667	2336	2123	1649	1107	630	48313
																							Average =		47,810

AADT

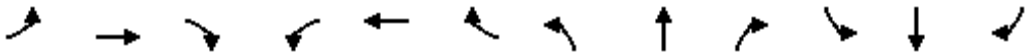
Year	AADT	DHV-30	K %	D %
2014	36,618	3,531	10	56
2013	36,791	3,556	10	51
2012	37,362	3,620	10	58
2011	34,783	3,611	10	54
2010	34,307			

Seasonal Adjustment Factor

Avg. July	47,810
2013 Avg.	36,791
Difference:	-30%

NO SEASONAL ADJUSTMENT NEEDED.

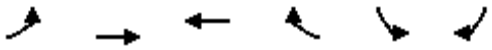
2015 Existing Intersection Capacity Analysis Results



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	58	73	31	2	123	0	75	1	2	0	1	62
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.60	0.60	0.60	0.76	0.76	0.76	0.85	0.85	0.85	0.75	0.75	0.75
Hourly flow rate (vph)	97	122	52	3	162	0	88	1	2	0	1	83
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	162			173			591	508	148	511	534	162
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	162			173			591	508	148	511	534	162
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	93			100			75	100	100	100	100	91
cM capacity (veh/h)	1417			1416			357	438	905	449	423	883

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	270	164	92	84
Volume Left	97	3	88	0
Volume Right	52	0	2	83
cSH	1417	1416	363	868
Volume to Capacity	0.07	0.00	0.25	0.10
Queue Length 95th (ft)	5	0	25	8
Control Delay (s)	3.1	0.1	18.2	9.6
Lane LOS	A	A	C	A
Approach Delay (s)	3.1	0.1	18.2	9.6
Approach LOS			C	A

Intersection Summary				
Average Delay	5.5			
Intersection Capacity Utilization	36.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	47	28	63	40	10	32
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.75	0.75	0.78	0.78	0.58	0.58
Hourly flow rate (vph)	63	37	81	51	17	55
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	132				269	106
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	132				269	106
tC, single (s)	4.1				6.4	6.3
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.4
p0 queue free %	96				98	94
cM capacity (veh/h)	1441				693	937

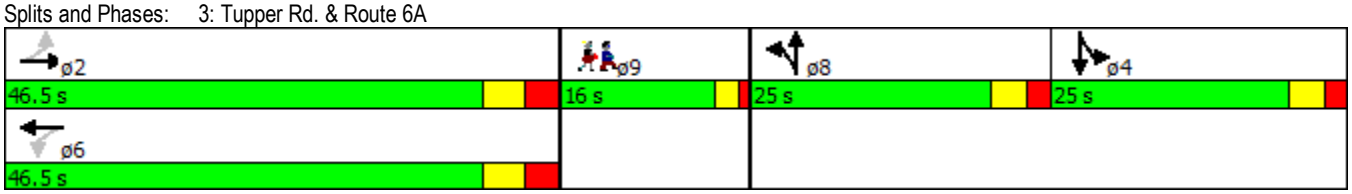
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	100	132	72
Volume Left	63	0	17
Volume Right	0	51	55
cSH	1441	1700	865
Volume to Capacity	0.04	0.08	0.08
Queue Length 95th (ft)	3	0	7
Control Delay (s)	4.9	0.0	9.5
Lane LOS	A		A
Approach Delay (s)	4.9	0.0	9.5
Approach LOS			A

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	20.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	49	12	12	101	55	21	57	21	39	20	2
Satd. Flow (prot)	0	3075	0	0	3245	0	0	1693	0	0	3260	0
Flt Permitted					0.932			0.990			0.969	
Satd. Flow (perm)	0	3075	0	0	3036	0	0	1693	0	0	3260	0
Satd. Flow (RTOR)		21			74			10			3	
Lane Group Flow (vph)	0	109	0	0	226	0	0	143	0	0	92	0
Turn Type		NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2			6								
Total Split (s)	46.5	46.5		46.5	46.5		25.0	25.0		25.0	25.0	
Total Lost Time (s)		6.5			6.5			5.0			5.0	
Act Effct Green (s)		20.9			20.9			11.2			10.5	
Actuated g/C Ratio		0.41			0.41			0.22			0.20	
v/c Ratio		0.09			0.18			0.38			0.14	
Control Delay		15.3			12.9			22.7			21.0	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		15.3			12.9			22.7			21.0	
LOS		B			B			C			C	
Approach Delay		15.3			12.9			22.7			21.0	
Approach LOS		B			B			C			C	
Queue Length 50th (ft)		10			17			35			11	
Queue Length 95th (ft)		21			44			73			27	
Internal Link Dist (ft)		200			215			519			187	
Turn Bay Length (ft)												
Base Capacity (vph)		2426			2406			693			1326	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.04			0.09			0.21			0.07	

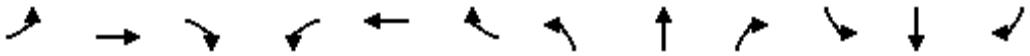
Intersection Summary	
Cycle Length: 112.5	
Actuated Cycle Length: 51.6	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.38	
Intersection Signal Delay: 17.1	Intersection LOS: B
Intersection Capacity Utilization 33.4%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 3: Tupper Rd. & Route 6A



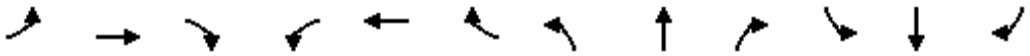
Lane Group	ø9
Lane Configurations	
Volume (vph)	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Total Split (s)	16.0
Total Lost Time (s)	
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	49	12	12	101	55	21	57	21	39	20	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5			6.5			5.0			5.0	
Lane Util. Factor		0.95			0.95			1.00			0.95	
Frpb, ped/bikes		1.00			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.97			0.95			0.97			1.00	
Flt Protected		1.00			1.00			0.99			0.97	
Satd. Flow (prot)		3075			3245			1691			3260	
Flt Permitted		1.00			0.93			0.99			0.97	
Satd. Flow (perm)		3075			3037			1691			3260	
Peak-hour factor, PHF	0.56	0.56	0.56	0.74	0.74	0.74	0.69	0.69	0.69	0.66	0.66	0.66
Adj. Flow (vph)	0	88	21	16	136	74	30	83	30	59	30	3
RTOR Reduction (vph)	0	14	0	0	49	0	0	9	0	0	3	0
Lane Group Flow (vph)	0	95	0	0	177	0	0	134	0	0	89	0
Confl. Peds. (#/hr)			3	3								
Heavy Vehicles (%)	0%	12%	0%	17%	0%	2%	5%	4%	5%	5%	0%	0%
Turn Type		NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2			6								
Actuated Green, G (s)		19.0			19.0			8.3			7.6	
Effective Green, g (s)		19.0			19.0			8.3			7.6	
Actuated g/C Ratio		0.34			0.34			0.15			0.13	
Clearance Time (s)		6.5			6.5			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		1037			1024			249			440	
v/s Ratio Prot		0.03						c0.08			c0.03	
v/s Ratio Perm					c0.06							
v/c Ratio		0.09			0.17			0.54			0.20	
Uniform Delay, d1		12.8			13.1			22.2			21.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.0			0.1			2.4			0.2	
Delay (s)		12.8			13.2			24.6			21.9	
Level of Service		B			B			C			C	
Approach Delay (s)		12.8			13.2			24.6			21.9	
Approach LOS		B			B			C			C	

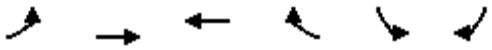
Intersection Summary			
HCM 2000 Control Delay	17.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	56.3	Sum of lost time (s)	19.5
Intersection Capacity Utilization	33.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	109	296	133	5	356	0	158	7	12	6	7	165
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.93	0.93	0.93	0.80	0.80	0.80	0.87	0.87	0.87
Hourly flow rate (vph)	115	312	140	5	383	0	198	9	15	7	8	190
Pedestrians		1									3	
Lane Width (ft)		11.0									11.0	
Walking Speed (ft/s)		4.0									4.0	
Percent Blockage		0									0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	386			452			1199	1008	382	1027	1078	387
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	386			452			1199	1008	382	1027	1078	387
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	90			100			0	96	98	96	96	71
cM capacity (veh/h)	1170			1120			104	217	670	187	198	664

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	566	388	221	205
Volume Left	115	5	198	7
Volume Right	140	0	15	190
cSH	1170	1120	112	563
Volume to Capacity	0.10	0.00	1.97	0.36
Queue Length 95th (ft)	8	0	454	41
Control Delay (s)	2.6	0.2	530.0	15.0
Lane LOS	A	A	F	C
Approach Delay (s)	2.6	0.2	530.0	15.0
Approach LOS			F	C

Intersection Summary				
Average Delay	88.3			
Intersection Capacity Utilization	83.0%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	78	187	250	41	44	96
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.71	0.71	0.88	0.88	0.90	0.90
Hourly flow rate (vph)	110	263	284	47	49	107
Pedestrians		1				
Lane Width (ft)		11.0				
Walking Speed (ft/s)		4.0				
Percent Blockage		0				
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	331				790	308
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	331				790	308
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	91				85	86
cM capacity (veh/h)	1240				330	736

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	373	331	156
Volume Left	110	0	49
Volume Right	0	47	107
cSH	1240	1700	530
Volume to Capacity	0.09	0.19	0.29
Queue Length 95th (ft)	7	0	30
Control Delay (s)	3.0	0.0	14.6
Lane LOS	A		B
Approach Delay (s)	3.0	0.0	14.6
Approach LOS			B

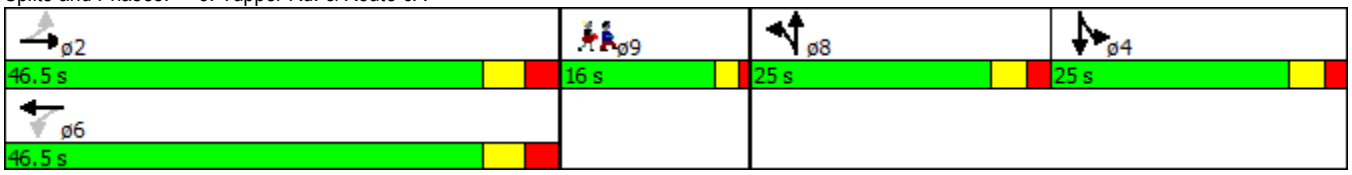
Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	274	100	34	256	218	84	161	40	171	139	15
Satd. Flow (prot)	0	3309	0	0	3197	0	0	1752	0	0	3355	0
Flt Permitted		0.939			0.886			0.986			0.974	
Satd. Flow (perm)	0	3110	0	0	2841	0	0	1751	0	0	3350	0
Satd. Flow (RTOR)		49			187			6			4	
Lane Group Flow (vph)	0	423	0	0	518	0	0	340	0	0	378	0
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2			6								
Total Split (s)	46.5	46.5		46.5	46.5		25.0	25.0		25.0	25.0	
Total Lost Time (s)		6.5			6.5			5.0			5.0	
Act Effct Green (s)		16.3			16.3			20.6			13.4	
Actuated g/C Ratio		0.23			0.23			0.30			0.19	
v/c Ratio		0.55			0.64			0.65			0.59	
Control Delay		24.6			19.9			31.5			30.4	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		24.6			19.9			31.5			30.4	
LOS		C			B			C			C	
Approach Delay		24.6			19.9			31.5			30.4	
Approach LOS		C			B			C			C	
Queue Length 50th (ft)		66			58			106			68	
Queue Length 95th (ft)		152			149			#328			146	
Internal Link Dist (ft)		200			215			519			187	
Turn Bay Length (ft)												
Base Capacity (vph)		1860			1757			522			995	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.23			0.29			0.65			0.38	

Intersection Summary	
Cycle Length: 112.5	
Actuated Cycle Length: 69.6	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.65	
Intersection Signal Delay: 25.9	Intersection LOS: C
Intersection Capacity Utilization 71.0%	ICU Level of Service C
Analysis Period (min) 15	

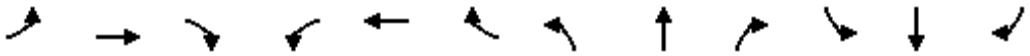
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Tupper Rd. & Route 6A



Lane Group	ø9
Lane Configurations	
Volume (vph)	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Total Split (s)	16.0
Total Lost Time (s)	
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	274	100	34	256	218	84	161	40	171	139	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.5			6.5			5.0			5.0	
Lane Util. Factor		0.95			0.95			1.00			0.95	
Frpb, ped/bikes		1.00			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.96			0.94			0.98			0.99	
Flt Protected		1.00			1.00			0.99			0.97	
Satd. Flow (prot)		3308			3195			1751			3357	
Flt Permitted		0.94			0.89			0.99			0.97	
Satd. Flow (perm)		3109			2842			1751			3357	
Peak-hour factor, PHF	0.90	0.90	0.90	0.98	0.98	0.98	0.84	0.84	0.84	0.86	0.86	0.86
Adj. Flow (vph)	8	304	111	35	261	222	100	192	48	199	162	17
RTOR Reduction (vph)	0	38	0	0	144	0	0	4	0	0	3	0
Lane Group Flow (vph)	0	385	0	0	374	0	0	336	0	0	375	0
Confl. Peds. (#/hr)							1		3	3		1
Heavy Vehicles (%)	0%	1%	2%	0%	2%	2%	4%	0%	0%	1%	0%	0%
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2			6								
Actuated Green, G (s)		16.4			16.4			20.6			13.4	
Effective Green, g (s)		16.4			16.4			20.6			13.4	
Actuated g/C Ratio		0.23			0.23			0.29			0.19	
Clearance Time (s)		6.5			6.5			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		710			649			502			626	
v/s Ratio Prot								c0.19			c0.11	
v/s Ratio Perm		0.12			c0.13							
v/c Ratio		0.54			0.58			0.67			0.60	
Uniform Delay, d1		24.4			24.6			22.6			26.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.9			1.2			3.4			1.5	
Delay (s)		25.2			25.9			26.0			28.3	
Level of Service		C			C			C			C	
Approach Delay (s)		25.2			25.9			26.0			28.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	71.8	Sum of lost time (s)	19.5
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

2015 EXISTING INTERSECTION LEVEL OF SERVICE RESULTS

	AM PEAK HOUR					PM PEAK HOUR				
NAME	**V/C**	**DELAY**	**LOS**	**50th Q**	**95th Q**	**V/C**	**DELAY**	**LOS**	**50th Q**	**95th Q**
Unsignalized Intersections										
1 Tupper Rd. & Route 6A										
EB L	0.07	3	A	-	5	0.10	3	A	-	8
WB L	0.00	0	A	-	0	0.00	0	A	-	0
NB LTR	0.25	18	C	-	25	*	**	F	-	454
SB LTR	0.10	10	A	-	8	0.36	15	C	-	41
2 Tupper Rd. & Freezer Rd.										
EB L	0.04	5	A	-	3	0.09	3	A	-	7
SB LR	0.08	10	A	-	7	0.29	15	B	-	30
Signalized Intersections										
3 Tupper Rd. & Route 6A										
EB LTR	0.09	13	B	10	21	0.54	25	C	66	152
WB LTR	0.17	13	B	17	44	0.58	26	C	58	149
NB LTR	0.54	25	C	35	73	0.67	26	C	106	#328
SB LTR	0.20	22	C	11	27	0.60	28	C	68	146
Intersection	**0.25**	**17**	**B**			**0.60**	**26**	**C**		

Crash Data & Crash Rates

Source massDOT

Accident Data — TUPPER ROAD @ ROUTE 6A (WEST)

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Travel Directions	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection			Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
2735945	SANDWICH	30-Jan-11	4:25 PM	Property damage only (none injured)	2	0	0	Angle	V1:Westbound / V2:Northbound	Dry	Daylight	Clear/Unknown	CRANBERRY HIGHWAY Rte 6A W	MAIN STREET Rte 130 N	TUPPER ROAD					
2735967	SANDWICH	2-Mar-11	2:57 PM	Property damage only (none injured)	2	0	0	Angle	V1:Northbound / V2:Eastbound	Dry	Daylight	Clear/Unknown	CRANBERRY HIGHWAY Rte 6A E	TUPPER ROAD						
2735820	SANDWICH	30-May-11	3:41 PM	Property damage only (none injured)	4	0	0	Head-on	V1:Eastbound / V2:Eastbound / V3:Westbound / V4:Westbound	Dry	Daylight	Clear/Unknown	CRANBERRY HIGHWAY Rte 6A W	MAIN STREET Rte 130 N	TUPPER ROAD					
2934836	SANDWICH	25-Feb-12	5:30 PM	Non-fatal injury	2	2	0	Head-on	V1:Eastbound / V2:Westbound	Dry	Dusk	Clear	Rte 130 S	Rte 6A E						
3085538	SANDWICH	3-May-12	1:49 PM	Non-fatal injury	2	1	0	Angle	V1:Southbound / V2:Westbound	Dry	Daylight	Clear	TUPPER ROAD	Rte 6A W	Rte SR130					
3084774	SANDWICH	11-May-12	7:26 AM	Property damage only (none injured)	2	0	0	Sideswipe, opposite direction	V1:Westbound / V2:Northbound	Dry	Daylight	Clear	Rte 130 N	Rte 6A E	TUPPER ROAD					
3116212	SANDWICH	21-May-12	12:02 PM	Non-fatal injury	2	1	0	Rear-end	V1:Eastbound / V2:Eastbound	Wet	Daylight	Rain	CRANBERRY HIGHWAY Rte 6A E	TUPPER ROAD						
3301765	SANDWICH	7-Dec-12	1:58 PM	Property damage only (none injured)	2	0	0	Angle	V1:Eastbound / V2:Southbound	Dry	Daylight	Cloudy/Clear	CRANBERRY HIGHWAY Rte 6A E	TUPPER ROAD						
3545786	SANDWICH	28-Jul-13	12:00 AM	Property damage only (none injured)	1	0	0	Single vehicle crash	V1:Westbound	Dry	Dark - lighted roadway	Cloudy	ROUTE 6A Rte 6A W	TUPPER ROAD	MAIN STREET					

Source massDOT

Accident Data — FREEZER ROAD @ TUPPER ROAD

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Travel Directions	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection			Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
3242398	SANDWICH	11-Aug-12	7:34 PM	Non-fatal injury	3	2	0	Angle	V1:Southbound / V2:Westbound / V3:Eastbound	Dry	Dusk	Clear	TUPPER RD	FREEZER RD						
3427862	SANDWICH	5-May-13	1:10 PM	Non-fatal injury	2	3	0	Angle	V1:Northbound / V2:Westbound	Dry	Daylight	Clear	TUPPER RD	FREEZER RD						

Source massDOT

Accident Data — TUPPER ROAD @ ROUTE 6A (EAST)

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Travel Directions	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection			Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
3116212	SANDWICH	21-May-12	12:02 PM	Non-fatal injury	2	1	0	Rear-end	V1:Eastbound / V2:Eastbound	Wet	Daylight	Rain	CRANBERRY HIGHWAY Rte 6A E	TUPPER ROAD						
3154563	SANDWICH	20-Jun-12	8:42 AM	Property damage only (none injured)	2	0	0	Rear-end	V1:Southbound / V2:Southbound	Dry	Daylight	Clear	ROUTE 6A Rte 6A	TUPPER ROAD						

ATTACHMENT 5.C-3: TRAFFIC ENGINEER LETTER

TETRA TECH

September 19, 2016

Mr. Jeffrey Ribeiro
Regulatory Planner
Cape Cod Commission
3225 Main Street, PO Box 226
Barnstable, MA 02630

Re: NRG Canal 3 Expansion Project
9 Freezer Road
Sandwich, MA 02563

Dear Mr. Ribeiro:

In accordance with your request, Tetra Tech is providing the Cape Cod Commission with this written confirmation of two key findings related to the proposed NRG Canal 3 Expansion Project, as was originally documented in the December 2015 filing with the Energy Facilities Siting Board.

These findings include the following:

- Because no increase in staffing is expected at the facility, and because ULSD will be delivered by barge and ammonia by rail, the project will not result in an increase in trip generation from the existing conditions, except for temporary increases during the construction phase.
- No modification to the current site access to/from public ways will occur as a result of the proposed expansion project.

We trust that the above information satisfies your request. Please feel free to contact us should you have any questions.

Very truly yours,

Nancy B. Doherty

Nancy B. Doherty, P.E.
Senior Engineer

P:\67639\143-67639-15002\DOCS\REPORTS\CCC\AUGUST 9.DOCX

Marlborough Technology Park
100 Nickerson Road, Marlborough, MA 01752
Tel 508.786.2200 Fax 508.786.2201 tetratech.com

ATTACHMENT 5.D-1: NITROGEN LOADING CALULATIONS

Nitrogen Loading

Project #:	60436698	Page:	1 of 1
Client:	NRG	Date:	February 18, 2016
Site:	Canal Plant Site	By:	R. Twiss
Subject:	Nitrogen Loading Calc_Rev 4	App.:	Y. Zhang

AECOM

VARIABLES:

-Project Area: 12.2 Acre => 528,317 SF

-Roof Area: 52,273 SF } Impervious

-Paving Area: 89,072 SF }

-Natural Area: 381,972 SF } Pervious

-Lawn Area: 5,000 SF Minimum }

-Title V Flow from Existing Training Building: Design flow 440 gpd per Title V inspection form dated 11/14/2008 supplied by client

-Recharge Rate: 19 inch/yr (Sandwich)[1]

WASTEWATER:

440 gpd x [3.785 L/ gal] x [35 mg/L] => 58,289 mg/d

IMPERVIOUS SURFACES:

Roof => 52,273 SF x [40 inch/year] x [1 ft/12 in] x [28.32 L/ft³] x [1 yr/365 d] => 13,519 L/d

13,519 L/d x [0.75 mg/L] => 10,139 mg/d

Paving => 89,072 SF x [40 inch/year] x [1 ft/12 in] x [28.32 L/ft³] x [1 yr/365 d] => 23,037 L/d

23,037 L/d x [1.5 mg/L] => 35,556 mg/d

LAWN:

5,000 SF x [3 lbs/ 1,000 ft²*yr] x [1 yr/ 365 d] x 454,000 mg/ 1 lb] x [0.25] => 4,664 mg/d

NATURAL:

381,972 SF x [19 inch/yr] x [1 ft/12 inch] x [28.32 L/ ft³] x [1 yr/365 d] => 46,925 L/d

SUMMARY:

58,289 + 10,139 + 35,556 + 4,664

13,519 + 23,037 + 46,925 L

=> 1.30 ppm

Assumptions:

1) The proposed design does not have any new septic discharges in the work area, though the work area does produce septic discharges. These discharge flows were used in calculations.
2) It is not anticipated that more than 5,000 SF of lawn will be installed and fertilized in the work area
3) This calculation is specific to the proposed work area only. It is assumed the addition loading from the remaining site features and activities will not increase to over 5.0 ppm.

References:

1. Cape Cod Commission. 1992. Technical Bulletin 91-001. Nitrogen Loading

ATTACHMENT 5.H-1: NATURAL RESOURCES INVENTORY REPORT

Natural Resource Inventory Report

Canal Unit 3 Project

Prepared by:

TRC Environmental Corporation
650 Suffolk Street
Lowell, Massachusetts 01854

September 2016

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) conducted an inventory of natural resources present on the upland portion of a 52-acre parcel of land (the "Property") that includes the proposed 12-acre Canal Unit 3 development site (the "Site"). The natural resource inventory described herein was conducted by Mr. Scott Heim (Senior Ecologist) of TRC on September 9, 2016 and followed the guidelines issued by the Cape Cod Commission for plant and wildlife habitat assessment (Technical Bulletin 92-002). Mr. Heim's resume is attached to this report. This report summarizes the results of the natural resources inventory.

The Property is located west of Freezer Road, south of the Cape Cod Canal and the Canal Service Road, and north of a railroad right-of-way owned by the Massachusetts Department of Transportation. The Bourne/Sandwich town line represents the western boundary of the Site. The Canal Unit 3 Project Site occupies approximately 12-acres of the total 52-acres Property[1].

Canal Unit 3 is proposed on a previously developed 12-acre portion of the Property which is currently occupied by warehouse space, two ammonia storage tanks, temporary trailers, and a gravel parking lot. Sparse plant communities consist primarily of both maintained and unmaintained areas of herbaceous vegetation are present within the proposed Site. In addition, there are early successional scrub/shrub communities located adjacent to the proposed development Site.

The natural resource inventory was conducted during mostly sunny conditions with temperatures (in degrees Fahrenheit) ranging from the mid-70s to lower 80s. Specific methods associated with the natural resource inventory features are discussed along with the results of the inventory.

2.0 SOILS

The Natural Resources Conservation Service soil mapping of the Site identifies one soil type present at the Site – Udipsamments, smoothed. Soils representative of the Udipsamment soil series are areas have been previously disturbed through excavation/placement of fill material.

3.0 VEGETATION

The location of various plant communities as well as the presence of invasive plant species on the Property were noted during the field reconnaissance conducted by TRC. Results are presented below for each of these features.

[1] Approximately 4 acres of the 52-acre Property consists of water.

3.1 Plant Communities

During the inspections conducted at the Site, a walk-over survey for the 48 acre upland portion of the site (including the 12-acre Project Site) identified distinct vegetative (plant) communities and their approximate locations. A total of three plant community types were identified and delineated on the Property including (1) grassland, (2) early successional scrub-shrub, and (1) red cedar/grassland community. The locations of these communities are depicted in Figure 1. Descriptions for each of the identified plant communities are provided below. Representative photographs of the predominant plant communities present on the Property are attached to this report.

1. Grassland

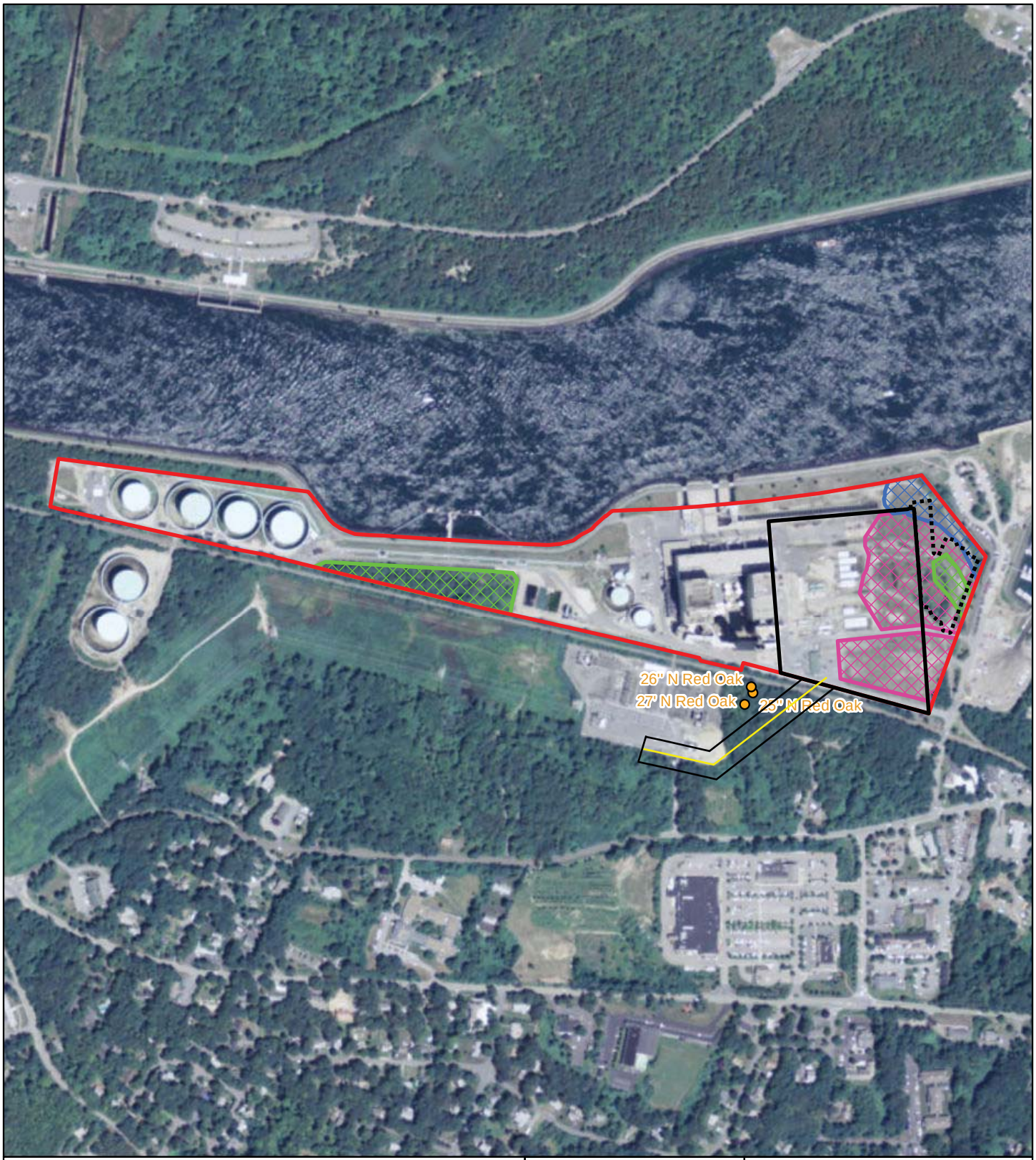
The areas surrounding many of the existing structures and associated infrastructure either contains sparse and short vegetation or is maintained as a grass area (Figure 1). The most prevalent species identified in this plant community include little bluestem (*Schizachyrium scopariumand*) and crabgrass (*Digitaria* spp.), with lesser occurrences of white sweet clover (*Melilotus albus*), brown knapweed (*Centaurea jacea*), and small seedlings/saplings of staghorn sumac (*Rhus typhina*). Uncommon species include Queen Anne's lace (*Daucus carota*), heath aster (*Symphyotrichum ericoides*), fleabane (*Erigeron* sp.), goldenrod (*Solidago* sp.), beggar's tick (*Bidens frondosa*), pasture rose (*Rosa carolina*), bayberry (*Myrica pensylvanica*), rush (*Juncaceae* sp.), and willow (*Salix* sp.). Occasional individuals observed include red cedar (*Juniperus virginiana*), multiflora rose (*Rosa multiflora*), pokeweed (*Phytolacca americana*) and horseweed (*Conyza canadensis*).

2. Early Successional Scrub-Shrub

This successional scrub-shrub community was identified within the eastern and central portions of the Site (see Figure 1). Abundant species consisted primarily of big-toothed aspen (*Populus grandidentata*) and gray birch (*Betula populifolia*). Common species include autumn olive (*Elaeagnus umbellata*), red cedar, Asiatic bittersweet (*Celastrus orbiculatus*), staghorn sumac, poison ivy *(Toxicodendron radicans*), red maple (*Acer rubrum*), and common reed (*Phragmites australis*). Less abundant species include multiflora rose, goldenrod, brown knapweed, and arrow-wood (*Viburnum dentatum*), with rare occurrences of pitch pine (*Pinus rigida*) and glossy-leaved buckthorn (*Frangula alnus*). Saplings and pole-sized trees of the species identified above were typically less than 20 feet tall and have a diameter breast height (dbh) ranging from one to five inches.

3. Red Cedar / Grassland

Red cedar and herbaceous species (primarily little bluestem and brown knapweed) are equally predominant in this plant community which is present within the northeastern portion of the Site. The red cedars are generally sapling to pole-sized and less than 15 feet in height. Common species observed include common reed, big bluestem (*Andropogon gerardii*) and white sweet clover, with lesser occurrences of big toothed aspen and poison ivy. Uncommon species include arrow-wood, pitch pine, black



Impact Area
Laydown Area
Site Boundary
Successional Shrubland
Maintained Grassland
Red Cedar / Grassland
Specimen Tree Locations
Electric Transmission Interconnection
Electric Transmission Corridor

N

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 250 500 Feet

Massachusetts

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
978-970-5600

VEGETATIVE COMMUNITY LOCATION AND IMPACTS MAP

5 FREEZER ROAD

SANDWICH, MA

FIGURE 1 | SEPTEMBER 2016

R:\Projects\GIS_2016\227434_CanalUnit3_SandwichMA\mxd\FIG1_Impacts_Map_20160920.mxd

cherry (*Prunus serotina*), northern red oak (*Quercus rubra*), Asiatic bittersweet, crabapple (*Malus* sp.) and multiflora rose.

3.2 Specimen Trees

Specimen trees are identified by their size (generally large dbh of 24 inches or larger), form (e.g., single undamaged bole) and age relative to adjacent trees. During the inspection, no large specimen trees were noted on the Property. Although no specimen trees are present on the Property, three specimen trees were identified to the south of the Property (and east of the existing Eversource switchyard). The dbh of each specimen tree was determined using a steel diameter tape and each specimen tree was located using a handheld GPS unit with sub-meter accuracy. The location of the three nearby specimen trees are depicted in Figure 1.

The specimen trees included three northern red oaks (25, 26 and 27 inches dbh, respectively). The northern red oaks are located within a nearby mixed oak-pitch pine woodland community.

3.3 Wetland Resource Areas

The identification of wetland resource areas at the Site was previously conducted by TRC in accordance with state definitions. A Request for Determination of Applicability was previously filed with the Sandwich Conservation Commission in order to confirm the locations of the delineated wetland resource areas present on and adjacent to the Site. The Sandwich Conservation Commission approved the wetland resource area delineation on their Determination of Applicability issued February 23, 2016. Descriptions of the identified wetlands are provided below for both inland and coastal wetland resource areas present on the Site.

Floodplains

Land Subject to Coastal Storm Flowage is defined by the Massachusetts Wetlands Protection Act as land that is inundated by coastal storms up to and including the 100-year storm. The latest Flood Insurance Rate Map (FIRM) effective July 16, 2014 indicates that the majority of the Site (elevation 14 feet NADV88 or lower) is within Zone AE which represents the limits of flooding associated with the 100-year storm. The central portion of the Property that is not included within the limits of the 100-year storm are also outside the limits of the 500-year storm floodplain (Zone X – 0.2% annual chance of flooding).

Bordering Vegetated Wetlands

No Bordering Vegetated Wetlands were identified on the Site. However, several nearby palulstrine emergent wetlands (Wetlands A, B, C, D, E and L) associated with drainage swales/ditches adjacent to the Eversource switchyard and/or railroad right-of-way were previously identified. These narrow wetlands are comprised primarily of common reed. In addition, a forested wetland containing an intermittent stream (Wetland F) is present

immediately to the east of the Eversource switchyard. The outer boundaries of these Bordering Vegetated Wetlands have previously been confirmed by the Sandwich Conservation Commission.

Wetland F represents a palustrine forested wetland. An intermittent stream that varies in width from 5 to 15 feet with surface water depths of approximately 2 to 3 inches is present within this wetland. The stream exits Wetland F and enters Wetland C via a culvert that is located under the railroad. Vegetation within Wetland F is comprised primarily of red maple in the tree overstory with sweet pepperbush (*Clethra alnif*olia), spicebush (*Lindera benzoin*), arrow-wood and highbush blueberry (*Vaccinium corymbosum*) present in the shrub understory. Skunk-cabbage (*Symplocarpus foetidus*) is the dominant herbaceous species present.

3.4 Invasive Species

During the inspection of the Site the presence and locations of invasive species as defined by the Cape Cod Technical Bulletin 01-001 were noted. Five species listed as Invasive were noted on the Site during inspections. The Invasive plant species noted on the Site included Asiatic bittersweet, autumn olive, glossy-leaved buckthorn, common reed, and multiflora rose.

The relative abundance of these invasive plants ranged from rare (only few individuals present) to common (common component of the plant community). Table 1 lists each invasive plant species noted on the Site and presents its relative abundance within each of the 3 plant communities identified.

Table 1. Relative Abundance of Invasive Plants within Each Plant Community

Invasive Plant Species	Plant Community		
	1	**2**	**3**
Celastrus orbiculatus	-	C	R
Elaeagnus umbellata	-	C	-
Frangula alnus	-	R	-
Phragmites australis	-	C	C
Rosa multiflora	R	U	R

Plant Communities:

1 – Grassland
2 – Early Successional Scrub-Shrub
3 – Red Cedar / Grassland

Relative Abundance:

D – Dominant member of tree, shrub or ground cover stratum within the community
C – Common within the community
U – Uncommon within the community
R – Rare with only few individuals present in community
- – Not observed

4.0 WILDLIFE

Wildlife present on the Site were identified based on sightings, sound (birds) and sign (e.g., scat, burrows, feathers, etc.) during the inspection. Due to the developed conditions present throughout most of the Site, limited wildlife was noted and species were primarily found in the early successional scrub-shrub and red cedar/grassland community types. Species observed were those commonly present near developed areas at Cape Cod and include northern cardinal, black-capped chickadee, American goldfinch, song sparrow, and mourning dove.

Additional avian species are expected to be present on the Site and would include breeding birds during the spring/summer as well as migratory species in the spring/fall. These avian species would be expected to predominately use the more heavily vegetated portions of the Property although species such as killdeer may also nest in the sparsely or non-vegetated portions of the Property. Reptiles such as various snake species and mammals including a variety of small mammals (mice, voles, shrews) were not observed but would also be expected to inhabit the Property. However, since the entire Site is enclosed by fencing, larger mammals and reptiles (e.g., turtles) may be precluded from accessing the Site.

5.0 DEVELOPMENT IMPACTS

Impacts associated with the proposed Project on the plant communities, specimen trees, wetlands, invasive species and wildlife are discussed in the following sections.

5.1 Plant Communities

The Project with associated features, including a stormwater collection and infiltration system, storage tanks and access roadways, will replace the existing vegetation present on portions of the Site. The current extent, anticipated impact area and remaining area of each plant community that is not impacted is presented in Table 2.

Table 2. Project Impacts to Each Plant Community

Area (Acres)	Community			
	1	2	3	Total
Existing Area	**7.29**	**2.86**	**1.43**	**11.58**
Construction Impact Area	**4.94**	**0.00**	**0.04**	**4.98**
Laydown Area	**1.34**	**0.49**	**0.20**	**2.03**
Remaining Area	**1.02**	**2.37**	**1.19**	**4.58**

Plant Communities:

1 – Grassland
2 – Early Successional Scrub-Shrub
3 – Red Cedar / Grassland

The Project will impact 4.9 acres of grassland which includes maintained areas as well as areas containing sparse and short vegetation. There will also be limited impacts to the early successional scrub-shrub and red cedar/grassland habitats as portions of these communities will be utilized as construction laydown area. As the impacted plant communities currently consist of early successional vegetation and sparsely vegetated areas, no significant impacts are expected to result to plant communities from the proposed development.

5.2 Specimen Trees

No specimen trees are present on the Property. The proposed electrical transmission line from the proposed Project to the existing Eversource switchyard was slightly redesigned to avoid removing the three specimen northern red oak trees located northeast of the switchyard. Therefore, no removal of specimen trees are anticipated from the proposed Project, there may be some trimming and active tree growth management in and around the transmission line. The located of the three specimen trees are depicted in Figure 1.

5.3 Wetland Resource Areas

The project design has avoided impacts to Bordering Vegetated Wetlands and erosion and sedimentation control measures have been incorporated to avoid indirect impacts to wetland resource areas near the Site and surrounding the existing Eversource switchyard. A Notice of Intent will be submitted to the Sandwich Conservation Commission for their review and approval for the proposed project.

The proposed transmission line will traverse over Wetland F and will require the topping of any overstory trees greater than 20 feet in height. Smaller trees up 15 to 20 feet in height will be maintained as well as an understory scrub-shrub wetland community under the proposed transmission line. This will involve periodic inspections and hand cutting of any tree growth in excess of 20 feet in height. The transmission line will not impact any significant trees within this forested wetland and the remaining small trees and shrubs are anticipated to continue to provide similar functions as the existing wetland (although habitat will be modified in a portion of this wetland). In addition, one utility pole will be located within the 100-foot buffer zone to Bordering Vegetated Wetlands. These areas are already disturbed in association with the Eversource switchyard.

5.4 Invasive Species

Invasive plant species present within the 7.0 acres of the Site that will be cleared will be adversely affected by the Project. The primary invasive species that will have their distribution on the Site reduced include multiflora rose, autumn olive and Asiatic bittersweet as these are the pervasive invasive species identified within the grassland and early successional scrub-shrub habitats that will be most affected by the Project construction.

5.5 Wildlife

Overall, there will be some minor impacts to wildlife that use the grassland habitat and early successional habitats as these plant communities will be directly impacted by the Project. However, the small size of these habitats, the existing level of disturbance in the vicinity, and their isolation due to the existing fencing limit their habitat value to many wildlife species. In addition, similar habitats are located elsewhere on the Site or in the vicinity. These existing habitats also do not provide any significant wildlife corridor function with nearby habitats.

6.0 MITIGATION

Mitigation is not proposed for the Project as it will not cause any significant impacts to existing plant communities, specimen trees, wetland resource areas or wildlife. Design measures have been incorporated into the Project in order to avoid both direct and indirect impacts to sensitive environmental resource areas.

Attachment A

Photographs of Project Site

Photograph A-1: Grassland community in vicinity of existing shed.

Photograph A-2: Grassland community within fenced area in southeastern portion of site.

Photograph A-3: Sparse vegetation in central portion of site.

Photograph A-4: Unvegetated/sparsely vegetated area where proposed facility will be sited.

Photograph A-5: Successional shrubland community within eastern portion of site.

Photograph A-6: Successional shrubland in western portion of site. This community is fenced around it's perimeter.

Photograph A-7: Red cedar / grassland community in northeastern portion of site.

Attachment B

Natural Resources Inventory Preparer Resume

SCOTT J. HEIM

EDUCATION
M.S., Wildlife Ecology, University of New Hampshire
B.S., Forest Biology, State University of New York - College of Environmental Science and Forestry
A.A.S., Pre-Professional Forestry, Paul Smith's College

Mr. Heim has been employed by TRC since 1992, and is currently a Senior Ecologist. Mr. Heim has more than 25 years of experience as a wetland scientist, wildlife ecologist, permitting specialist, and manager of a wide variety of environmental tasks associated with development and infrastructure improvement projects. Mr. Heim has been responsible for a wide variety of biological field survey efforts ranging from wetland delineations and rare species surveys to vegetation mapping and assessments including GPS/GIS mapping. Mr. Heim has conducted wildlife habitat evaluations utilizing a variety of methodologies (Habitat Evaluation Procedures and species-specific habitat assessments). He has extensive experience in preparing wildlife species lists for habitat cover types and conducting wildlife sampling programs utilizing a variety of methodologies including transect surveys and variable-circular plots (avian species), live-trapping (small mammals), and winter track count surveys. Impact studies from proposed development activities on listed rare species habitats have also been conducted by Mr. Heim. Vegetation has been sampled utilizing random quadrants and plots within identified vegetative cover types. Specific project experience includes the following:

GenOn Energy, Inc. (GenOn) – Bowline Unit 3 and Transmission Line Wetland/Stream Delineation, Rare/Threatened/Endangered (RTE) Species Survey, and Environmental Permitting – Haverstraw and Ramapo, Rockland County, NY
Performed surveys along seven miles of existing overhead transmission line and underground pipeline ROWs for state endangered Torrey's mountain mint (*Pycnanthemum torrei*) and hyssop-skullcap (*Scutellaria integrifolia*), state threatened timber rattlesnake (*Crotalus horridus*) habitat, and vegetative community surveys for rocky summit grassland, highbush blueberry (*Vaccinium corymbosum*) bog thicket, and chestnut oak (*Quercus prinus*) forest. None of the identified species or vegetative communities was identified within the ROWs; however, state rare winged monkeyflower (*Mimulus alatus*) was discovered within the ROW along an unnamed tributary to the South Branch of Minisceongo Creek. Prepared the required New York Natural Heritage Program (NYNHP) reporting form to document the species occurrence.

Federal Aviation Administration Technical Center, Cooper's Hawk Survey – Pleasantville, NJ
A survey for active nest sites of the state-threatened Cooper's hawk was undertaken by Mr. Heim on a portion of the approximately 5,000-acre FAA William J. Hughes Technical located in the Pinelands National Reserve in

southern New Jersey. TRC conducted the surveys using transects within areas of suitable habitat to detect Cooper's hawks through direct observation or vocalization. In addition, playback recordings were also conducted in an attempt to elicit vocal responses. One active Cooper hawk nest site was located and documented by Mr. Heim. The results of the study will be used to assess the impacts and propose mitigation measures to the breeding Cooper's hawks from groundwater remediation activities proposed in the vicinity.

Orange and Rockland Utilities, Rare Species Surveys, Line 60 Reconductoring Project – Rockland County, NY
Mr. Heim was project manager for evaluating habitat and potential impacts to the bog turtle (*Clemmys muhlenbergii*), timber rattlesnake (*Crotalus horridus)*, and Allegheny woodrat (*Neotoma magister*) from a 10-mile transmission line reconductoring project. The bog turtle is a federal and state endangered species while the rattlesnake and woodrat are state-listed threatened and endangered species, respectively. A Phase 1 Bog Turtle Habitat Survey was conducted and submitted to the U.S. Fish and Wildlife Service. This survey concluded that potential bog turtle habitat was not present within the project area. A report summarizing rattlesnake/woodrat habitat survey results was also prepared. This report also provided appropriate recommendations to minimize impacts to these state-listed species.

Armenia Mountain Wind Energy Project – PA
A wind energy farm was proposed within 10,000 acres of leased land located in northcentral Pennsylvania. Mr. Heim oversaw a plant survey for *Gaultheria hispidula*, a state-listed Species of Special Concern within the project area. Mr. Heim found two populations of *Gaultheria hispidula* and prepared a report detailing the survey methodology, results and anticipated effects to the rare plants from the proposed project. The Pennsylvania Department of Conservation and Natural Resources (DCNR) approved the report and requested monitoring of the populations for a period of five years. A monitoring program was subsequently submitted and approved by the DCNR and the monitoring program is being implemented.

KeySpan Energy, 250 MW Spagnoli Road Energy Center – Huntington, NY
Mr. Heim served as Project Ecologist for the preparation of natural resource sections of an Article X Preliminary Scoping Statement and an Article X Application for a 250 MW combined cycle power project to be constructed by KeySpan Energy Development Corporation in the town of Huntington, Suffolk County, New York. Responsibilities included preparation of an ecological effects assessment regarding wetlands, vegetation and wildlife and presented expert testimony during the administrative hearings. The Article X Certificate was issued in 2003.

Laurel Mountain Wind Energy Project – Barbour/Randolph Counties, WV
Mr. Heim assisted with conducting a field survey/mapping program for the federally-endangered, running buffalo clover (*Trifolium stoloniferum*), populations of which were discovered within disturbed habitats in the project area. The results of these surveys were subsequently used to guide the refinement of road/turbine layouts to avoid or minimize wetland and endangered species impacts.

Atlantic City International Airport, Pilot Mitigation Program and Grassland Restoration – NJ
Mr. Heim was project manager for a grassland study at the Atlantic City Airport that provides valuable habitat for a number of rare avian (i.e. grasshopper sparrow and upland sandpiper) and lepidopteran species. The study characterized important vegetation and soil features within several reference grassland communities by identifying dominant grasses and herbs, tree and shrub seedlings, as well as depth and physical and chemical soil properties. The study assessed the driving mechanisms behind the reference grassland plant community and the important plant species in the community. The results of the characterization were analyzed to determine the optimum conditions for proposed grassland mitigation. Pilot mitigation plots were subsequently planted in several barren areas to evaluate the feasibility of re-establishing grassland habitat for both rare lepidopteran and avian species.

Islander East Proposed Gas Pipeline – Long Island, NY
In response to NYSDEC concerns over impacts to four state-listed rare plant species potentially present within the pipeline right-of-way, Mr. Heim oversaw the preparation of a NYSDEC-approved quantitative rare plant survey methodology as well as the survey itself. A population of the endangered plant *Carex bullata* (button sedge) was identified by Mr. Heim during the field survey. The extent of this population was subsequently mapped in order to ensure that the construction of the proposed pipeline avoided impacts to this population.

University of Connecticut Landfill – Storrs, CT
Mr. Heim conducted a site inspection of a former landfill facility to characterize habitats and conduct a survey for ecological receptors inhabiting three wetlands that were present adjacent to the landfill. Characterization of site wetland habitats included identifying dominant plant species and other important features that may allow or preclude wildlife use of the site. The site characterization focused on the wetlands' potential to provide important habitat requirements for wildlife as well as to identify wildlife usage of the site wetlands through visual observation, auditory detection, and sign (e.g., tracks, nests). Results of the site inspection concerning the habitat characterization and the presence of ecological receptors on the site were presented by Mr. Heim. A list of wildlife species and their respective foraging guild were presented as part of the report. The list was based on the identification of wildlife species noted during the site inspection as well as on site characteristics that may provide habitat for additional wildlife. A

vernal pool providing potential habitat for an observed state-listed rare salamander species was identified within one of the adjacent wetlands.

Federal Aviation Administration William J. Hughes Technical Center, Forest Mitigation Bank Study and Management Plan – NJ
Mr. Heim was project manager for a forest habitat characterization and management study that described existing forest mitigation sites, predicted future forest stand characteristics based on the composition of the existing community and developed habitat management goals to benefit the avian species of concern. Mr. Heim oversaw the collection of data to characterize dominant herbs, tree and shrub seedlings, and substrate cover type within four forest mitigation areas. The species composition of basal sprouts, discrete saplings, and mature shrubs were also assessed and predictions for the forest mitigation areas were developed. Mr. Heim identified a variety of appropriate habitat management strategies, including such silvicultural activities as selective thinning, to optimize forested habitat features for the avian species of concern.

AES Fox Hill Wind Energy Project – Potter County, PA
A 105 MW or 142.5 MW wind energy facility was proposed on 11,500 leased acres in northcentral Pennsylvania. Mr. Heim conducted a plant survey for two state-listed Threatened Species within the project area. A very small population of *Carex retrorsa* was identified and Mr. Heim prepared a report detailing the survey methodology, results and anticipated effects to the rare plant from the proposed project. The Pennsylvania Department of Conservation and Natural Resources (DCNR) approved the report and agreed that impacts to the population associated with the project were not likely to be significant.

Connecticut Resource Recovery Authority – Environmental and Engineering Services, Franklin, CT
Mr. Heim conducted rare plant surveys for *Asplenium montanum* (mountain spleenwort) and *Podostemum ceratophyllum* (riverweed). Two populations of *Asplenium montanum* were identified by Mr. Heim on or immediately adjacent to the site. Mr. Heim also assisted in conducting surveys for the state-listed wood turtle on the site.

ATTACHMENT 5.H-2: NHESP CORRESPONDENCE

MESA Information Request Form

Please complete this form to request site-specific information from the Natural Heritage & Endangered Species Program (Please submit only one project per request form).

Please include a check for $50.00 made out to Comm. of MA – NHESP.*

Requestor Information

Name: Jackie Bruce

Affiliation: Tetra Tech, Inc.

Address: 238 Littleton Road, Suite 201B

City: Westford State: MA Zip Code: 01886

Daytime Phone: (978) 212-3284 Ext. Email address: jackie.bruce@tetratech.com

Project Information

Project or Site Name: Canal Unit 3 and Canal Community Solar

Location: 9 Freezer Road Town: Sandwich

Name of Landowner or Project Proponent: NRG Canal 3 Development LLC and NRG Renew Canal 1 LLC

Acreage of the Property: 88 acres

Description of Proposed Project and Current Site Conditions: (If necessary attach additional sheet)

See Continuation Sheet (attached).

☑ Will this project be reviewed as a Notice of Intent by the local Conservation Commission?
☑ Will this project be undergoing MEPA review for reasons other than rare species?
☑ Have you enclosed the required copy of a USGS topographic map in the scale 1:24,000 or 1:25,000 (not copy reduced) with the site location clearly marked and centered on the copy page? (Copies of Natural Heritage Atlas pages are not accepted)

Please **mail** this completed form and topographic map to:

Regulatory Review
Natural Heritage and Endangered Species Program
MA Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581

Questions regarding this form should be directed according to the county that the property is located:
Berkshire, Essex, Franklin, Hampshire, Hampden, Middlesex & Worcester Counties call: 508-389-6361
Barnstable, Bristol, Dukes, Nantucket, Norfolk, Plymouth & Suffolk Counties call: 508-389-6385

Persons requesting information will receive a written response within 30 days of receipt of all information required. Please do not ask for an expedited review. ***If you are requesting information for habitat management or conservation purposes and you are a non-profit conservation group, government agency or working with a government agency please fill out a Data Release Form.

MESA Information Request Form

(Continuation Page)

Proposed Project and Current Site Conditions:

NRG Canal 3 Development LLC seeks to permit, construct, and operate a dual-fueled simple cycle electric peaking unit (north side of railroad tracks) and NRG Renew Canal 1 LLC seeks to permit, construct, and operate a 6,568-panel solar array, south of the railroad tracks. Both projects are proposed to be located within the existing Canal Generating Station property in Sandwich, Barnstable County, Massachusetts. The property is bisected by an existing railroad right of way.

Although the two proposed projects will only occupy a fraction of the Canal Generating Station property, review of the entire study area (outlined on the Attached Figure 1 Study Area) is requested, as project-related interconnections and relocation of existing facilities may occur in select locations.

For the new peaking unit facility to the north of the existing railroad tracks, the majority of the site is currently developed to support the existing Canal Generating Station, a 1,200- megawatt dual-fueled steam electric generating plant.

The area to the south of the railroad tracks in the location of the solar array is partially developed with two tanks surrounded by wooded areas and a cleared transmission corridor to the west.

The area to the south of the railroad tracks in the location of the electric interconnection to the substation is wooded.

Figure 1
Study Area

NRG Renew Canal 1 LLC
Canal 3 Development LLC
Sandwich, Massachusetts

P:\67639\143-67639-15002\GIS\Species Figures\Figure1_Study Area.mxd

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Jack Buckley, *Director*

August 28, 2015

Jackie Bruce
Tetra Tech, Inc.
238 Littleton Road
Suite 201B
Westford MA 01886

RE: Project Location: 9 Freezer Road
Town: SANDWICH
NHESP Tracking No.: 15-34696

To Whom It May Concern:

Thank you for contacting the Natural Heritage and Endangered Species Program of the MA Division of Fisheries & Wildlife (the "Division") for information regarding state-listed rare species in the vicinity of the above referenced site. Based on the information provided, this project site, or a portion thereof, is located **within** *Priority Habitat 15* (PH 15) and *Estimated Habitat 79* (EH 79) as indicated in the *Massachusetts Natural Heritage Atlas* (13th Edition). Our database indicates that the following state-listed rare species have been found in the vicinity of the site:

Scientific name	Common Name	Taxonomic Group	State Status
Sternula antillarum	Least Tern	Bird	Special Concern
Sterna hirundo	Common Tern	Bird	Special Concern

The species listed above are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wildlife are also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website (www.mass.gov/nhesp).

Please note that projects and activities located within Priority and/or Estimated Habitat **must** be reviewed by the Division for compliance with the state-listed rare species protection provisions of MESA (321 CMR 10.00) and/or the WPA (310 CMR 10.00).

Wetlands Protection Act (WPA)

If the project site is within Estimated Habitat and a Notice of Intent (NOI) is required, then a copy of the NOI must be submitted to the Division so that it is received at the same time as the local conservation commission. If the Division determines that the proposed project will adversely affect the actual Resource Area habitat of state-protected wildlife, then the proposed project may not be permitted (310 CMR 10.37, 10.58(4)(b) & 10.59). In such a case, the project proponent may request a consultation with the Division to discuss potential project design modifications that would avoid adverse effects to rare wildlife habitat.

A streamlined joint MESA/WPA review process is available. When filing a Notice of Intent (NOI), the applicant may file concurrently under the MESA on the same NOI form and qualify for a 30-day streamlined joint review. For a copy of the NOI form, please visit the MA Department of Environmental Protection's website: http://www.mass.gov/dep/water/approvals/wpaform3.doc.

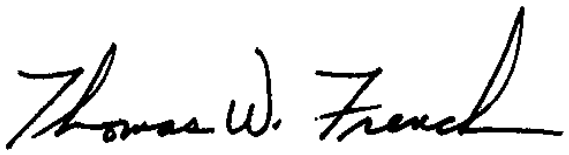
MA Endangered Species Act (MESA)

If the proposed project is located within Priority Habitat and is not exempt from review (see 321 CMR 10.14), then project plans, a fee, and other required materials must be sent to Natural Heritage Regulatory Review to determine whether a probable "take" under the MA Endangered Species Act would occur (321 CMR 10.18). Please note that all proposed and anticipated development must be disclosed, as MESA does not allow project segmentation (321 CMR 10.16). For a MESA filing checklist and additional information please see our website: www.mass.gov/nhesp ("Regulatory Review" tab).

We recommend that rare species habitat concerns be addressed during the project design phase prior to submission of a formal MESA filing, as avoidance and minimization of impacts to rare species and their habitats is likely to expedite endangered species regulatory review.

This evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. If you have any questions regarding this letter please contact Lauren Glorioso, Endangered Species Review Assistant, at (508) 389-6361.

Sincerely,



Thomas W. French, Ph.D.
Assistant Director

Bruce, Jackie

From: Glorioso, Lauren (FWE) <lauren.glorioso@state.ma.us>
Sent: Monday, September 14, 2015 4:11 PM
To: Bruce, Jackie
Subject: RE: Info. request, Sandwich, NHESP 15-34696

Jackie,

Thank you for sending the figure which depicts both proposed projects on property (north and south of the rail tracks). The proposed work does not appear to be within Priority Habitat for rare species, therefore no review pursuant to the MA Endangered Species Act (MESA) is required. If there are future changes to the proposed project to include areas of Priority Habitat, please contact our office.

Sincerely,

Lauren Glorioso
Endangered Species Review Assistant
Natural Heritage & Endangered Species Program | Division of Fisheries & Wildlife | 1 Rabbit Hill Road | Westborough, MA 01581 | ph: 508-389-6361 | fax: 508-389-7890 | lauren.glorioso@state.ma.us | **www.mass.gov/nhesp**

From: Bruce, Jackie [mailto:Jackie.Bruce@tetratech.com]
Sent: Monday, September 14, 2015 2:43 PM
To: Glorioso, Lauren (FWE)
Subject: RE: Info. request, Sandwich, NHESP 15-34696

Hi Lauren,

Per our discussion, I have attached a figure which shows the limits of disturbance for the two projects proposed on the property previously reviewed by NHESP. As you can see, the Solar Site (**pink**) is located on the southern portion (**orange**), away from the Cape Cod Canal. We are hoping to get your confirmation that work in this area should not impact any known RTE species.

The Simple-Cycle Site (**black**), is proposed on the northern portion (**red**), with interconnection corridors (**aqua**, **yellow**, and **purple**) extending across the Property. A new ULSD pipe (**blue**) is proposed on the existing dock. While a Ch. 91 Permit Minor Modification will be pursued for this work, no 'in water' work is proposed in association with this project.

Please let me know if you have any questions. I greatly appreciate your insight on this matter.

Sincerely,
Jackie Bruce

Jackie G Bruce | Environmental Planner
Direct **(978) 212-3284** | Fax **(978) 692-4592** | Mobile **(860) 748-8745** | Jackie.Bruce@tetratech.com

Tetra Tech | Complex World, Clear Solutions™
238 Littleton Road, Suite 201B, Westford, MA 01886 | tetratech.com

---

From: Glorioso, Lauren (FWE) [mailto:lauren.glorioso@state.ma.us]
Sent: Friday, August 28, 2015 7:11 PM

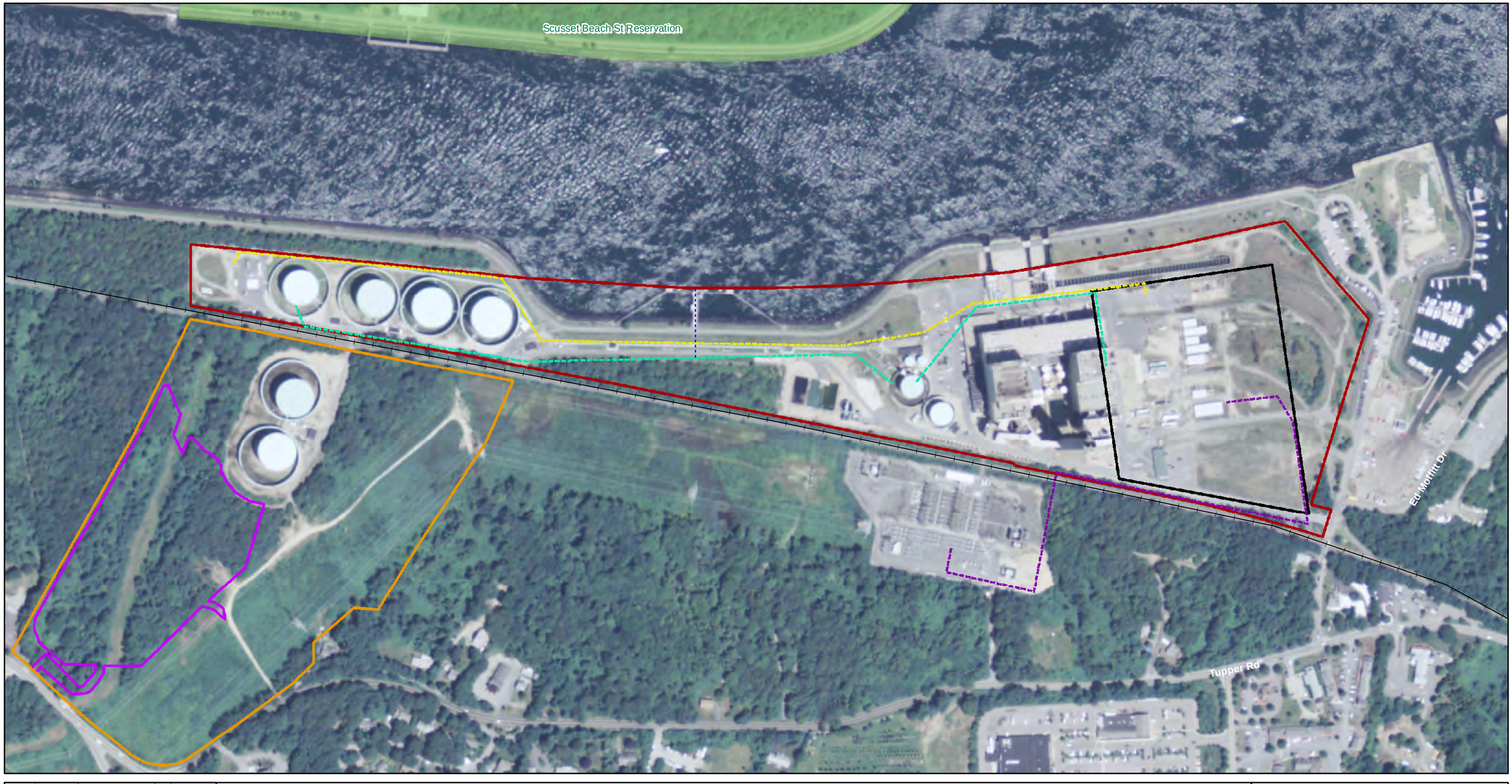
To: Bruce, Jackie <Jackie.Bruce@tetratech.com>
Subject: Info. request, Sandwich, NHESP 15-34696

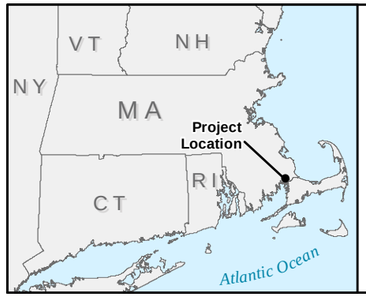
Jackie,

Please see the attached letter regarding the Information Request form submitted to NHESP. Please note that the request area provided with the Information Request form included area over the Cape Cod Canal which our letter reflects, however, based on the project description it sounds like the project may be proposed entirely outside of Priority Habitat (not extending into thte waters of the canal), thus a MESA filing would not be required. If you have questions or require a hard copy, please contact our office.

Sincerely,

Lauren Glorioso
Endangered Species Review Assistant
Natural Heritage & Endangered Species Program | Division of Fisheries & Wildlife |1 Rabbit Hill Road | Westborough, MA 01581 | ph: 508-389-6361 | fax: 508-389-7890 | lauren.glorioso@state.ma.us | **www.mass.gov/nhesp**





Legend

- Northern Area
- Southern Area
- Simple-Cycle Site
- Solar Site
- Railroad
- New ULSD Pipe on Dock
- Proposed Oil Interconnection
- Proposed Natural Gas Interconnection
- Proposed Electrical Interconnection

N

0 100 200 400 Feet

Figure 3
Project Site Aerial Photograph

NRG Canal 3 Development LLC
NRG Renew Canal 1 LLC
Sandwich, Massachusetts

R:\Projects_2014\Canal_3\maps\Figure3_Canal3_Detail_Aerial.mxd

ATTACHMENT 5.H-3: USFWS IPAC REPORT

Canal

IPaC Trust Resource Report

Generated June 30, 2015 01:54 PM MDT

US Fish & Wildlife Service

IPaC Trust Resource Report

Project Description

NAME

Canal

PROJECT CODE

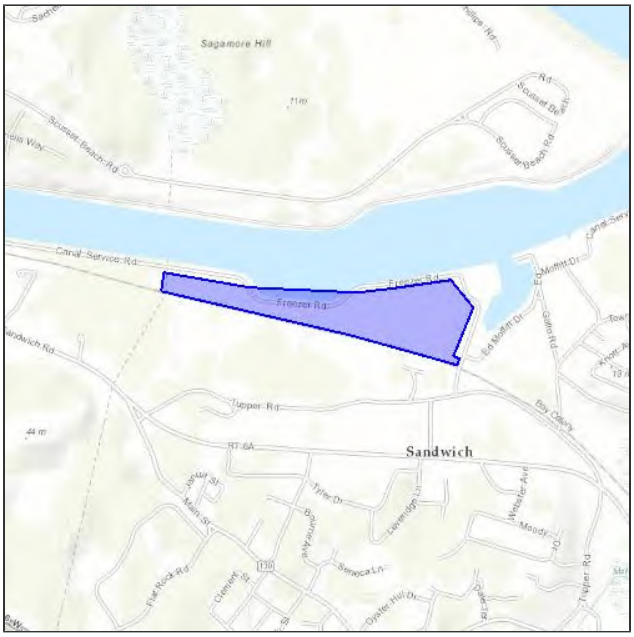
KXLGO-ESGFF-E5JHO-REX7V-W5TGZU

LOCATION

Barnstable County, Massachusetts

DESCRIPTION

No description provided



U.S. Fish & Wildlife Contact Information

Species in this report are managed by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 3301-5094
(603) 223-2541

Endangered Species

Proposed, candidate, threatened, and endangered species that are managed by the Endangered Species Program and should be considered as part of an effect analysis for this project.

This unofficial species list is for informational purposes only and does not fulfill the requirements under Section 7 of the Endangered Species Act, which states that Federal agencies are required to "request of the Secretary of Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action." This requirement applies to projects which are conducted, permitted or licensed by any Federal agency.

A letter from the local office and a species list which fulfills this requirement can be obtained by returning to this project on the IPaC website and requesting an Official Species List from the regulatory documents section.

Birds

Red Knot Calidris canutus rufa — **Threatened**

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0DM

Roseate Tern Sterna dougallii dougallii — **Endangered**

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B07O

Mammals

Northern Long-eared Bat Myotis septentrionalis — **Threatened**

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JE

Critical Habitats

Potential effects to critical habitat(s) within the project area must be analyzed along with the endangered species themselves.

There is no critical habitat within this project area

Migratory Birds

Birds are protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Any activity which results in the take of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service (1). There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured.

You are responsible for complying with the appropriate regulations for the protection of birds as part of this project. This involves analyzing potential impacts and implementing appropriate conservation measures for all project activities.

American Oystercatcher Haematopus palliatus — **Bird of conservation concern**
Season: Breeding
https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0G8

American Bittern Botaurus lentiginosus — **Bird of conservation concern**
Season: Breeding
https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0F3

Bald Eagle Haliaeetus leucocephalus — **Bird of conservation concern**
Year-round
https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B008

Black-billed Cuckoo Coccyzus erythropthalmus — **Bird of conservation concern**
Season: Breeding
https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0HI

Blue-winged Warbler Vermivora pinus — **Bird of conservation concern**
Season: Breeding

Canada Warbler Wilsonia canadensis — **Bird of conservation concern**
Season: Breeding

Fox Sparrow Passerella iliaca — **Bird of conservation concern**
Season: Wintering

Hudsonian Godwit Limosa haemastica — **Bird of conservation concern**
Season: Migrating

Least Bittern Ixobrychus exilis — **Bird of conservation concern**
Season: Breeding

Least Tern Sterna antillarum — **Bird of conservation concern**
Season: Breeding

Pied-billed Grebe Podilymbus podiceps — **Bird of conservation concern**
Year-round

Prairie Warbler Dendroica discolor — **Bird of conservation concern**
Season: Breeding

Purple Sandpiper Calidris maritima — **Bird of conservation concern**
Season: Wintering

Rusty Blackbird Euphagus carolinus — **Bird of conservation concern**
Season: Wintering

Saltmarsh Sparrow Ammodramus caudacutus **Bird of conservation concern**
Season: Breeding

Seaside Sparrow Ammodramus maritimus **Bird of conservation concern**
Season: Breeding

Short-eared Owl Asio flammeus **Bird of conservation concern**
Season: Wintering
https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0HD

Snowy Egret Egretta thula **Bird of conservation concern**
Season: Breeding

Upland Sandpiper Bartramia longicauda **Bird of conservation concern**
Season: Breeding
https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0HC

Wood Thrush Hylocichla mustelina **Bird of conservation concern**
Season: Breeding

Worm Eating Warbler Helmitheros vermivorum **Bird of conservation concern**
Season: Breeding

Refuges

Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. If your project overlaps or otherwise impacts a Refuge, please contact that Refuge to discuss the authorization process.

There are no refuges within this project area

Wetlands

Impacts to NWI wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes.

Project proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

DATA LIMITATIONS

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

DATA EXCLUSIONS

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

DATA PRECAUTIONS

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Wetland data is unavailable at this time.

ATTACHMENT 5.H-4: SANDWICH CONSERVATION COMMISSION WETLAND DELINEATION APPROVAL

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

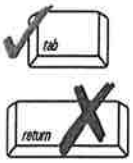
App

WPA Form 2 – Determination of Applicability

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40
Town of Sandwich Wetlands Bylaw, Ch. 7 SCC2016D-01

A. General Information

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



From:

Sandwich
Conservation Commission

To: Applicant

NRG Canal LLC
Name
9 Freezer Road
Mailing Address
Sandwich | MA | 02563
City/Town | State | Zip Code

Property Owner (if different from applicant):

Commonwealth Electric Company
Name
Property Tax Department, P.O. Box 567
Mailing Address
Norwood | MA | 02062-0567
City/Town | State

1. Title and Date (or Revised Date if applicable) of Final Plans and Other Documents:

Title — Date
Title — Date
Title — Date

2. Date Request Filed:

11/20/15

B. Determination

Pursuant to the authority of M.G.L. c. 131, § 40, the Conservation Commission considered your Request for Determination of Applicability, with its supporting documentation, and made the following Determination.

Project Description (if applicable):

N/A - No work proposed at this time.

Project Location:

9 Freezer Road
Street Address
Sandwich
City/Town
86, 91 and 92
Assessors Map/Plat Number
Map 86:13-16, 18,19 Map 91:1-3 Map 92:2
Parcel/Lot Number

B. Determination (cont.)

The following Determination(s) is/are applicable to the proposed site and/or project relative to the Wetlands Protection Act and regulations:

Positive Determination
Note: No work within the jurisdiction of the Wetlands Protection Act may proceed until a final Order of Conditions (issued following submittal of a Notice of Intent or Abbreviated Notice of Intent) or Order of Resource Area Delineation (issued following submittal of Simplified Review ANRAD) has been received from the issuing authority (i.e., Conservation Commission or the Department of Environmental Protection).

☐ 1. The area described on the referenced plan(s) is an area subject to protection under the Act. Removing, filling, dredging, or altering of the area requires the filing of a Notice of Intent.

☒ 2a. The boundary delineations of the following resource areas described on the referenced plan(s) are confirmed as accurate. Therefore, the resource area boundaries confirmed in this Determination are binding as to all decisions rendered pursuant to the Wetlands Protection Act and its regulations regarding such boundaries for as long as this Determination is valid.

☐ 2b. The boundaries of resource areas listed below are not confirmed by this Determination, regardless of whether such boundaries are contained on the plans attached to this Determination or to the Request for Determination.

☐ 3. The work described on referenced plan(s) and document(s) is within an area subject to protection under the Act and will remove, fill, dredge, or alter that area. Therefore, said work requires the filing of a Notice of Intent.

☐ 4. The work described on referenced plan(s) and document(s) is within the Buffer Zone and will alter an Area subject to protection under the Act. Therefore, said work requires the filing of a Notice of Intent or ANRAD Simplified Review (if work is limited to the Buffer Zone).

☐ 5. The area and/or work described on referenced plan(s) and document(s) is subject to review and approval by:

Name of Municipality

Pursuant to the following municipal wetland ordinance or bylaw:

Name | Ordinance or Bylaw Citation

B. Determination (cont.)

☐ 6. The following area and/or work, if any, is subject to a municipal ordinance or bylaw but not subject to the Massachusetts Wetlands Protection Act:

☐ 7. If a Notice of Intent is filed for the work in the Riverfront Area described on referenced plan(s) and document(s), which includes all or part of the work described in the Request, the applicant must consider the following alternatives. (Refer to the wetland regulations at 10.58(4)c. for more information about the scope of alternatives requirements):

- ☐ Alternatives limited to the lot on which the project is located.
- ☐ Alternatives limited to the lot on which the project is located, the subdivided lots, and any adjacent lots formerly or presently owned by the same owner.
- ☐ Alternatives limited to the original parcel on which the project is located, the subdivided parcels, any adjacent parcels, and any other land which can reasonably be obtained within the municipality.
- ☐ Alternatives extend to any sites which can reasonably be obtained within the appropriate region of the state.

Negative Determination

Note: No further action under the Wetlands Protection Act is required by the applicant. However, if the Department is requested to issue a Superseding Determination of Applicability, work may not proceed on this project unless the Department fails to act on such request within 35 days of the date the request is post-marked for certified mail or hand delivered to the Department. Work may then proceed at the owner's risk only upon notice to the Department and to the Conservation Commission. Requirements for requests for Superseding Determinations are listed at the end of this document.

☐ 1. The area described in the Request is not an area subject to protection under the Act or the Buffer Zone.

☐ 2. The work described in the Request is within an area subject to protection under the Act, but will not remove, fill, dredge, or alter that area. Therefore, said work does not require the filing of a Notice of Intent.

☐ 3. The work described in the Request is within the Buffer Zone, as defined in the regulations, but will not alter an Area subject to protection under the Act. Therefore, said work does not require the filing of a Notice of Intent, subject to the following conditions (if any).

☐ 4. The work described in the Request is not within an Area subject to protection under the Act (including the Buffer Zone). Therefore, said work does not require the filing of a Notice of Intent, unless and until said work alters an Area subject to protection under the Act.

SANDWICH CONSERVATION COMMISSION

File No. SCC2016D-01
Plans:

Title	Date	Signed & Stamped By:	On File with:
Overall Wetland Location Plan 9 Freezer Road Sandwich, MA 02563 Scale: As Noted 6 Sheets	08/26/15	Richard J. Taraczynski CRPE #33746	Sandwich Conservation Commission

Conditions:

1. The Sandwich Conservation Commission members, their agent(s) and employees shall have the right to enter and inspect the premises to evaluate compliance with this Determination.

2. This Determination is valid for three (3) years from the date of issuance. Determinations will not be extended. The wetland resource delineation submitted under this Determination is verified by the Commission, as presented, EXCEPT regarding the issue of whether a perennial or intermittent stream exists within the boundaries of the mapped wetlands on the site.

3. **Modifications** or **revisions** to the **site plan(s)** or **project** must be submitted to the Conservation Commission with supporting documentation for review. A determination will be made by the Commission as to whether the proposed changes are within the scope of the original approval or if a new filing is required.

4. An appeal period is in effect under 310 CMR 10.00 for ten (10) working days following the issuance of the written decision. Work may commence within that appeal period at the applicant's risk. If the Determination is appealed, all work must cease until issuance of a final Determination.

5. Work completed in violation of this Determination of Applicability or work not approved under this Determination may result in the issuance of a Stop work or Enforcement Order, Court Action fines and a filing with the Commission

6. The project shall comply with all local, state, and federal, bylaws, laws, permits and regulations, prior to and during construction.

7. Any activities that involve future alterations of the jurisdictional one hundred (100) foot buffer zone (including landscape modifications) will require additional review by the Sandwich Conservation Commission.

8. No activity is approved under this determination.

9. A sign not less than two (2) or larger than three (3) square feet in size shall be posted at the site facing the traveled way(s) prior to the start of any work. The sign shall have a white background, and bear the characters, black in color, three (3) inches in height, **File No. SCC2016D-01**. The sign shall remain in place until the completion of the project.

FILE NO. SCC2016D-01
NRG Canal LLC
9 Freezer Road
Sandwich, MA 02563
02/16 DJD/hkh

B. Determination (cont.)

☐ 5. The area described in the Request is subject to protection under the Act. Since the work described therein meets the requirements for the following exemption, as specified in the Act and the regulations, no Notice of Intent is required:

Exempt Activity (site applicable statuatory/regulatory provisions)

☐ 6. The area and/or work described in the Request is not subject to review and approval by:

Name of Municipality

Pursuant to a municipal wetlands ordinance or bylaw.

Name | Ordinance or Bylaw Citation

C. Authorization

This Determination is issued to the applicant and delivered as follows:

☑ by hand delivery on 2/23/16.
Date

☐ by certified mail, return receipt requested on
Date

This Determination is valid for **three years** from the date of issuance (except Determinations for Vegetation Management Plans which are valid for the duration of the Plan). This Determination does not relieve the applicant from complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.

This Determination must be signed by a majority of the Conservation Commission. A copy must be sent to the appropriate DEP Regional Office (see http://www.mass.gov/eea/agencies/massdep/about/contacts/find-the-massdep-regional-office-for-your-city-or-town.html) and the property owner (if different from the applicant).

Signatures:

01/20/16
Date

SANDWICH CONSERVATION COMMISSION

File No. SCC2016D-01
Plans:

Title	Date	Signed & Stamped By:	On File with:
Overall Wetland Location Plan 9 Freezer Road Sandwich, MA 02563 Scale: As Noted 6 Sheets	08/26/15	Richard J. Taraczynski CRPE #33746	Sandwich Conservation Commission

Conditions:

1. The Sandwich Conservation Commission members, their agent(s) and employees shall have the right to enter and inspect the premises to evaluate compliance with this Determination.

2. This Determination is valid for three (3) years from the date of issuance. Determinations will not be extended. The wetland resource delineation submitted under this Determination is verified by the Commission, as presented, EXCEPT regarding the issue of whether a perennial or intermittent stream exists within the boundaries of the mapped wetlands on the site.

3. **Modifications** or **revisions** to the **site plan(s)** or **project** must be submitted to the Conservation Commission with supporting documentation for review. A determination will be made by the Commission as to whether the proposed changes are within the scope of the original approval or if a new filing is required.

4. An appeal period is in effect under 310 CMR 10.00 for ten (10) working days following the issuance of the written decision. Work may commence within that appeal period at the applicant's risk. If the Determination is appealed, all work must cease until issuance of a final Determination.

5. Work completed in violation of this Determination of Applicability or work not approved under this Determination may result in the issuance of a Stop work or Enforcement Order, Court Action fines and a filing with the Commission

6. The project shall comply with all local, state, and federal, bylaws, laws, permits and regulations, prior to and during construction.

7. Any activities that involve future alterations of the jurisdictional one hundred (100) foot buffer zone (including landscape modifications) will require additional review by the Sandwich Conservation Commission.

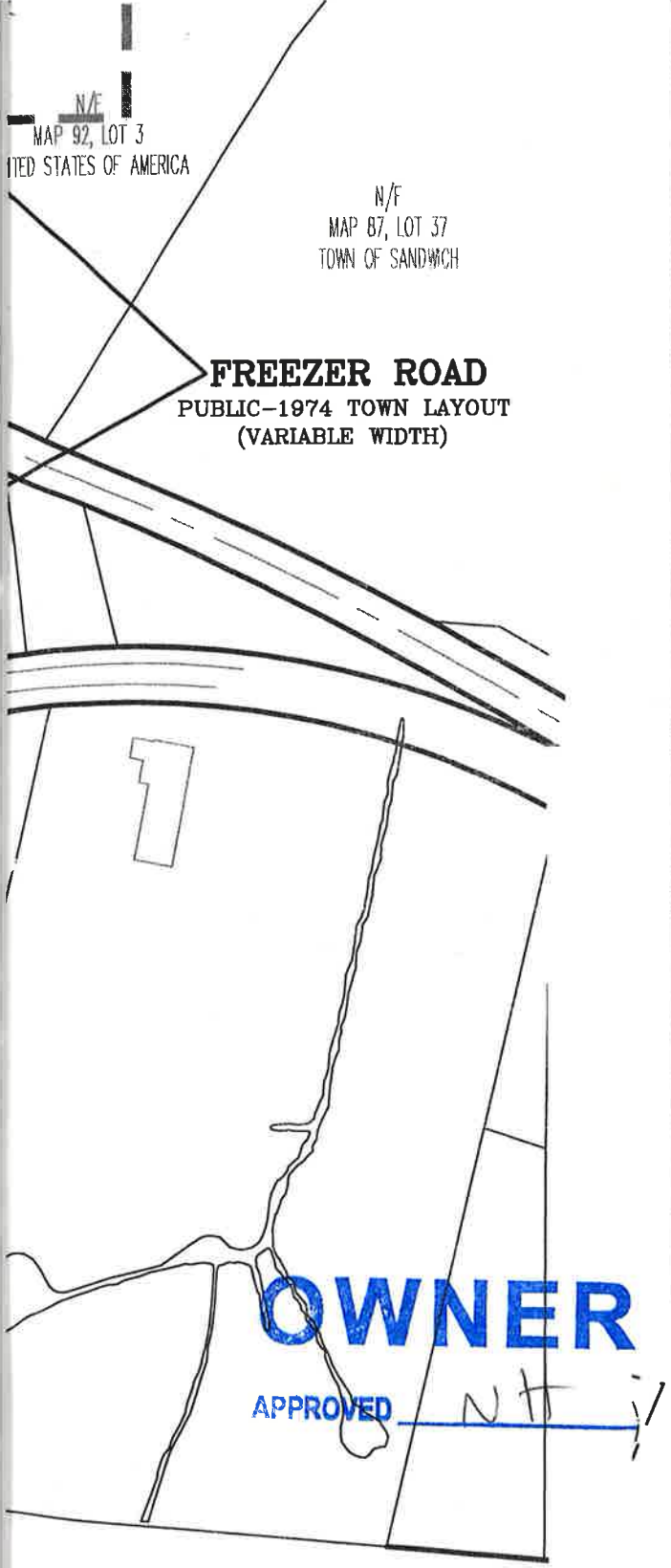
8. No activity is approved under this determination.

9. A sign not less than two (2) or larger than three (3) square feet in size shall be posted at the site facing the traveled way(s) prior to the start of any work. The sign shall have a white background, and bear the characters, black in color, three (3) inches in height, **File No. SCC2016D-01**. The sign shall remain in place until the completion of the project.

FILE NO. SCC2016D-01
NRG Canal LLC
9 Freezer Road
Sandwich, MA 02563
02/16 DJD/hkh

D. Appeals

The applicant, owner, any person aggrieved by this Determination, any owner of land abutting the land upon which the proposed work is to be done, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate Department of Environmental Protection Regional Office (see http://www.mass.gov/eea/agencies/massdep/about/contacts/find-the-massdep-regional-office-for-your-city-or-town.html) to issue a Superseding Determination of Applicability. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and Fee Transmittal Form (see Request for Departmental Action Fee Transmittal Form) as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Determination. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant if he/she is not the appellant. The request shall state clearly and concisely the objections to the Determination which is being appealed. To the extent that the Determination is based on a municipal ordinance or bylaw and not on the Massachusetts Wetlands Protection Act or regulations, the Department of Environmental Protection has no appellate jurisdiction.



EX. BRUSH LINE

EX. GUY WIRE ANCHOR

EX. UTILITY POLE

EX. CATCHBASIN

EX. BENCHMARK

EX. TREE

EX. TRANSMISSION TOWER

EX. LIGHT

EX. MANHOLE

EX. SIGN

EX. POST

EX. CONTROL STATION

EX. SWAMP

EX. BOUND

16.7 EX. SPOT ELEVATION

EX. HYDRANT

WG EX. WATER GATE

EX. DRAINAGE DITCH

PROPERTY LINE

INTERIOR PROPERTY LINE

WETLAND STUDY AREA

APPROVED
SANDWICH CONSERVATION COMMISSION
Date JAN 20 2016 Initials NH

RDA No. SC2016D-01

This plan is approved as part of the referenced filing. Modifications or revisions to this plan or the project must be submitted, in writing, to the Commission with supporting information, for review. A decision will be made by the Board if the changes are within the scope of the primary filing or if an additional filing is required.

FILE:2796.00 WLP2–R2

OVERALL WETLAND LOCATION PLAN
FOR
CANAL GENERATING STATION
SANDWICH, MASSACHUSETTS
AUGUST 26, 2015

Sheet	of
1	6

JOB NUMBER
2796.0

ATTACHMENT 5.I-1: ECONOMIC AND FISCAL IMPACT ANALYSIS

ECONOMIC & FISCAL IMPACT ANALYSIS:

CANAL 3 PROJECT

Prepared by

Clyde W. Barrow, Ph.D., General Manager
Pyramid Associates, LLC

for

NRG Canal 3 Development LLC
for submission

to the

CAPE COD COMMISSION

October 2016

ECONOMIC & FISCAL IMPACT ANALYSIS:

CANAL 3 PROJECT

MAJOR FINDINGS

Capital Investment:
Approximately $275.4 million capital investment

Direct Economic Impacts (Construction):
1,056 jobs and $55.9 million labor income
Average Annual Wage = $52,900

Indirect & Induced Economic Impacts (Construction):
471 jobs and $20.5 million labor income

Indirect & Induced Economic Impacts (Operations):
18 jobs and $1.3 million in annual employee compensation

Fiscal Impact (Operations):
$2.7 million in average annual PILOT and Host Community Agreement payments to Town of Sandwich and other local entities[1]

[1] Over the initial 21 years of commercial operation of the Canal 3 Project

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

TABLES

1.00 PURPOSE OF THE REPORT

NRG Canal 3 Development LLC ("NRG") is proposing to modernize and upgrade the Canal Generating Station ("Canal") located at 9 Freezer Road, Sandwich, Massachusetts.[2] The Canal Unit 3 Project ("Canal 3 Project") being proposed by NRG qualifies as a Development of Regional Impact (DRI) under the Cape Cod Commission Act of 1990, particularly as implemented in Section 3(e)(i) of the Commission's Enabling Regulations Governing Review of Developments of Regional Impact. These regulations state that a development project qualifies as a DRI if it involves "new construction of any building or buildings (including any accessory and auxiliary structures) with a Gross Floor Area greater than 10,000 square feet."[3]

The proposed Canal 3 Project will construct a simple cycle combustion turbine, primarily peaking unit, on a 12 acre site in the Town of Sandwich (Parcel ID 92-002) that is currently zoned Industrial and classified as an Electric Generating Plant. The purpose of the Canal 3 Project is to promote electrical grid reliability in the Southeastern Massachusetts/Rhode Island load zone. The new generating capacity will operate mainly on days of peak demand -- in very cold or very hot weather -- or during system contingencies, such as unexpected outages or major weather events.

As a DRI, it is assumed that the Canal 3 Project will be reviewed by the Cape Cod Commission against the Economic Development Goals and the Minimum Performance Standards ("MPS") established in the 2009 Regional Policy Plan (RPP) and the Commission's *Economic Development Technical Bulletin, No. 04-002.*

> The 2009 RPP establishes four major Economic Development (ED) Goals:
>
> **ED1** To promote the design and location of development and redevelopment to preserve the Cape's environmental and cultural heritage, use infrastructure efficiently, minimize adverse impacts, and enhance the quality of life for Cape Codders.
>
> **ED2** To promote a balanced regional economy with a broad business, industry, employment, cultural, and demographic mix capable of support year-round and quality employment opportunities.
>
> **ED3** To promote economic activity that retains and attracts income to the region and benefits residents, thus increasing economic opportunity for all.

[2] The land is owned by NRG Canal LLC, an indirect subsidiary of NRG Energy, Inc. Property for the new unit will be leased by the current owner to NRG Canal 3 Development LLC, a subsidiary of NRG Energy, Inc. that will own and operate Canal 3.

[3] Barnstable County Ordinance, 90-12 (as subsequently amended and revised, effective March 2011).

> **ED4** To provide adequate capital facilities and infrastructure that meet community and regional needs, expand community access to services, and improve the reliability and quality of services.

The Commission's *Economic Development Technical Bulletin, No. 04-002* (2004, 1) is designed "to help applicants understand how Developments of Regional Impact (DRI) are reviewed from the economic development perspective" and it "describes data required and information requested from the applicant to facilitate a thorough analysis."

MPS 3.1.1 states that in reviewing any Development of Regional Impact, the Commission weighs the estimated/anticipated benefits and detriments of the project and that the applicant bears the burden of demonstrating to the Commission that the benefits of the project outweigh the detriments. MPS 3.1.1 further states that the Commission will evaluate the economic impacts of proposed developments taking into account net job creation, fiscal impact, employee benefits, housing needs, and services and/or products provided and that the Commission will consider any negative or positive impacts that a project may have on the Cape Cod economy. Therefore, as stated in the *Economic Development Technical Bulletin* (2004, 1), the economic data that the DRI applicants are "responsible for providing" are at least those that the Commission needs to minimally fulfill its obligation to "evaluate the economic impacts of the proposed developments" and "consider any negative or positive impacts that a project may have on the Cape Cod economy."

The Regional Policy Plan, Part I.3, Minimum Performance Standard (MPS) 3.1.1 states that "Commercial/Industrial Developments of Regional Impact applicants shall be responsible for providing economic data" to the Commission. For this purpose, and in compliance with this standard, NRG retained Dr. Clyde W. Barrow, General Manager of Pyramid Associates, LLC (see Appendix B), to prepare an economic and fiscal impact analysis of the proposed DRI.

2.00 PROJECT INFORMATION

NRG's parent NRG Energy, Inc. is the leading integrated power company in the United States with the nation's largest and most diverse competitive electric generation portfolio and leading retail electricity platform. NRG Energy, Inc. is a Fortune 200 company that is pioneering the development of smarter energy choices and delivering exceptional service to almost 3 million residential and commercial customers throughout the country.[4] In addition, NRG Energy, Inc. actively contributes to the local communities where NRG employees live and work by contributing millions of dollars to organizations and charities that have a direct impact on the lives of the people in NRG Energy Inc. communities, including food banks, housing, and supplemental education to people in need.[5] NRG Energy Inc. has won numerous awards for industry leadership and many of its nationwide econrg initiatives, which are targeted toward meeting the challenges of climate change, clean air, and natural resources protection.[6]

2.10 PROJECT DESCRIPTION

The Canal 3 Project will primarily involve the installation of a state-of-the-art simple cycle combustion turbine for peaking service. The electric generating capacity of this new turbine will provide additional needed load capacity to the Southeast Massachusetts/Rhode Island (SEMA/RI) load zone in the Independent System Operator-New England (ISO-NE) electrical grid, which is an area of the ISO New England grid that is currently underserved by electricity providers.[7]

The Canal 3 Project will achieve its objective by installing a modern, high efficiency turbine that uses primarily clean natural gas to provide a nominal 350[8] megawatts of new generating capacity. The new turbine will modernize and upgrade NRG's existing Canal Generating Station at 9 Freezer Road, Sandwich, Massachusetts (see Figure 1, Figure 2, and Figure 3). The proposed Canal 3 Project will be built on a portion of the 12 acre site in the Town of Sandwich (Parcel ID 92-002) that is currently zoned Industrial and classified as an Electric Generating Plant.[9] By installing the new turbine at this location, NRG will be able to build on the existing infrastructure of the Canal Generating Station so the new facility will not require a new gas line, electrical substation, or additional fuel storage tanks.

---

[4] http://www.nrg.com/company/about/who-we-are/

[5] See, NRG, *2015 Sustainability Report*, available at http://www.nrg.com/documents/sustainability/2015-nrg-sustainability-report.pdf

[6] See, http://www.nrg.com/company/about/who-we-are/awards-accolades/

[7] At the close of ISO-NE's forward capacity auction FCA #9, the auction prior to FCA #10 in which Canal participated, a shortfall of 238 Megawatts of generation capacity was identified in the SEMA/RI load zone. For more information, see, http://www.iso-ne.com/static-assets/documents/2015/02/fca9_finalresults_final_02272015.pdf

[8] The gross electrical output of the CTG will vary from approximately 330 MW at higher ambient temperatures to approximately 365 MW at very low temperatures.

[9] The land is owned by NRG Canal LLC, an indirect subsidiary of NRG Energy, Inc. Property for the new unit will be leased by the current owner to NRG Canal 3 Development LLC, a subsidiary of NRG Energy, Inc. that will own and operate Canal 3.

Based on the current schedule, Canal 3 construction is expected to begin in June 2017 and begin commercial operation by June 2019.

Figure 1
Aerial View of Existing Canal Generating Station, Sandwich, Massachusetts

Figure 2
Aerial View of NRG Development Projects at Canal Generating Station, Sandwich, Massachusetts

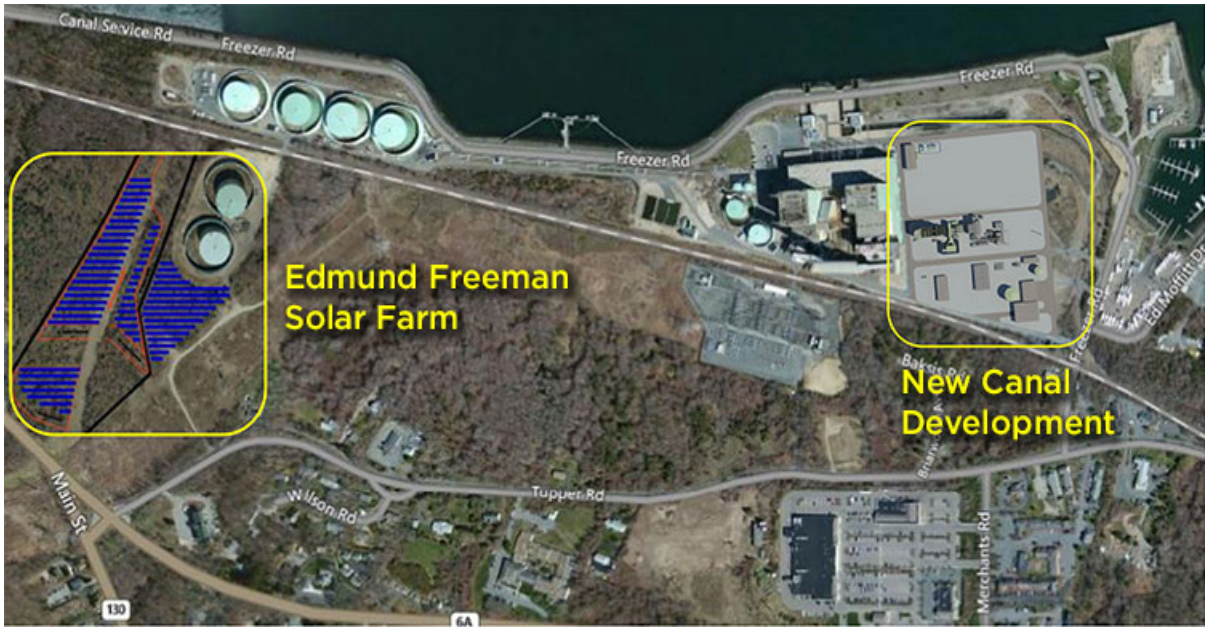


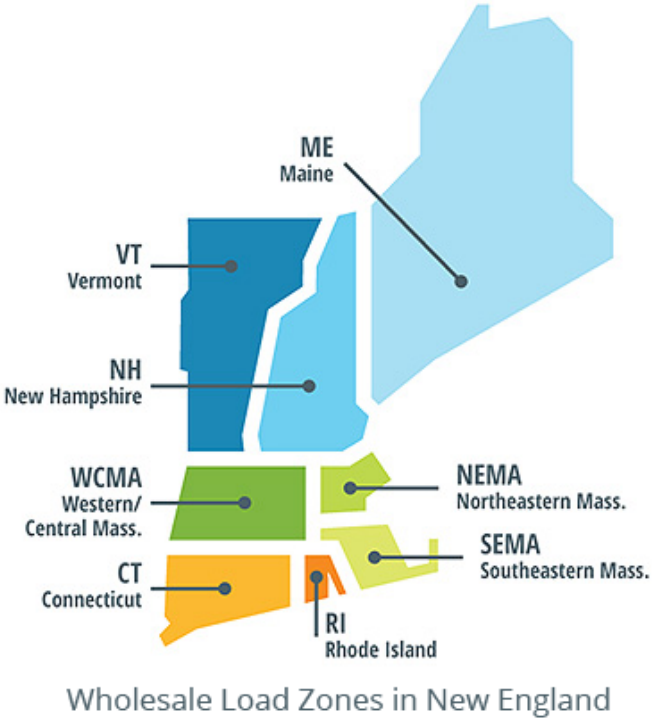
Figure 3
Visual Impact of Canal Generating Station, Sandwich, Massachusetts

2.20 DEFINTION OF THE MARKET

2.21 Market Area

The Canal 3 Project is unique in terms of the market share estimate required by the Commission's *Economic Development Technical Bulletin* (2004), because it does not exclusively serve a local market defined by a town or cluster or towns or a regional market defined by Barnstable County. The Canal 3 Project's market area is the ISO New England electric grid, which consists of the six New England states, including Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. This grid is sub-divided into load zones (see Figure 4). The Canal 3 Project's generating capacity is intended to supply the Southeastern Massachusetts[10] and Rhode Island load zones as these zones are currently undersupplied by electricity providers, particularly during periods of peak demand or unexpected outages.[11]

Figure 4
ISO New England Load Zones



(source: http://www.iso-ne.com/markets-operations/market-performance/load-costs)

[10] Includes Cape Cod.

[11] At the close of ISO-NE's forward capacity auction FCA #9, the auction prior to FCA #10 in which Canal participated, a shortfall of 238 Megawatts of generation capacity was identified in the SEMA/RI load zone. For more information, see, http://www.iso-ne.com/static-assets/documents/2015/02/fca9_finalresults_final_02272015.pdf

2.22 Market Size

The ISO New England grid consists of 7.1 million retail electricity customers serving a total population of 14.7 million residents. This grid delivered 126,955 gigawatt-hours (GWh) of total annual energy in 2015, with 136,355 GWh being the all-time highest total annual energy served in 2005. The reached 28,130 megawatts (MW) all-time summer peak demand on August 2, 2006 and 22,818 MW all-time winter peak demand on January 15, 2004. The region's peak demand under normal weather conditions is forecast to grow 0.2% annually, while the region's peak demand under extreme summer weather is forecast to grow 0.3% annually.

The ISO New England electric grid currently has 350 generators with 31,000 MW of generating capacity and 11,500 MW of proposed generating capacity consisting mostly of natural gas and wind. 4,200 MW of non-gas generating capacity will have retired between 2013 to 2019, with about 30% of the grid's generating capacity (over 10,000 MW) either retiring or at-risk of retirement by 2020.[12]

2.23 Market Capture & Substitution

Table 1 provides an estimate of Canal 3's maximum potential "market share" defined as the percentage of annual electrical generation in the Southeast Massachusetts load zone. The calculation is based on NRG's proposed permit limit for annual operations of Canal 3 as a percent of historical annual generation in the Southeast Massachusetts load zone of ISO New England. Based on this formula, Canal 3 could provide up to 6.6% of the annual electrical generation for this load zone (see Table 1).

This SEMA/RI load zone is currently underserved by electricity suppliers, and Canal 3 will only operate during periods of peak demand, so there will not be any substitution effect or negative economic impact on existing Cape Cod businesses.

[12] http://www.iso-ne.com/about/key-stats

Table 1
Estimated Max Potential Market Share of Canal 3 Power Generating Plant

	SEMA Generation (GWh) -Actual-	Canal 3 Generation (GWh) @ 50% Max CF (Proposed Permit Limit)	% "Market Share"
2004	27,644	1,459	**5.3%**
2005	27,061	1,459	**5.4%**
2006	24,871	1,459	**5.9%**
2007	27,324	1,459	**5.3%**
2008	24,734	1,459	**5.9%**
2009	21,350	1,459	**6.8%**
2010	23,334	1,459	**6.3%**
2011	19,444	1,459	**7.5%**
2012	18,319	1,459	**8.0%**
2013	18,124	1,459	**8.0%**
2014	20,256	1,459	**7.2%**
2015	19,842	1,459	**7.4%**
12 year Avg	**22,692**		**6.6%**

Source: ISO New England, NRG Energy, Inc., and Pyramid Associates, LLC.

2.24 Competitive Impacts

Because natural gas accounts for approximately 42% of all electricity generation in the ISO New England market area, the price of electricity in the market area tends to track the price of natural gas.[13]

In economic theory, additional supply from new and efficient natural gas-fired generators could result in a reduction in electricity rates so long as demand remains constant or declines in the market area as it has done from 2004 to 2015 (see Table 1).

2.30 LOCAL PURCHASES

The Canal 3 Project will make approximately $418,000 in local purchases annually for temporary contract labor, maintenance, environmental security and safety, professional services, and operations and management support.

[13] ISO New England, Inc., *ISO New England Overview*, Presentation to the Joint Committee on Energy, Utilities, and Technology, Maine State Legislature, Augusta, Maine, January 20, 2011, see, http://www.iso-ne.com/pubs/pubcomm/pres_spchs/2011/final_maine_jan20_11_post.pdf

2.40 PROJECT LOCATION

The proposed Canal 3 Project is located in an Economic Center (see Figure 5). It is not located in an Industrial and Service Trade Area, nor is it located in a Village.

Figure 5
Regional Land Use Vision Map

The Cape Cod Commission Act also authorizes the Commission to designate specific resource-sensitive areas as Districts of Critical Planning Concern (DCPC) for specific planning and regulatory efforts.[14] The proposed Canal 3 Project will not be located in a DCPC.[15]

[14] Cape Cod Commission, *Cape Cod Regional Policy Plan* (Barnstable, MA, 2012), p. 3, available at http://www.capecodcommission.org/resources/RPP/2012RPP_printJan2013.pdf

[15] "Cape Cod Districts of Critical Planning Concern, as of September 2013," available at http://www.capecodcommission.org/departments/planning/DCPC/designated?searched=district+of+critical&advsearch=exactphrase&highlight=ajaxSearch_highlight+ajaxSearch_highlight1

2.50 CAPITAL INVESTMENT

The proposed Canal 3 Project will require approximately a $275.4 million capital investment. The capital investment includes $130.3 million in building and construction (47.3%),[16] $23.8 million in fees, interest, and insurance (8.6%), $18.8 million in professional services (6.8%). NRG Energy will spend approximately $102.5 million on combustion turbines and related equipment (37.2.0%)[17] (see Table 2).

Table 2

Canal 3 Project:
Estimated Capital Investment

Item	Est. Cost
Site Work/Construction	$126,033,000
Refurbishing Existing Fuel Storage T	$3,260,000
Landscaping	$500,000
NRG Network Communications	$500,000
Construction Sub-Total	**$130,293,000**
Major Equipment (turbine, etc.)	$102,541,000
Fees, Interest, & Insurance	$23,768,000
Professional Services	$18,793,000
Miscellaneous Sub-Total	**$145,102,000**
TOTAL	**$275,395,000**

Source: NRG Energy, Inc.

[16] The construction work includes site preparation, concrete, installation of mechanical equipment, instrumentation, and controls, insulation, painting, piping, electrical, noise abatement, refurbishment of existing fuel storage tanks, and the installation of NRG network communications.

[17] Includes architectural and construction engineering services, construction management services, legal services, environmental consultants, traffic engineering, civil and construction engineers, and economic and fiscal impact analysis.

3.00 ECONOMIC & EMPLOYMENT IMPACTS

3.10 DEFINITIONS

Economic impacts measure the importance of an economic activity primarily in terms of the output, employment, and personal income generated by that activity:

> **Output** -- the value of goods and services produced at the identified business establishment or construction project.
>
> **Employment** -- the number of people employed at the identified business establishment or construction project, including wage and salary employees and self-employed persons.
>
> **Personal Income** -- the wages, benefits, and other income derived from employment that is linked geographically to the identified work site.

Economic impacts consist of direct impacts, indirect impacts, induced impacts, and total impacts:

Direct Economic Impacts are the economic activities carried out at a business establishment or construction project and are therefore an immediate consequence of the economic activity that would not have occurred in the absence of the business establishment or construction project.

Indirect Economic Impacts are generated by off-site economic activities that are attributable to the identified business establishment. These economic activities occur mainly as a result of *non-payroll expenditures* or *local purchases* by the business within a defined local area (e.g., county). Local expenditures include a range of operating expenses such as construction materials, office supplies, motor transport, horticultural services, furniture, utilities, maintenance and repairs, business machines, business services, management consulting, and so forth. Indirect impacts differ from direct impacts insofar as they originate entirely off-site, although the indirect impacts would not have occurred in the absence of the identified business establishment.

Induced Economic Impacts are the multiplier effects of the direct and indirect impacts created by successive rounds of spending by employees and proprietors.[18]

Total Economic Impacts are the sum of the direct, indirect, and induced impacts.

[18] Most of the take-home income earned by employees is spent locally. Some of this spending becomes income to local individuals who provide services to employees. Some the spending by employees goes to local businesses and becomes income to the business owners and their employees. Subsequently, part of these second-round incomes are also spent locally and thus become income to another set of individuals. As successive rounds of spending occur, additional income is created in the local area, region, and state. The impact of these successive rounds of spending is called the "multiplier effect."

3.20 METHODOLOGY

The North American Industry Classification System (NAICS) classifies all business establishments into one or more of twenty major Sectors. The Canal 3 Project is classified under NAICS Sector Code 221112 Electric Power Generation:

> **221112 Electric Power Generation, Fossil Fuel (e.g., coal, gas, oil)**
> This U.S. industry comprises establishments primarily engaged in operating fossil fuel powered electric power generation facilities. These facilities use fossil fuels, such as coal, oil, or gas, in internal combustion or combustion turbine conventional steam process to produce electric energy. The electric energy produced in these establishments is provided to electric power transmission systems or to electric power distribution systems.

Economic models can be used to forecast personal income, employment, business sales, and value-added impacts for most industries, including retail stores. The available models represent a continuum of sophistication and cost that must be balanced against project budgets and the potential size of project impacts (where dynamic modeling becomes more important). The available models consist of Input/Output Models and Economic Simulation Models.

Input/Output (I/O) Models are essentially accounting tables which trace the linkages of inter-industry purchases and sales within a given county, region, state, or country. They utilize information on technologies and local trade. Technology data consists of information on the inputs from other industries that are used to produce a dollar of output for each specific industry. Local trade data consists of information on how much of a given industry's purchases are supplied by other firms located within the study area. The I/O model yields multipliers that are used to calculate the total direct, indirect, and induced effect on jobs, income, and output generated per dollar of spending on various types of goods and services in the study area. Input/Output Models calibrated for specific counties are commercially available for any part of the United States from the Minnesota IMPLAN Group (MIG, Inc.) and the U.S. Bureau of Economic Analysis (RIMS II – Regional Input/Output Multiplier System II).

The indirect and induced economic impacts of the proposed Canal 3 Project were calculated and specified using IMPLAN (Impact Analysis for PLANing), which is an Input/Output modeling system developed by applied economists at the University of Minnesota and the U.S. Forest Service. Figures on direct employment supplied by NRG were confirmed using IMPLAN by insuring that standard input (labor)/output (sales) accounts were consistent with established data for Barnstable County. The IMPLAN modeling system has been in use since 1979 and is currently used by over 500 private consulting firms, university research centers, and government agencies. The IMPLAN modeling system uses input-output analysis to construct quantitative models of trade flow relationships between businesses and between businesses and final consumers. From this data, one can examine the effects of a change in one or several economic activities to predict its effect on a specific state, regional, or local economy (impact analysis).

The IMPLAN input-output accounts capture all monetary market transactions for consumption in a given time period. The IMPLAN input-output accounts are based on industry survey data collected periodically by the U.S. Bureau of Economic Analysis and follow a balanced account format recommended by the United Nations. IMPLAN also includes social accounting data (e.g., personal income and gross state product) that makes it possible to measure non-industrial transactions such as the payment of indirect taxes by businesses and households. The IMPLAN database provides data coverage for the entire United States by county and has the ability to incorporate user-supplied data at each stage of the model building process to insure that estimates of economic impacts are both up-to-date and specific to an economic area.[19] IMPLAN can construct local input-output models in units as small as five-zip code clusters.

IMPLAN's Regional Economic Accounts and Social Accounting Matrices are used to construct local, county, or state-level multipliers specific to an economic area. Multipliers describe the response of an economy to a change in demand or production. The multipliers allow economic impact analysis to move from a descriptive input-output model to a predictive model. Each industry that produces goods or services generates demand for other goods and services and this demand is multiplied through a particular economy until it dissipates through "leakage" to economies outside the specified area. Thus, multipliers calculate the response of the economic area to a change in demand or production.

IMPLAN models *discern and calculate leakage* from local, regional, and state economic areas based on workforce configuration, the inputs required by specific types of businesses, and the availability of both inputs in the economic area. Consequently, *economic impacts that accrue to other regions or states as a consequence of a change in demand are not counted as impacts within the economic area*. The model accounts for substitution and displacement effects by deflating industry-specific multipliers to levels well below those recommended by the U.S. Bureau of Economic Analysis. In addition, multipliers are applied only to *personal disposable income* to obtain a more realistic estimate of the multiplier effects from increased demand. The model only includes personal income such as wages, benefits, and proprietor income that are linked geographically to the workplace site. The reliability of these estimates has been proven through empirical testing.

A predictive model is constructed by specifying a series of new expenditures in a specific economic area (e.g., new employment or construction) which is then applied to the industry multipliers for that particular region. Based on these calculations, the model estimates final demand, which includes employment, employee compensation (excluding benefits), and point-of-work personal income (including benefits). The initial IMPLAN data details all purchases in a given area, including imported goods and services. Importantly, IMPLAN's Regional Economic Accounts exclude imports to an economic area so the calculation of economic impacts identifies only those impacts specific to the targeted economic area.

[19] The IMPLAN modeling system draws on a variety of statistical sources, including the Bureau of Labor Statistics Growth Model, Bureau of the Census, ES-202 employment and earnings data, the Regional Economic Information System (REIS), and the Bureau of Economic Analysis Gross State Product data.

IMPLAN calculates this distinction by applying Regional Purchase Coefficients (RPC) to predict regional purchases based on an economic area's particular characteristics. The Regional Purchase Coefficient represents the proportion of goods and services that will be purchased regionally under normal circumstances, based on the area's economic characteristics described in terms of actual trade flows within the area. IMPLAN also contains a Local Purchase Coefficient (LPC) that allows one to calculate the maximum possible economic impacts on an area if all inputs that can be purchased within the area are purchased within that area. The LPC is useful for calculating the potential impact of local vendor and employment preference arrangements.

Economic impacts are normally calculated separately for the *construction phase* and *operations phase* of a business establishment. The economic impacts of construction and other capital expenditures are inherently limited in duration and last only as long as construction and related capital purchases are underway. The operations phase of a business establishment generates economic impacts that continue as long as the facility remains in existence.

3.21 Assignment to IMPLAN Industry Sectors

Construction and building expenditures were assigned to the following IMPLAN Codes for purposes of calculating direct, indirect, and induced impacts:

- 54 Construction of New Power & Communication Structures
- 433 Monetary Authorities and Depository Credit Intermediation
- 434 Nondepository Credit Intermediation & Related Activities
- 437 Insurance Carriers
- 447 Legal Services
- 449 Architectural, Engineering, & Related Services
- 454 Management Consulting Services
- 455 Environmental & Other Technical Consulting Services
- 460 Miscellaneous Scientific & Technical Services
- 462 Office Administrative Expenses
- 520 Other Government Enterprises

Operations phase revenues were assigned to IMPLAN Codes for purposes of calculating direct, indirect, and induced impacts:

- 42 Electric Power Generation

3.22 Regional Purchase Coefficient

The IMPLAN model assumes that all construction is purchased from local contractors and professional service firms, who then purchase goods and services from inside and outside the local area according to the average for the industry. This assumption has been manually adjusted to an RPC of 48.9%, by excluding most expenditures for fees, interest, insurance, and professional services as well as the entire cost (100%) of the combustion turbines and related machinery, to generate a more accurate estimate of construction-related output, employment, and income impacts for Barnstable County.[20]

3.23 Trade and Freight Margins

When a business establishment purchases goods or services, the expenditure covers at least the price of the goods or services, but it may also include the cost of shipping, insurance, wholesale margin, retail margin, and brokerage fees. IMPLAN provides sector-specific margins to account for these "exported" expenditures. It is assumed that construction services are purchased directly from contractors.

3.30 CONSTRUCTION PHASE

The proposed Canal 3 Project will require approximately a $275.4 million capital investment. The capital investment includes $130.3 million in building and construction (47.3%),[21] $23.8 million in fees, interest, and insurance (8.6%), $18.8 million in professional services (6.8%). NRG Energy will spend approximately $102.5 million on combustion turbines and related equipment (37.2.0%).[22]

The construction phase impacts were adjusted in the model to an RPC of 48.9%, because most (90%) of the expenditures for fees, interest, insurance, and professional services were excluded from the construction phase model, as was the entire cost (100%) of the combustion turbines and related machinery. It is assumed that these expenditures are made off-Cape to insure that the model yields a more accurate estimate of construction-related output, employment, and income impacts for Barnstable County. After these adjustments, the Consultant estimates that the Direct Economic Impact on Barnstable County will be approximately $148.5 million in building and construction output spread across Calendar Years 2017, 2018, and 2019 (i.e., the construction phase).

[20] In other words, it is assumed that most insurance and interest payments, as well as regulatory fees, and professional services (e.g., architectural and construction management) are purchased from vendors headquartered outside Barnstable County. By excluding these expenses from the economic impact model, the model generates a more accurate estimate of the economic impact of the construction phase on Barnstable County. The model also excludes the cost of major equipment such as the combustion turbine, SCR and CO catalyst system and generator step-up transformer which will be manufactured outside Barnstable County.

[21] The construction work includes site preparation, concrete, installation of mechanical equipment, instrumentation, and controls, insulation, painting, piping, electrical, noise abatement, refurbishment of existing fuel storage tanks, and the installation of NRG network communications.

[22] The $275.4 million capital investment does not include any additional capital investments in public infrastructure or mitigation measures that may be required by the Cape Cod Commission.

3.31 Direct Employment & Compensation Impacts

The IMPLAN model predicts that the construction of the Canal 3 Project will generate 1,056 direct construction jobs over a 24-month period and $55.9 million in direct employee compensation (see Table 3). These jobs will have an annual average wage of $52,900 (2016 dollars), which does not include payments for fringe benefits.

Table 3
Canal 3 Project:
Employment & Compensation Impacts of Construction Phase

	Direct	Indirect	Induced	Total
Employment	1,056	181	290	1,527
Compensation	$55,862,008	$7,881,980	$12,574,702	$76,318,690
Annual Avg. Wage	$52,900	$43,547	$43,361	$49,979

Note: 2016 dollars.

3.32 Indirect & Induced Employment & Compensation Impacts

The IMPLAN model predicts that construction of the Canal 3 Project will support an additional 181 jobs in Barnstable County through indirect impacts (i.e., construction-related purchases) and 290 jobs through induced impacts (i.e., consumer purchases by construction workers). The employment generated by indirect and induced impacts will support an additional $20.5 million in employee compensation in Barnstable County during the construction phase of the project (see Table 3).

The IMPLAN modeling system is able to specify the sector distribution of indirect and induced impacts by calculating the regional effect of construction purchases based on the BEA's input-output accounts for Barnstable County calculating the effect of increased consumer demand (employment) from gross state product data. The model predicts that indirect and induced impacts will be distributed widely across the county as these impacts will be distributed across 158 of IMPLAN's 536 industry account sub-codes.

The most significant indirect and induced impacts will occur in sectors that provide construction-related inputs (e.g., real estate and wholesale trade) and consumer services to construction industry employees (e.g., food and beverage services, banks, health care, and retail) (see Table 4).

Table 4

Canal 3 Project:
Sector Distribution of Major Indirect and Induced Employment Impacts During Construction Phase, June 2017 thru December 2019

Industry	Indirect	Induced	Total Off-site
Real Estate	13	22	**35**
Wholesale Trade	17	5	**22**
Environmental & Other Technical Consulting	18	2	**20**
Full Service Restaurants	2	16	**18**
Retail - Clothing & Clothing Accessories	13	3	**16**
Architectural, Engineering, & Related Services	15	1	**16**
Hospitals	0	15	**15**
Retail - Food & Beverage Stores	4	11	**15**
Retail - Nonstore Retailers	12	3	**15**
Retail - Miscellaneous Store Retailers	10	4	**14**
Limited Service Restaurants	1	13	**14**
Monetary Authorities & Depository Credit Intermediation	7	5	**12**
Services to Buildings	6	6	**12**
Offices of Physicians	0	11	**11**
Other Financial Investment Activities	2	8	**10**
Retail - General Merchandise Stores	5	5	**10**
Retail - Health & Personal Care Stores	6	3	**9**
All Other Food & Drinking Places	1	8	**9**
Nondepository Credit Intermediation & Related Activities	8	1	**9**
Nursing & Community Care Facilities	0	8	**8**

Source: IMPLan Version 3.0 (2016). Includes only 20 largest impact sectors.

3.40 OPERATIONS PHASE

The operations phase of any business establishment generates economic impacts that continue as long as the establishment remains in existence. The IMPLAN modeling system uses U.S. Bureau of Labor Statistics earnings and income data and the U.S. Bureau of Economic Analysis Regional Economic Information System (REIS) to calculate place of work income. Indirect and induced impacts have been estimated on the basis of current (2016) earnings specific to the local area and on the basis of a staffing matrix specific to the proposed Canal 3 Project.

3.41 Indirect & Induced Employment & Compensation Impacts

The Canal 3 Project will make average annual payments of approximately $2.7 million to the Town of Sandwich and other local government entities. These payments will support an additional 17 jobs in Barnstable County as indirect impacts (i.e., facility-related non-payroll purchases) and 1 job through induced impacts (i.e., employee purchases) (see Table 5). The employment generated by indirect and induced impacts will support an additional $1.3 million in employee compensation in Barnstable County. It will also make approximately $418,000 in local purchases annually for temporary contract labor, maintenance, environmental security and safety, professional services, and operations and management support.

The IMPLAN modeling system is able to specify the sector distribution of indirect and induced impacts by calculating the regional effect of a business establishment's purchases based on the BEA's input-output accounts for Barnstable County and by calculating the effect of increased consumer demand (employment) from gross state product data. The model predicts that indirect and induced impacts will be distributed across 109 of IMPLAN's

536 industry account sub-codes. The most significant indirect and induced impacts will occur in sectors that provide operational inputs to the facility or that provide retail, health care, and financial, services to the facility's employees.

3.50 TOTAL COMBINED ECONOMICS IMPACTS

3.51 Total Combined Employment Impacts

The total combined employment impacts for construction and operations will be realized over a 42 month period with the beginning of construction in June 2017 to the opening of the new power generating plant in June 2019, followed by its subsequent operation for the remainder of 2019 and into 2020. The estimated rate at which all employment impacts will be realized in Barnstable County is illustrated in Table 5.

Table 5

Canal 3 Project:
Total Combined Employment Impacts

	FY 2017	CY 2018	CY 2019	CY 2020
Direct Economic Impacts	**201**	**634**	**222**	**-**
Construction	201	634	222	-
Operations	-	-	-	-
Indirect Economic Impacts	**34**	**109**		**17**
Construction	34	109	38	-
Operations	-	-	8	17
Induced Economic Impacts	**55**	**174**	**61**	**1**
Construction	55	174	61	-
Operations	-	-	-	1
Total Economic Impacts	**290**	**916**	**321**	**18**
Construction	290	916	321	0
Operations	-	-	-	18

Sources: IMPlan Version 3.0 (2016), Pyramid Associates, LLC (2016), & NRG Energy, Inc. (2016). **Note:** Direct, Indirect & Induced jobs = Total jobs (i.e., full-time + part-time).

3.52 Total Combined Compensation Impacts

The total combined compensation impacts for construction and operations on an annualized basis are shown in Table 6. Construction impacts will be realized over a 24-month period, while operations impacts, which include the indirect economic benefits of PILOT and HCA payments are shown for the first 21 years of plant operations.

Table 6

Canal 3 Project: Total Compensation Impacts (Annual Average)

	Direct	Indirect	Induced	Total
Average Annual Economic Benefit During 24-mo Construction Period	$ 27,931,004	$ 3,940,990	$ 6,287,351	**$ 38,159,345**
Average Annual Economic Benefit During First 21 Years of Operations	$ -	$ 1,271,965	$ -	**$ 1,271,965**

Sources: NRG (2016); Implan 3.0 (2016).

4.00 FISCAL IMPACT INFORMATION

The fiscal impacts and benefits of the proposed Canal 3 Project are defined by a Host Community Agreement ("HCA") and a Payment in Lieu of Taxes Agreement ("PILOT") negotiated between the Town of Sandwich and NRG. The Town of Sandwich has relied on its own technical consultants, municipal officials, town staff and legal counsel to analyze the proposed Canal 3 Project and the Town of Sandwich has concluded "that, subject to the agreements contained and/or described herein, and Owner's strict adherence to all applicable federal, state and local permits, laws and regulations, the net result of the Project's construction and operation is consistent with preservation of the human and natural environment and will protect the interests of the Town."[23] The relevant details of these agreements are discussed below with respect to the various municipal services and benefits covered by the PILOT and HCA.

4.10 PAYMENT IN LIEU OF TAXES (PILOT) AGREEMENT

The PILOT covers all real and personal property taxes otherwise due for the new facility but it does not affect any payments, other than real and personal property taxes, owed by NRG to the Town of Sandwich, including, but not limited to, payments due under the HCA, vehicle excise taxes, and amounts for services, if any, provided by the Town to NRG and the Canal 3 Project, such as water and sewer services. The term of the PILOT is for 21 years starting at the Canal 3 Project Commercial Operation Date ("COD").

The existing Canal Generating Station will continue to be assessed and taxed pursuant to the terms of the Tax Valuation Agreement dated April 3, 2014 by and between the Town and NRG Canal LLC and/or G.L. c. 59, as applicable, and is not subject to the PILOT.
In FY 2016, the existing Canal Generation Station was assessed at $120 million and paid $1.84 million in property tax payments.

[23] *Host Community Agreement between the Town of Sandwich and NRG Canal 3 Development LLC*

The amounts listed below in Table 7 are to be paid in equal installments on a quarterly basis to the Town of Sandwich Tax Collector. "FY 1" as listed below shall be the first fiscal year in which the COD occurs by December 31 of such fiscal year.

Table 7
NRG PILOT Payments to the Town of Sandwich

FISCAL YEAR	PILOT PAYMENT	COMMUNITY PRESERVATION ACT PAYMENT	SANDWICH WATER DISTRICT PAYMENT
FY 1 *(COD)*	3,559,951	106,799	183,251
FY 2	2,172,957	65,189	111,854
FY 3	1,941,791	58,254	99,955
FY 4	1,710,626	51,319	88,056
FY 5	1,770,498	53,115	91,137
FY 6	1,832,465	54,974	94,327
FY 7	1,859,022	55,771	97,629
FY 8	1,924,088	57,723	101,046
FY 9	1,991,431	59,743	104,582
FY 10	2,061,131	61,834	108,243
FY 11	2,133,271	63,998	112,031
FY 12	2,207,936	66,238	115,952
FY 13	2,285,213	68,556	120,011
FY 14	2,365,196	70,956	124,211
FY 15	2,447,978	73,439	128,558
FY 16	2,555,757	76,673	134,219
FY 17	2,709,102	81,273	142,272
FY 18	2,871,649	86,149	150,808
FY 19	3,043,947	91,318	159,856
FY 20	3,226,584	96,798	169,448
FY 21	3,420,179	102,605	179,615
Total	**50,090,772**	**1,502,724**	**2,617,061**

For the purposes of the PILOT, each fiscal year begins on July 1 and ends on June 30 of the following calendar year.

4.11 HOST COMMUNITY AGREEMENT

Commencing at receipt of a building permit from the Town of Sandwich until the COD, NRG will contribute twenty five thousand dollars ($25,000) per year to the Sandwich Public Schools and fifty thousand dollars ($50,000) per year to the Town of Sandwich for the purpose of providing fire, emergency management services, police and first responder training on responses to the Facility and adjoining parcels. For a period of 21 years starting at the COD, NRG will contribute fifty thousand dollars ($50,000) per year to the Sandwich Public Schools and one hundred thousand dollars ($100,000) per year to the Town of Sandwich for the purpose of providing fire, emergency management services, police and first responder training on responses to the Facility and adjoining parcels (see Table 8).

Payments are to be made in equal installments on a fiscal quarter basis, prorated for partial fiscal years. "FY 1" as listed below in Table 8 is the first fiscal year in which the COD occurs by December 31 of such fiscal year. For the purposes of the HCA, each fiscal year begins on July 1 and ends on June 30 of the following calendar year.

In the event that a building permit from the Town of Sandwich has been issued and the COD is delayed, NRG will also make supplemental payments in the amount of $1 million per year for up to two years.

Table 8
NRG HCA Payments to the Town of Sandwich and Sandwich Public Schools

FISCAL YEAR	Public Safety & Emergency Management Training and Equipment	School Curriculum Fund
FY-1	37,500	18,750
FY 0	50,000	25,000
FY 1 *(COD)*	100,000	50,000
FY 2	100,000	50,000
FY 3	100,000	50,000
FY 4	100,000	50,000
FY 5	100,000	50,000
FY 6	100,000	50,000
FY 7	100,000	50,000
FY 8	100,000	50,000
FY 9	100,000	50,000
FY 10	100,000	50,000
FY 11	100,000	50,000
FY 12	100,000	50,000
FY 13	100,000	50,000
FY 14	100,000	50,000
FY 15	100,000	50,000
FY 16	100,000	50,000
FY 17	100,000	50,000
FY 18	100,000	50,000
FY 19	100,000	50,000
FY 20	100,000	50,000
FY 21	100,000	50,000
Total	**2,187,500**	**1,093,750**

4.20 MUNICIPAL SERVICES

4.21 Water

Under the terms of the HCA, NRG shall be responsible at its sole cost, for providing sufficient water to the power generating facility to ensure proper environmental and air quality controls are in place, in accordance with All Applicable Laws. The Canal 3 Facility will use well water from its own well and will not rely on the Sandwich Water District system in connection with NRG's provision of water to the Project and/or Facility, except if necessary during emergency conditions. Nevertheless, NRG will pay approximately $2.6 million to the Sandwich Water District over a 21 year period under the terms of the PILOT (see Table 7).

Furthermore, NRG will submit to the Town copies of all submissions required of NRG pursuant to the provisions of G.L. c. 21G and 310 C.M.R. §36.00, including, but not limited to, the following: (i) application for permit; (ii) annual statements of withdrawal; (iii) filings for five-year permit reviews; (iv) permit renewal applications; and (v) permit amendment applications. NRG shall submit copies of the foregoing to the Town at the time these submissions are due to the Massachusetts Department of Environmental Protection ("MassDEP").

4.22 Sewer

The proposed Canal 3 Project will not have any sewer use and, therefore, it will not use the Town of Sandwich sanitary sewer service.

However, under the terms of the HCA, NRG will consider in good faith ways to assist in the evaluation and development of a wastewater treatment plant to be located on Cape Cod for the benefit of the Town of Sandwich and/or other municipalities on Cape Cod.

4.23 Solid Waste

Solid waste disposal for the proposed Canal 3 Project will be provided by Republic Services, a private vendor, and paid for by NRG. Consequently, the new power generating facility will not place any new demand on the town's Department of Public Works, which is responsible for solid waste disposal.

4.24 Public Schools

Under the terms of the HCA, NRG agrees to work with the Town of Sandwich to support and sponsor education programs in the Sandwich Public Schools for science initiatives and as part of the Massachusetts Science, Technology, Engineering and Math ("STEM") program. Under the terms of the HCA, commencing at the receipt of a building permit from the Town of Sandwich until the COD, NRG will contribute twenty five thousand dollars ($25,000) per year to the Sandwich Public Schools. For a period of 21 years starting at the COD, NRG will contribute fifty thousand dollars ($50,000) per year to the Sandwich Public Schools (see Table 8).

The Sandwich Public Schools will place the STEM funding in a donation and/or gift account in accordance with G.L. c. 44, §53A and will utilize such funds at the discretion of the Superintendent of Sandwich Public Schools.

4.25 Public Safety

Under the terms of the HCA, commencing at the receipt of a building permit from the Town of Sandwich until the COD, NRG will contribute fifty thousand dollars ($50,000) per year to the Town of Sandwich for the purpose of providing fire, emergency management services, police and first responder training on responses to the Facility and adjoining parcels. For a period of 21 years starting at the COD, NRG will contribute one hundred thousand dollars ($100,000) per year to the Town of Sandwich for the purpose of providing fire, emergency management services, police and first responder training on responses to the Facility and adjoining parcels (see Table 8).

The Town will place the emergency preparedness funds in a donation and/or gift account in accordance with G.L. c. 44, §53A and will utilize such funds at the discretion of the Town Manager.

4.26 Human Services

The proposed Canal 3 Project's customers are not expected to generate any additional demand for human services. NRG Energy, Inc. pays above average wages for the state and county and it directly provides extensive fringe benefits to its employees, including comprehensive health care coverage.

4.27 Parks & Recreation

The proposed Canal 3 Project's customers are not expected to generate any additional demand for parks or recreation. However, under the terms of the HCA, and in the event that NRG dredges the Cape Cod Canal in connection with the Project (excluding any required dredging by the U.S. Army Corps of Engineers, NRG will use commercially reasonable efforts to place and shape compatible dredge material on Town of Sandwich beaches.

4.28 Public Transit

NRG has agreed to work with Town of Sandwich officials to develop a traffic management plan under the terms of the Host Community Agreement. All construction and operations-related heavy truck traffic shall only access the Facility via Tupper Road to Freezer Road, unless otherwise identified in the Traffic Management Plan, which shall be subject to the approval of the Town's Chief of Police. The Traffic Management Plan shall also address deliveries by barge and shall be subject to the approval of the Town's Harbormaster. Barge deliveries will enter the facility from the Canal bulkhead east of the Town marina and will be heavy-hauled via Ed Moffet Drive to Freezer Rd. It is expected that heavy hauls will be performed at night to reduce traffic interferences. Large equipment modules will be delivered by barge to the extent possible. NRG has also agreed to utilize Sandwich police details as may be required or directed by the Town during construction and operation of the

facility to ensure the safety of the surrounding area at Freezer Road. During construction, any material deviations from this Traffic Management Plan must be submitted for approval to the Sandwich Chief of Police and Sandwich Harbormaster for their approval, not to be unreasonably withheld, delayed or denied. NRG's use of such details in connection with construction or operation of the facility or upon local public ways shall be subject to the rules and requirements of the Sandwich Chief of Police and the Sandwich Harbormaster.

Following completion of the Project, but in no event later than six (6) months following completion of the construction, NRG has agreed to repair any material damage to any street or streets near the project site and/or in NRG's construction routes in Sandwich caused by construction of the Project. Such repairs will be completed in accordance with commonly accepted standards of road construction and condition.

4.29 Independent Technical Consultants

NRG will make a one-time payment to the Town of Sandwich in the amount of seventy-five thousand dollars ($75,000) for the Town to retain independent legal, environmental, noise, and other technical consultants necessary for the Town to review all Project proposals and permit applications and negotiate Project related agreements with NRG, including the HCA and the PILOT.

4.30 OTHER PROJECT BENEFITS

4.31 Charitable Contributions

NRG Energy, Inc. has made approximately $15,000 in charitable contributions across the Commonwealth of Massachusetts in 2016, including contributions to Smile Mass, Decibels Foundation, Habitat for Humanity Greater Boston, and the Boston Educational Development Foundation.

4.32 Decommissioning

The HCA requires NRG to decommission the power generating facility following the end of all use and/or operations of the facility, at NRG's sole cost and expense, in accordance with All Applicable Laws, in accordance with Good Industry Practice to manage long-term safety, security, and maintenance of facilities, including, without limitation, the potential dismantlement and sale of equipment and restoration of the Site.

SOURCES CONSULTED

Barnstable County, Massachusetts. 2012. *Cape Cod Regional Policy Plan.* Barnstable, MA: Cape Cod Commission. Available at http://www.capecodcommission.org/resources/RPP/2012RPP_printJan2013.pdf

Cape Cod Commission. 2004. *Economic Development Technical Bulletin, No. 04-002.* Barnstable, Massachusetts. Available at http://www.capecodcommission.org/resources/regulatory/EconomicDevelTechBulletin.pdf

Cape Cod Commission. 2011. *Enabling Regulations Governing Review of Developments of Regional IMPact,* Barnstable County Ordinance, 90-12 (as amended and revised, March 2011). Barnstable, Mass.

Cape Cod Commission. 2016. "Cape Cod Districts of Critical Planning Concern, as of September 2013." Available at http://www.capecodcommission.org/departments/planning/DCPC/designated?searched=district+of+critical&advsearch=exactphrase&highlight=ajaxSearch_highlight+ajaxSearch_highlight1

Commonwealth of Massachusetts. 2015. "Employment and Wages (ES-202)." Boston: Department of Labor and Workforce Development. see, http://lmi2.detma.org/lmi/lmi_es_a.asp#IND_LOCATION

Commonwealth of Massachusetts. 2015. "Occupational Employment and Wage Statistics." Boston: Department of Labor and Workforce Development. see, http://lmi2.detma.org/lmi/lmi_OES_a_allOcc.asp

Executive Office of the President. 2012. *North American Industry Classification System.* Washington, D.C.: Office of Management and Budget.

Host Community Agreement between the Town of Sandwich and NRG Canal 3 Development LLC (draft, June 27, 2016 and August 24, 2016).

Massachusetts Division of Workforce Development, "Employment & Wages (ES-202) through 4th Quarter 2015." Available at http://lmi2.detma.org/lmi/lmi_es_a.asp

Massachusetts Division of Workforce Development, "Occupational Employment & Wages All Industries." Available at http://lmi2.detma.org/lmi/lmi_oes_a.asp

NRG. 2015. *Sustainability Report.* Available at http://www.nrg.com/documents/sustainability/2015-nrg-sustainability-report.pdf

U.S. Bureau of the Census. 2016. "Selected Social Characteristics, Barnstable County, Massachusetts." *American Community Survey, 2010-2014 5-Year Estimates.*

US Bureau of Labor Statistics. 2010. "Standard Occupational Classification (SOC)." Available at http://www.bls.gov/soc/

[This page left blank intentionally]

APPENDIX A

Clyde W. Barrow, Ph.D.
Pyramid Associates, LLC
151 State Road, Suite 4
Westport, MA 02720
(978) 340-6234

Education

1984	Ph.D.	Political Science, University of California, Los Angeles, Los Angeles, CA
1979	M.A.	Political Science, University of California, Los Angeles, Los Angeles, CA
1977	B.A.	Political Science, Texas A & M University at Kingsville, Kingsville, TX

Specializations: ***Political Economy*** (Economic Impact Analysis, Industry & Economic Base Analysis; Market Feasibility Analysis);
Public Policy (Regional Economic Development, Workforce Development Policy; Applied Policy Research; Research Methods for Public Policy).

Work Experience

Sept. 2014 to present	***Chair/Professor of Public Policy***, Department of Political Science, University of Texas Rio Grande Valley (manage a department of 32 faculty on two campuses).
Sept. 2015 to Present	***Co-Director,*** Center for Survey Research, University of Texas Rio Grande Valley (a multi-disciplinary survey research center that specializes in behavioral surveys, public opinion and program evaluation)
Sept. 1992 to August 2014	***Director***, Center for Policy Analysis, University of Massachusetts Dartmouth (a multi-disciplinary applied research center that completed approximately 300 policy monographs from 1992-2014 for state and municipal government agencies; trade, business, and labor associations; and non-profit organizations).
Sept. 1987 to Aug. 2014	***Chancellor Professor***, Department of Public Policy (Jan. 2004 – present) ***Chair***, Department of Public Policy, University of Massachusetts Dartmouth (2006-2009). ***Professor,*** Department of Political Science (1996 – 2003) ***Acting Chair***, Department of Political Science (Jan. 1995 - June 1995, Jan. 1992 - August 1993) ***Associate Professor,*** Department of Political Science (1990 - 1996, tenured) ***Assistant Professor***, Department of Political Science 1987 - 1990)
Sept. 1985 to August 1987	***Visiting Assistant Professor,*** Texas A&M University - College Station, Department of Political Science
Sept. 1984 to August 1985	***Visiting Assistant Professor***, University of Texas at San Antonio, Division of Social and Policy Sciences

Self-Employment

Sept. 2006 to Present — **General Manager/Partner**, Pyramid Associates, LLC (a registered Massachusetts company specializing in regional economic development, economic impact analysis; economic base and industry analysis, market feasibility analysis, and gaming policy).

Consultantships

Sept. 2008 to Present — ***Council Member***, Gerson Lehrman Group (http://www.glgresearch.com/). Provide briefings and consultation about the gaming industry to capital management firms, investment banks, venture capital funds, and bond traders.

March 2013 to Present — **Academic Affiliate, Nathan Associates, Inc. (**a California based economic consulting firm that specializes in litigation consulting, business and industry consulting, and economic development) (http://www.nathaninc.com/). Provide independent research support to Nathan Associates on consulting projects.

Sept 2001 to May 2002 — ***Regional Economic Analyst,*** Statewide Economic Development Strategies Project, Massachusetts Department of Economic Development

June 1997 to 2009 — ***Regional Economic Analyst,*** Massachusetts Benchmarks Projects, Co-sponsored by the University of Massachusetts and Federal Reserve Bank of Boston (Southeastern Massachusetts and Cape Cod specialist) (www.massbenchmarks.org)

Jan. 1997 to Dec. 1999 — ***Advisory Board***, Southeastern Regional Planning and Economic Development District, Economic Development Committee

May 1996 to Oct. 1996 — ***Executive Staff Analyst,*** Regional Economic Development Strategies Project, Executive Office of Economic Affairs and Massachusetts Office of Business Development (Southeastern Massachusetts and Cape Cod regions)

Jan. 1994 to Dec. 1994 — ***Executive Staff Analyst***, Governor's Commission on Commonwealth Port Development (Southeastern Massachusetts region)

Jan. 1992 to Oct. 2009 — ***Research Analyst***, Office of the Mayor, City of Fall River, Massachusetts

Legislative and Administrative Testimony

April 7, 2015 — *Hearings*, House Committee on Ways & Means, General Court of the State of New Hampshire, held at Legislative Office Building, Room 202, Concord, New Hampshire.

April 6, 2015 — *Briefings*, Senior Staff in Connecticut Governor's Office of Policy & Management, Senate Majority Leader & Staff, House Minority Leader & Staff.

March 17, 2015 — *Hearings*, Committee on Public Safety & Security, Connecticut General Assembly, held at Legislative Office Building, Room 2C, Hartford, Connecticut.

February 17, 2015 — *Hearings*, Senate Committee on Ways & Means, General Court of the State of New Hampshire, held at Representatives Hall, Legislative Office Building, Concord, New Hampshire.

November 11-12, 2014	*Briefing*, Secretary of Administration Huebsch and Governor Scott Walker (and other staff), State of Wisconsin (via Skype teleconference), Madison, Wisconsin.
October 14-15, 2014 September 9, 2014	*Expert Testimony* in *State of Wisconsin, Claimant v. Forest County Potawatomi Community of Wisconsin, Respondent*, Milwaukee, Wisconsin.
September 26, 2014	*Expert Testimony* in *Kickapoo Traditional Tribe of Texas, Plaintiff in Intervention v. Texas Racing Commission et al., Defendants*, Austin, Texas.
February 6, 2014	*Hearings*, House Committee on Ways & Means, General Court of the State of New Hampshire, held at Legislative Office Building, Room 202, Concord, New Hampshire.
January 12, 2014	*Hearings*, Joint Standing Committee on Veterans and Legislative Affairs, Maine State Legislature, State House, Augusta, Maine
September 26, 2013	*Hearings*, Connecticut State Legislative Task Force on Expanded Video Gaming, held at State House, Hartford, Connecticut.
September 12, 2013	*Hearings*, New Hampshire Gambling Regulatory Oversight Authority, held at Legislative Office Building, Room 202, Concord, New Hampshire.
June 10, 2013	*Briefing*, Governor of California (Jerry Brown) and Chief Gaming Advisor, Office of the Governor, Sacramento, California.
May 8, 2013	*Briefing*, 52 Members of the New Hampshire General Court, 1st Year of the 163nd Session, Held at the Holiday Inn, Concord, New Hampshire.
April 17, 2013	*Hearings*, House Joint Committee of Finance and Ways and Means, 1st Year of the 163nd Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
June 14, 2012	*Educational Forum*, Massachusetts Gaming Commission, Held in the Hebert Auditorium, Quinsigamond Community College, Worcester, Massachusetts.
February 13, 2012	*Hearings*, House Committee on Ways & Means, 2nd Year of the 162nd Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
Sept. 29, 2011	*Hearings*, House Committee on Ways & Means, 1st Year of the 162nd Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
May 11, 2011	*Hearings*, 97th General Assembly of the State of Illinois, Senate Executive Committee, Held in State House, Springfield, Illinois (HB 1965).
May 4, 2011	*Hearings*, Massachusetts General Court, Joint Committee on Economic Development and Emerging Technologies, Held in Gardner Auditorium, State House, Boston, Massachusetts.
April 11, 2011	*Briefing*, Massachusetts General Court (Closed Door, Members Only Session), Held in Room A-2, State House, Boston, Massachusetts.

March 30, 2010	*Hearings*, House Committee on Local & Regulated Revenues, 2nd Year of the 161st Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
March 4, 2010	*Hearings*, Senate Finance Committee, 2nd Year of the 161st Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
November 16, 2009	*Briefing*, Embassy of France, Department of Economic Affairs Staff, (Conference call with Ministry of Trade), Held in Room 105, Center for Policy Analysis, North Dartmouth, Massachusetts.
November 9, 2009	*Briefing*, Massachusetts General Court (Closed Door, Members Only Session), Held in Room A-2, State House, Boston, Massachusetts.
October 28, 2009	*Hearings*, Massachusetts General Court, Joint Committee on Emerging Technologies and Economic Development, Held in Gardner Auditorium, State House, Boston, Massachusetts.
October 20, 2009	*Hearings*, New Hampshire Gaming Study Commission
July 1, 2009	*Briefing*, Massachusetts Speaker of the House and Executive Staff, Held in State House, Room 356, Boston, Massachusetts.
June 29, 2009	*Hearings*, Senate Committee on Economic Development & Emerging Technologies, 186th Session of the Massachusetts General Court, Held in the State House, Gardner Auditorium, Boston, Massachusetts.
March 17, 2009	*Briefing*, Massachusetts State Treasurer and Executive Staff, Held in State House, Room 227, Boston, Massachusetts.
March 10, 2009	*Briefing*, Chairman and Staff, Joint Committee on Economic Development & Emerging Technologies, 186th Session of the Massachusetts General Court, Held in State House, Room 42, Boston, Massachusetts.
March 3, 2009	*Hearings*, Senate Ways & Means Committee, 161st Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
Feb. 3, 2009	*Hearings*, House Committee on Local & Regulated Revenues, 161st Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 100, Concord, New Hampshire.
Sept. 16, 2008	*Hearings*, House Ways & Means Committee, 160th Session of the New Hampshire General Court, Held in the Legislative Office Building, Room 204, Concord, New Hampshire.
March 18, 2008	*Hearings*, Massachusetts General Court, Joint Committee on Emerging Technologies and Economic Development, Held in Gardner Auditorium, State House, Boston, Massachusetts.
Dec. 18, 2007	*Hearings*, Massachusetts General Court, Joint Committee on Bonding, Capital Expenditures and State Assets, Held in Gardner Auditorium, State House, Boston, Massachusetts.

Oct. 23, 2007	*Briefing*, Massachusetts House of Representatives, Held in the Massachusetts State House, Boston, Massachusetts.
May 22, 2007	*Briefing*, Special Committee on Gaming/Casinos, New Bedford City Council, Held at City Hall, New Bedford, Massachusetts.
May 1, 2007	*Briefing*, Governor's Study Group on Gaming, Held at the Massachusetts Department of Economic Development, Saltonstall Building, Boston, Massachusetts.
Sept. 18, 2006	*Briefing*, Canadian Consulate & Visiting Trade Delegation, Held at the Canadian Consulate, Boston, Massachusetts.
May 4, 2006	*Hearings*, Rhode Island House of Representatives, Finance Committee, Held in the Joseph T. Trainor Hearing Room (035), State House, Providence, Rhode Island.
April 3, 2006	*Briefing*, SE Massachusetts U.S. Congressional Delegation (Frank, Delahunt, McGovern), Held at Woodland Commons Conference Center, University of Massachusetts Dartmouth, North Dartmouth, Massachusetts.
March 24, 2005	*Hearings*, Massachusetts Board of Higher Education, Held at One Ashburton Place, 21st Floor, Boston, Massachusetts
May 24, 2004	*Hearings*, Rhode Island State Senate, Committee on Constitution & Gaming Issues, Held in Room 313, State House, Providence, Rhode Island.
May 13, 2004	*Hearings*, Rhode Island House of Representatives, Finance Committee, Held in the Joseph T. Trainor Hearing Room, State House, Providence, Rhode Island
May 6, 2004	*Briefing*, Rhode Island State Senate (meeting in caucus), Held in Room 313, Rhode Island State House, Providence, Rhode Island
Oct. 15, 2002	*Hearings*, Rhode Island House Commission to Study Gaming, Held in the Joseph T. Trainor Hearing Room, Room 35, Rhode Island State House, Providence, Rhode Island
July 30, 2002	*Hearings*, Rhode Island House Commission to Study Gaming, Held in the Joseph T. Trainor Hearing Room, Room 35, Rhode Island State House, Providence, Rhode Island
July 12, 2000	*Hearings*, "21st Century Veterans Employment and Training Act," U.S. House Committee on Veterans' Affairs, Subcommittee on Benefits, Held at 334 Cannon House Office Building, Washington, D.C.
March 16, 1999	*Hearings*, "The Massachusetts Casino Control Act," Senate No. 352 (1999), Joint Government Regulations, Massachusetts General Court, Held at Gardener Auditorium, State House, Boston, MA
Nov. 6, 1995	*Hearings*, A Proposal to Authorize Casino Gaming in New Bedford and Western Massachusetts, Joint Government Regulations Committee, Massachusetts General Court, Held Gardener Auditorium, State House, Boston, MA
Nov. 2, 1995	*Hearings*, An Act Providing for an Accelerated Transport Development & Improvement Program for the Commonwealth, Joint Standing Committee on Transportation, Massachusetts General Court, Held at Gardener Auditorium, State House, Boston, MA

March 1, 1994	*Briefing*, Clean Water Act: Proposed Amendments Concerning "Hardship Communities" and the Financing of Combined Sewer Overflow Facilities, U.S. House Committee on Public Works and Transportation, Held at the Rayburn Building, Washington, D.C.
May 17, 1991	*Hearings*, Unemployment Compensation Reform, Joint Committee on Commerce and Labor, Massachusetts General Court, Held at City Hall, New Bedford, Massachusetts
July 8, 1991	*Hearings*, Effect of the 1990-91 Recession on the U.S. Workforce: Its Impact on Southeastern Massachusetts, U.S. Senate Committee on Labor and Human Resources, Held at Benny Costa Plaza, Fall River, Massachusetts

Other Testimony & Presentations

More than 120 presentations to state and municipal public organizations in Massachusetts, including, City Councils, Boards of Selectmen, Workforce Investment Boards, Regional Planning Agencies, Economic Development Councils and Industrial Foundations, Chambers of Commerce, Trade Unions, School Committees, Federal and State Executive Departments & Agencies

Publications and Policy Monographs: Recent Examples

The Consultant has published 6 books, 2 edited books, 24 book chapters, 76 scholarly articles, 71 book reviews, and 59 articles in trade publications, magazines, and newspapers. The author has also delivered 185 conference papers and invited talks since 1984. He has also authored or co-authored 178 applied policy monographs over the last 15 years and has supervised the production of nearly 300 policy monographs at the Center for Policy Analysis. The Consultant has authored approximately 50 additional market feasibility, economic impact, and industry analyses since 2008 as a partner of Pyramid Associates, LLC. The following is a selected list of recent policy-related publications:

Barrow, Clyde W., Alan Meister, and David Borges. 2016 "An Empirical Framework for Assessing Market Saturation in the U.S. Casino Industry." *Gaming Law Review and Economics* vol. 20, no. 5 (June): 397-411.

Barrow, Clyde W. *Mashpee Senior Housing Facility: Economic & Fiscal Impact Analysis* (Revised and Updated), August 2015. Prepared for The Northbridge Cos. (Submitted to the Cape Cod Commission).

Barrow, Clyde W. *Satellite Gaming Facilities in Connecticut: Market Feasibility & Economic Impact Analysis*, May 2015. Prepared for Mohegan Tribal Gaming Authority & Mashantucket Pequot Gaming Enterprise. (Submitted to the Connecticut General Assembly).

Barrow, Clyde W. *Northeast Casino Gaming Update, 2015*. Prepared for the Northeast Casino Gaming Research Project, Pyramid Associates, LLC.

Borges, David R. and Clyde W. Barrow. *Xfinity Center: Economic Impact Report*, February 2015. Prepared for Live Nation!

Barrow, Clyde W. *The State Theatre: An Economic Impact Analysis*, April 2014. Prepared for The Field Organization. (Submitted to the Massachusetts Cultural Council).

Barrow, Clyde W. and David R. Borges. *Business Confidence and Policy Priorities Survey*. Boston, MA: Nutter, McClennen & Fish, LLP Attorneys at Law, March 2011.

Borges, David R. and Clyde W. Barrow. *Cape Cod Wastewater Survey*. Barnstable, Massachusetts: Cape Cod Wastewater Commission, 2008.

The Fiscal Impacts of a Circuit City on the Town of Barnstable, Massachusetts. North Dartmouth, MA: Center for Policy Analysis, 2008. Prepared for Circuit City, Inc. (Submitted to the Cape Cod Commission).

Barrow, Clyde W., David Terkla and Rebecca Loveland). "Sailing Into a Strong Future: The Massachusetts Marine Science and Technology Industry." *Massachusetts Benchmarks: The Quarterly Journal of the Massachusetts Economy*, Vol. 7, No. 4 (Fall 2005): 14-21.

Barrow, Clyde W. and David R. Borges). *Artists, Artisans, and Cultural Organizations: An Economic Impact Analysis of an Emerging Industry on Cape Cod & the Islands*. Barnstable, Mass.: Cape Cod Chamber of Commerce and Cape & Islands Community Development, Inc.

Barrow, Clyde W. "Cape Cod and the Islands: B&B + R&D = A New Economy." *Massachusetts Benchmarks: The Quarterly Journal of the Massachusetts Economy*, Vol. 7, No. 4 (Fall 2005): 22-30.

Barrow, Clyde W., Rebecca Loveland and David Terkla. *The Marine Science and Technology Industry in New England*. Boston: University of Massachusetts Donahue Institute, 2005.

Barrow, Clyde W. *More Than Dollars Alone: The Economic & Security Significance of Hanscom Air Force Base and Natick Soldier Systems Center*. Prepared for MassDevelopment Corporation, 2004 (Submitted to the U.S. Base Realignment and Closing Commission).

Barrow, Clyde W. "Southeastern Region," *Massachusetts Benchmarks: The Quarterly Review of Economic News & Insight*, Vol. 6, No. 1 (Winter/Spring 2003): 21-22.

Barrow, Clyde W. and David R. Borges. "Cape Cod and the Islands," *Massachusetts Benchmarks: The Quarterly Review of Economic News & Insight*, Vol. 6, No. 1 (Winter/Spring 2003): 23-24.

Barrow, Clyde W., Sylvie Didou-Aupetit, and John Mallea). *Globalization, Trade Liberalisation, and Higher Education in North America: The Emergence of a New Market Under NAFTA?* Dordrecht, The Netherlands: Kluwer Academic Publishers, 2003.

Barrow, Clyde W. "Southeastern Massachusetts Region," *Toward a New Prosperity: Building Regional Competitiveness Across the Commonwealth*, (Boston: Massachusetts Department of Economic Development, 2002): 71-80.

Barrow, Clyde W. and David R. Borges. "Cape and the Islands Region," *Toward a New Prosperity: Building Regional Competitiveness Across the Commonwealth*, (Boston: Massachusetts Department of Economic Development, 2002): 81-90.

Barrow, Clyde W. "Southeastern Massachusetts: Building a New Economy," *Massachusetts Benchmarks: The Quarterly Review of Economic News & Insight*, Vol. 5, No. 4 (Summer 2002): 16-20.

BJ's Wholesale Club: Economic and Fiscal Impacts on Cape Cod. Prepared for Nutter, McClennen & Fish, LLP, 2001 (Submitted to the Cape Cod Commission).

Barrow, Clyde W. "Cape Cod and the Islands: More Than a Resort Economy," *Massachusetts Benchmarks: The Quarterly Review of Economic News & Insight*, Vol. 4, no. 3 (Summer 2001): 17-23.

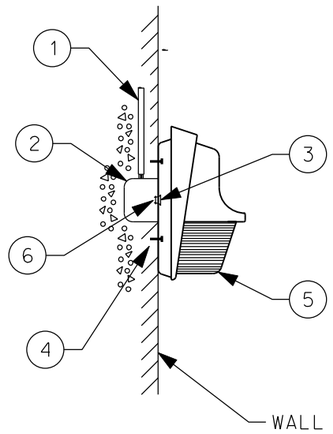
Barrow, Clyde W. "Southeastern Massachusetts: From Deindustrialization to Divergence." *Massachusetts Benchmarks: The Quarterly Review of Economic News & Insight*, Vol. 3, no. 2 (Spring 2000): 18-22.

Barrow, Clyde W. and David R. Borges. *Help!Wanted: Cape Code's Seasonal Workforce*. Prepared for the Cape Cod Commission.

Barrow, Clyde W. "Southeastern Massachusetts: A Region of Growth Without Development." *Massachusetts Benchmarks: The Quarterly Review of Economic News & Insight*, Vol. 1, no. 3 (Summer 1998): 9-10, 15-17.

ATTACHMENT 5.P-1: LIGHTING PLAN

Standard Details



BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
1	AS REQ'D	3/4" CONDUIT (NOTE 2)	-
2	1 EA	4" FLUSH MOUNTED OUTLET BOX	CROUSE-HINDS "CP" SERIES OR ENGINEERING APPROVED EQUAL
3	1 EA	3/4" INSULATED BUSHED NIPPLE	APPLETON #CN75I
4	AS REQ'D	HILTI OR EPOXY TYPE ANCHORS	-
5	1 EA	OUTDOOR WALL MOUNTED FIXTURE (NOTE 1)	-
6	1 EA	3/4" LOCKNUT	-

WALL MOUNTED AREA FIXTURE (WALLPACK)

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

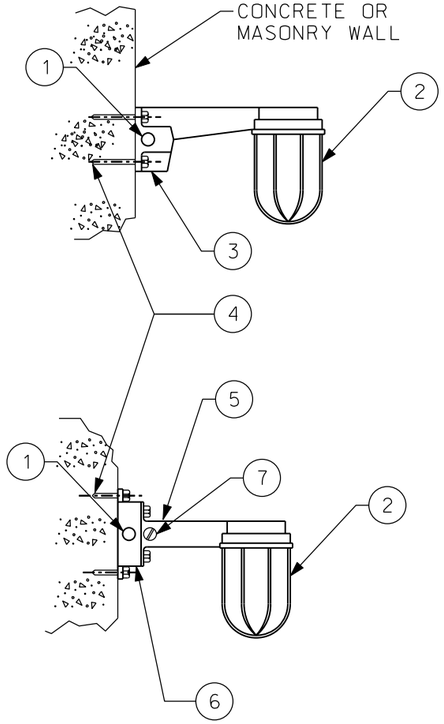
DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: —

WALL MOUNTED AREA FIXTURE (WALLPACK)

FOR: —

PROJ NO: — | DWG NO: CMS-830-07-SD-56014 | REV: 0



WALL MOUNTED FIXTURE
ON CONCRETE/MASONRY SURFACE

BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
(1)	AS REQ'D	3/4" RGS CONDUIT	–
(2)	1 EA	ENCLOSED & GASKETED FIXTURE W/ GLOBE & GUARD (WATTAGE AS REQ'D) (NOTE 1)	CROUSE-HINDS VAPORGARD SERIES OR ENGINEERING APPROVED EQUAL (NOTE 1)
(3)	1 EA	THRU FEED FIXTURE BRACKET	CROUSE-HINDS CHAMP SERIES
(4)	8 EA	HILTI #KB 1/4" x 3/4" KWIK BOLT WEDGE ANCHOR	HILTI #337922
(5)	1 EA	THRU FEED FIXTURE BRACKET	CROUSE-HINDS CHAMP SERIES
(6)	1 EA	CAST OUTLET BOX W/ GASKET	CROUSE-HINDS TYPE CPS OR ENGINEERING APPROVED EQUAL
(7)	1 EA	PLUG	–

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 – LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

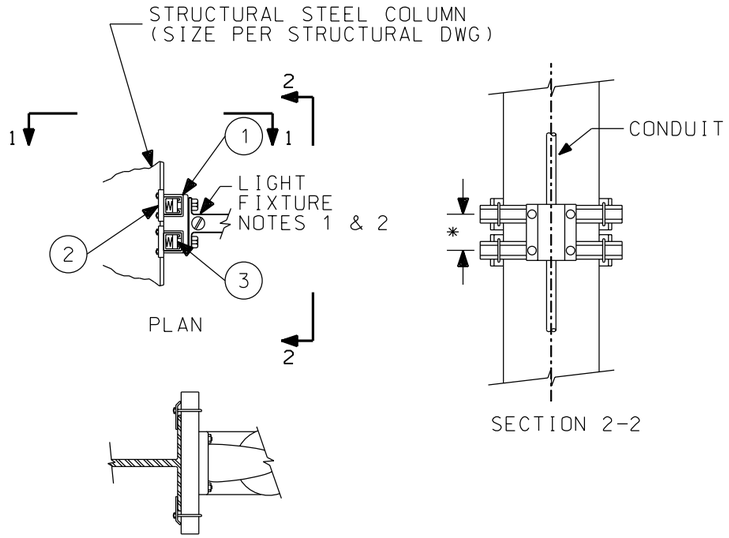
DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: –

WALL MOUNTED FIXTURE
ON CONCRETE/MASONRY SURFACE

FOR: –

PROJ NO: – | DWG NO: CMS-830-07-SD-56015 | REV: 0



NOTE:
VERTICAL STEEL SHOWN, HORIZONTAL STEEL SIMILAR.

WALL FIXTURE MOUNTED TO STRUCTURAL STEEL
(ACROSS FLANGE)

BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
(1)	2 EA (LGTH AS REQ'D)	STEEL CHANNEL (HDGAF)	UNISTRUT P1000 OR ENGINEERING APPROVED EQUAL
(2)	4 EA	BEAM CLAMP HOT DIPPED GALVANIZED	UNISTRUT #P2785 OR ENGINEERING APPROVED EQUAL
(3)	4 EA	STUD NUT W/ 1/4"x20 SS HEX NUT, LOCK & FLAT WASHERS	UNISTRUT #P2378-1 OR ENGINEERING APPROVED EQUAL

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

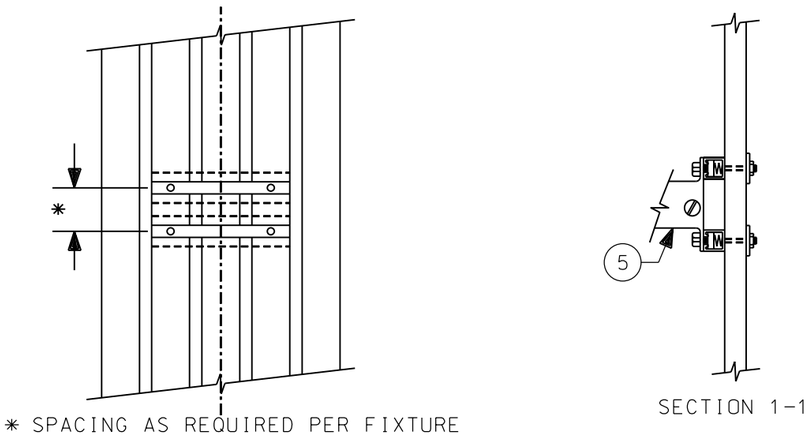
CLIENT DWG NO: —

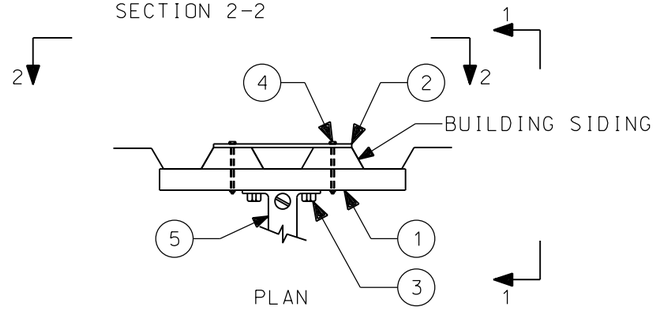
WALL FIXTURE MOUNTED
TO STRUCTURAL STEEL FLANGE

FOR: —

PROJ NO: — | DWG NO: CMS-830-07-SD-56017 | REV: 0

Form: CMS-830-00-FM-02110 CBI ANSI B





WALL FIXTURE MOUNTED ON STEEL OR ALUMINUM SIDING

BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
1	2 EA (LGTH AS REQ'D)	STEEL CHANNEL (HDGAF)	UNISTRUT P1000 OR ENGINEERING APPROVED EQUAL
2	2 EA (LGTH AS REQ'D)	1/4"x2" WIDE GALVANIZED STEEL BAR	-
3	4 EA	STUD NUT W/ 1/4"x20 SS HEX NUT, LOCK & FLAT WASHERS	UNISTRUT #P2378-1 OR ENGINEERING APPROVED EQUAL
4	4 EA	3/8"-16 SS HEX HEAD CAP SCREW W/ HEX NUT, FLAT LOCK & SQUARE WASHERS (LENGTH AS REQ'D)	-
5	1 EA	LIGHT FIXTURE (NOTE 1)	

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

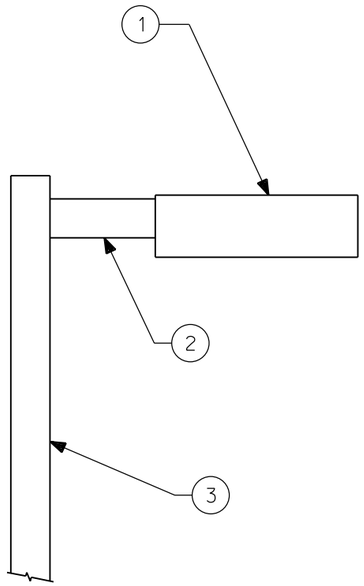
DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: -

WALL FIXTURE MOUNTED TO STEEL OR ALUMINUM SDG

FOR: -

PROJ NO: - | DWG NO: CMS-830-07-SD-56018 | REV: 0



BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
1	1 EA	250W COMMERCIAL CUT-OFF H.I.D. FIXTURE (NOTE 1)	–
2	1 EA	12" MOUNTED ARM (NOTE 1)	–
3	1 EA	25 FOOT SQUARE STRAIGHT STEEL POLE (NOTE 1)	–

25 FOOT POLE MOUNTED CUT-OFF FIXTURE

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

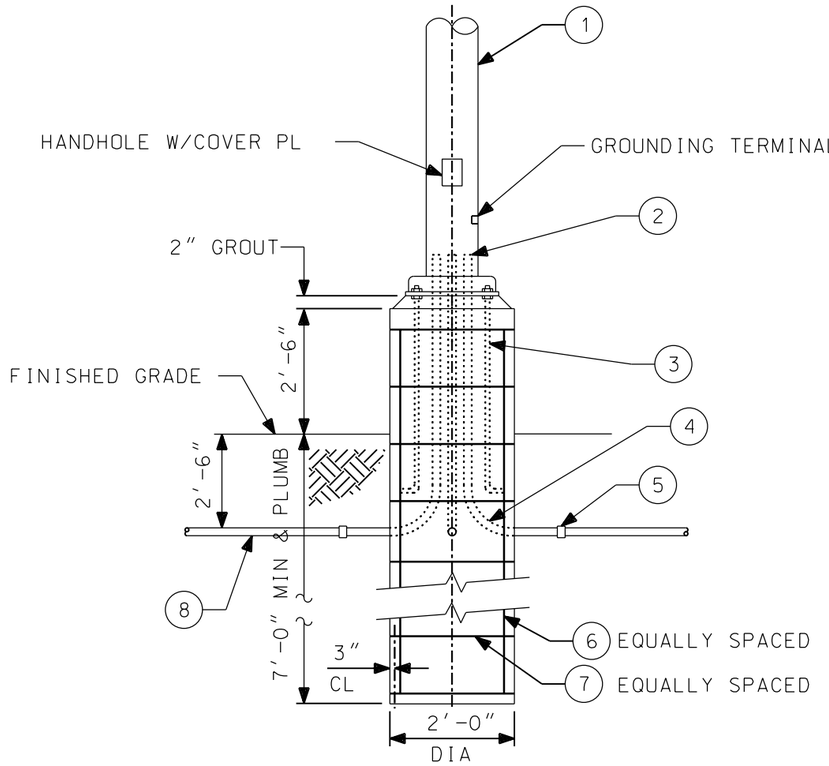
DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: –

25 FOOT POLE MOUNTED CUT-OFF FIXTURE

FOR: –

PROJ NO: – | DWG NO: CMS-830-07-SD-56033 | REV: 0



FOUNDATION DETAIL- POLE MOUNTED FIXTURE WITH CONDUIT FEED

BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
1	1 EA	FIXTURE POLE (NOTE 1)	–
2	3 EA	LIQUID-TIGHT BUSHING	CROUSE-HINDS TYPE "CGB" OR ENGINEERING APPROVED EQUAL
3	(NO. AS REQ'D)	ANCHOR BOLTS (PER POLE MFR.) NOTE 1)	–
4	3 EA	2" RGS CONDUIT (NOTES 1 & 5)	–
5	3 EA	RGS TO PVC CONDUIT ADAPTOR	–
6	8 EA	#6 BARS	–
7	8 EA	#4 BAR HOOPS	–
8	(LGTH AS REQ'D)	2" PVC CONDUIT	–

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.
3. FOUNDATION TO BEAR AGAINST UNDISTURBED EARTH OR COMPACTED BACKFILL AS APPROVED BY STRUCTURAL ENGINEER.
4. CONCRETE STRENGTH 3000 PSI @ 28 DAYS.
5. RGS CONDUIT TO BE PVC COATED OR SHALL BE COATED ASPHALTUM PRIOR TO POURING FOUNDATION.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

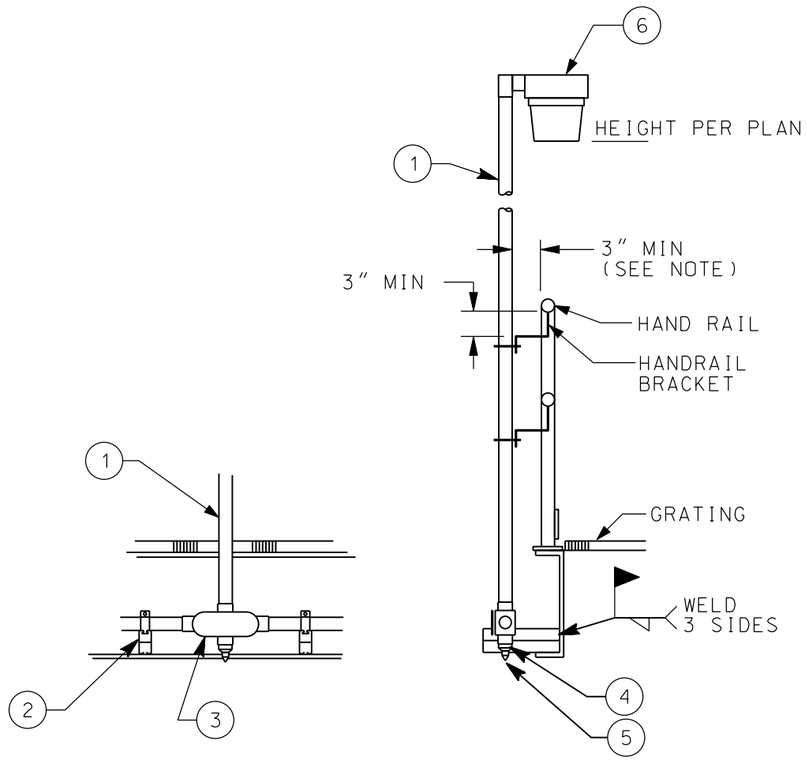
DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: –

FOUNDATION DETAIL
POLE MOUNTED FIXTURE
WITH CONDUIT FEED

FOR: –

PROJ NO: – | DWG NO: CMS-830-07-SD-56038 | REV: 0



STANCHION MOUNTED FIXTURE - METAL RAILING

BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
1	1 EA	1 1/2" RGS CONDUIT STANCHION	-
2	2 EA (TYP)	CHANNEL & ONE CONDUIT CLAMP	B-LINE #B22A OR ENGINEERING APPROVED EQUAL
3	1 EA	1 1/2" FORM 8 TYPE "X" CONDULET W/ COVER PLATE & GASKET	CROUSE-HINDS #158 OR ENGINEERING APPROVED EQUAL
4	1 EA	REDUCER 1 1/2" TO 3/4"	APPLETON CAT. #RB150-75 OR ENGINEERING APPROVED EQUAL
5	1 EA	3/4" BREATHER/DRAIN	CROUSE-HINDS TYPE CD2 OR ENGINEERING APPROVED EQUAL
6	1 EA	LIGHT FIXTURE (NOTE 1)	-

NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE FOR TYPE AND MTG. HEIGHT AS SHOWN ON PLAN DRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES
CMS-830-07-SD-56044 - HANDRAIL BRACKET

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

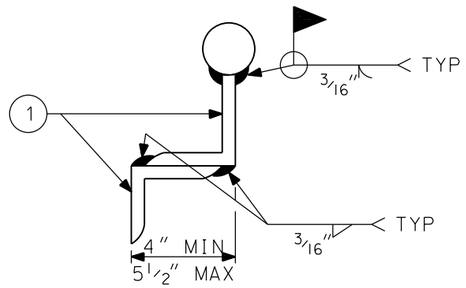
CLIENT DWG NO: -

STANCHION MOUNTED FIXTURE
METAL RAILING

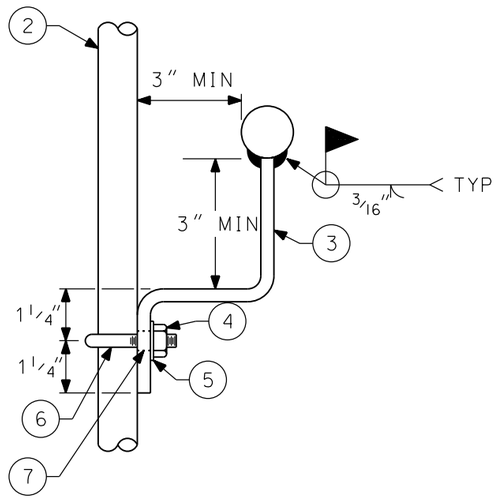
FOR: -

PROJ NO: - | DWG NO: CMS-830-07-SD-56043 | REV: 0

Form: CMS-830-00-FM-02110 CBI ANSI B



ALTERNATE METHOD



HANDRAIL BRACKET

BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
1	2 EA	∠ 3 1/2" x 3 1/2" x 3/8" (NOTE 1)	–
2	1 EA	1 1/2" RGS CONDUIT LIGHTING STANCHION	–
3	1 EA	3/8" x 4 1/2" FLAT BAR (NOTE 1)	–
4	2 EA	3/8" SS HEX NUT	–
5	2 EA	SS FLAT & LOCK WASHER (SS)	–
6	1 EA	3/8" U-BOLT (NOTE 1)	–
7	2 EA	7/16" HOLES	–

NOTES:

1. MATERIAL SHALL BE GALVANIZED OR PAINTED.

REF: CMS-830-07-SD-56043 - STANCHION MOUNTED FIXTURE

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

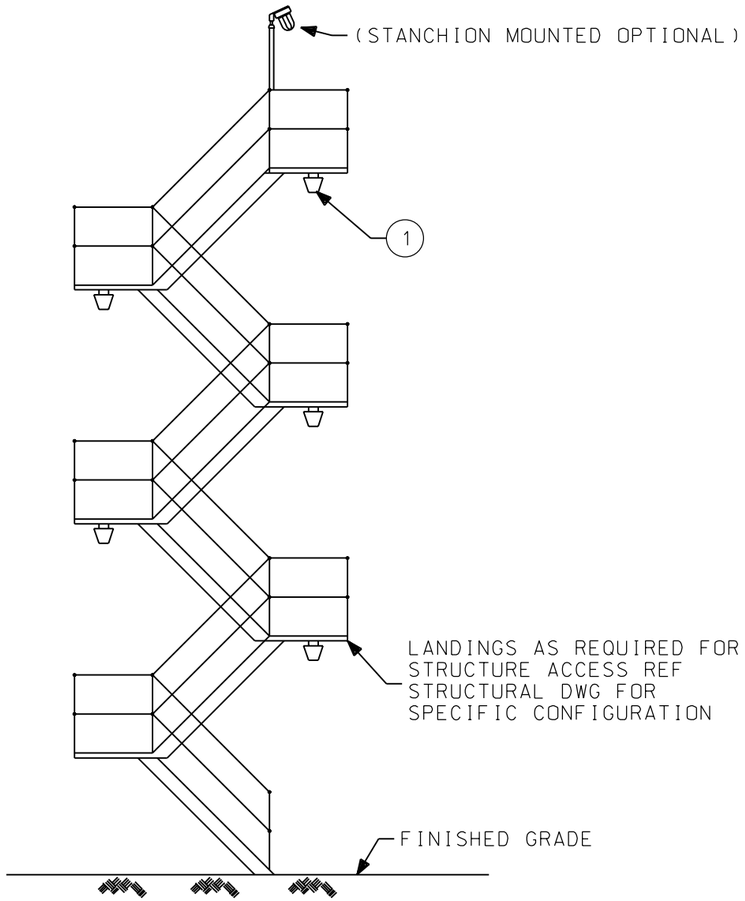
DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: –

HANDRAIL BRACKET FOR STANCHION MOUNTED FIXTURE (METAL RAILING)

FOR: –

PROJ NO: – | DWG NO: CMS-830-07-SD-56044 | REV: 0



BILL OF MATERIALS			
ITEM	QUANTITY	DESCRIPTION	PART NO.
(1)	AS REQ'D	CEILING MOUNT, ENCLOSED & GASKETED H.I.D. FIXTURE (NOTE 1)	–

EXTERIOR STAIRWAY LIGHTING MULTIPLE LANDINGS

NOTE:

1. REFER TO FIXTURE SCHEDULE FOR FIXTURE TYPE AND MOUNTING HEIGHT AS SHOWN ON PLAN GRAWING.
2. REFER TO PLAN DRAWING FOR TYPE.

REF: CMS-830-07-SD-56001 - LIGHTING INSTALLATION GENERAL NOTES

NO.	REVISION	DRAWN	CK'D	APPD	DATE
0	ISSUE FOR USE	EPF	RJK	PBO	16SEP2014

DRAWN: EPF | CK'D: RJK | APPD: PBO | DATE: 16SEP2014 | SCALE: NTS

CLIENT DWG NO: –

EXTERIOR STAIRWAY LIGHTING MULTIPLE LANDINGS

FOR: –

PROJ NO: – | DWG NO: CMS-830-07-SD-56047 | REV: 0

Calculations at Grade

Luminaire Schedule

Symbol	Label	Quantity	Manufacturer	Catalog Number	Description	Lamp	Number Lamps	Filename	Lumens Per Lamp	Light Loss Factor	Wattage
	FROM ROADWAY PLAN				MONGOOSE	250W CLEAR HPS	1	G250HP00LNFXXX.ies	28000	0.8	289
	FROM ROADWAY PLAN				SPECIFICATION BUILDING MOUNTED LUMINAIRE, 100W HPS, W/CLEAR LAMP.	ONE 100-WATT CLEAR ED-17 HIGH PRESSURE SODIUM, HORIZONTAL POSITION.	1	TWAC_100S.ies	9500	0.8	135
	H39/LP 2	3	Holophane	SMST15AHP00XXPF	SOMERSET	150W CLEAR HPS	1	SMST15AHP00XXPF.ies	16000	0.8	376

Luminaire Locations

		Location						Aim		
No.	Label	X	Y	Z	MH	Orientation	Tilt	X	Y	Z
20	H39/LP2	870810.90	282084.90	31.00	15.00	90.00	0.00			
21	H39/LP2	870754.90	282078.10	31.00	15.00	180.00	0.00			
22	H39/LP2	870857.80	282087.80	31.00	15.00	180.00	0.00			

Statistics

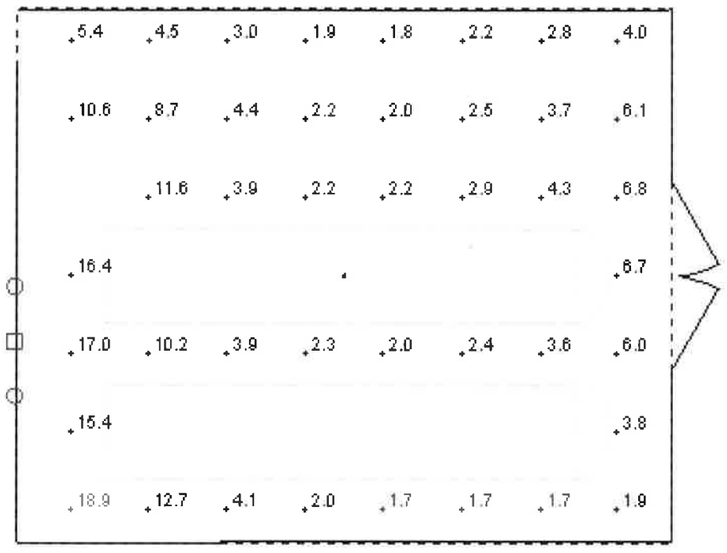
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
Calc Zone #5	+	5.4 fc	18.9 fc	1.7 fc	11.1:1	3.2:1
Calc Zone #6	+	8.5 fc	20.9 fc	3.3 fc	6.3:1	2.6:1

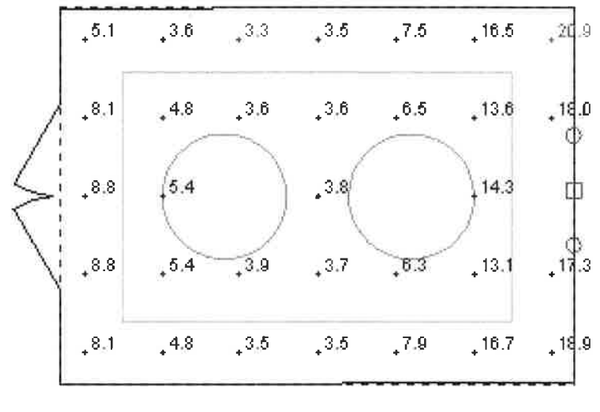
VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

TANK AREA PLAN





Current View

VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

TANK AREA PLAN

Luminaire Schedule

Symbol	Label	QTY	Manufacturer	Catalog Number	Description	Lamp	Number Lamps	Filename	Lumens per Lamp	LLF	Wattage
○ □	H16	10	Holophane	P3M050HPXGB00FDZXX	P3M MEDIUM PETROLUX III	50W CLEAR HPS	1	P3M050HPXGB00FDZXX.ies	4000	0.8	63
○ □ ○	H39/LP2	2	Holophane	SMST15AHP00XXPF	SOMERSET	150W CLEAR HPS	1	SMST15AHP00XXPF.ies	16000	0.8	376
□	DO NOT INCLUDE IN COUNT.. FIXTURE SHOWN ON OVERALL PLAN		TWAC 100S		SPECIFICATION BUILDING MOUNTED LUMINAIRE, 100W HPS, W/CLEAR LAMP.	ONE 100-WATT CLEAR ED-17 HIGH PRESSURE SODIUM, HORIZONTAL POSITION.	1	TWAC_100S.ies	9500	0.8	135

Luminaire Locations

		Location						Aim		
No.	Label	X	Y	Z	MH	Orientation	Tilt	X	Y	Z
1	C	181.32	17.61	15.00	15.00	270.00	0.00	181.32	17.61	0.00
4	H39/LP2	41.91	-8.66	15.00	15.00	0.00	0.00			
5	H39/LP2	90.64	-8.16	15.00	15.00	270.00	0.00			
3	H16	-275.28	52.38	8.00	8.00	233.69	0.00	-276.34	51.61	0.00
4	H16	-299.04	60.10	8.00	8.00	162.35	0.00	-298.64	58.84	0.00
5	H16	-313.75	39.85	8.00	8.00	90.00	0.00	-312.43	39.85	0.00
6	H16	-299.04	19.62	8.00	8.00	17.77	0.00	-298.64	20.87	0.00
7	H16	-275.27	27.35	8.00	8.00	310.64	0.00	-276.27	28.21	0.00
8	H16	-138.58	-38.83	8.00	8.00	90.00	0.00	-137.27	-38.83	0.00
9	H16	-108.95	-41.31	8.00	8.00	270.00	0.00	-110.27	-41.31	0.00
10	H16	-121.23	26.55	8.00	8.00	90.00	0.00	-119.91	26.55	0.00
11	H16	-121.39	53.28	8.00	8.00	90.00	0.00	-120.08	53.28	0.00
12	H16	-131.82	38.26	8.00	8.00	0.00	0.00	-131.82	39.57	0.00

Statistics

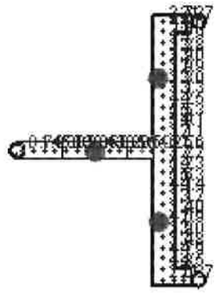
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
SCR PLATFORM	+	3.7 fc	6.0 fc	0.7 fc	8.6:1	5.3:1
AMMONIA SKID AREA	+	6.2 fc	14.0 fc	3.0 fc	4.7:1	2.1:1
SCR SOUTH YARD	+	3.1 fc	14.2 fc	0.2 fc	71.0:1	15.5:1
STACK PLATFORM	+	4.1 fc	5.5 fc	2.7 fc	2.0:1	1.5:1
TEMPERING INLET PLATFORM	+	3.4 fc	5.0 fc	1.0 fc	5.0:1	3.4:1

VISUAL

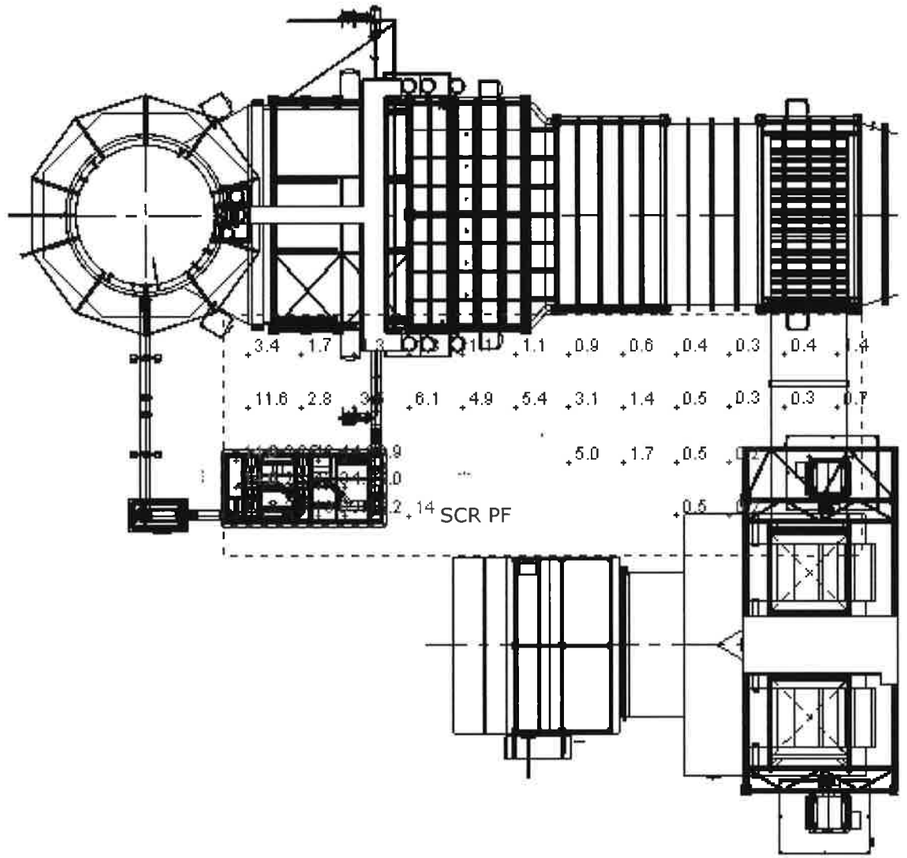
Designer

Date
8/30/2016
Scale
Not to Scale
Drawing No.

Summary
SCR YARD AND AMMONIA SKID



STACK PF



INLET PF

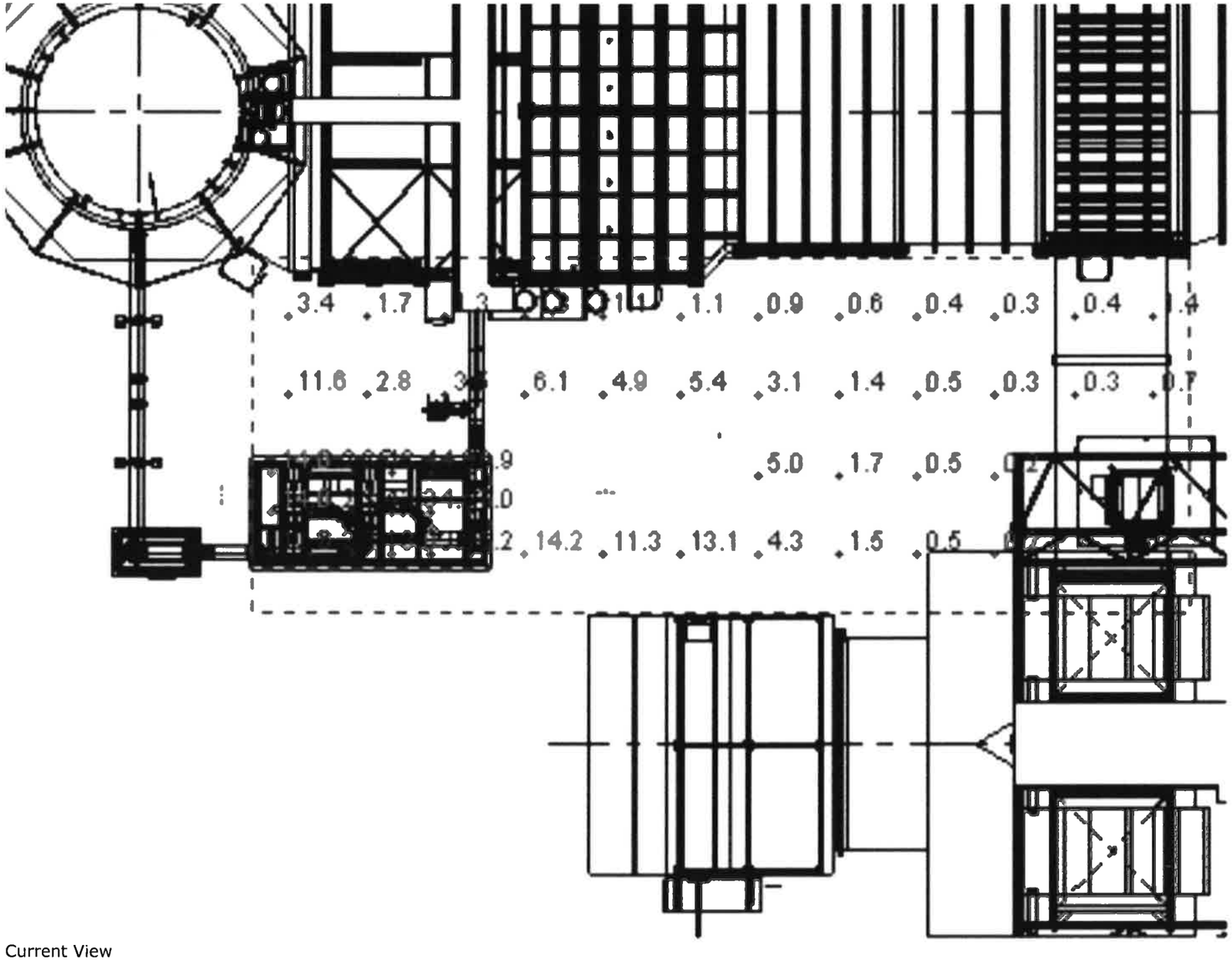
Current View

VISUAL

Designer

Date
8/30/2016
Scale
Not to Scale
Drawing No.

Summary
SCR YARD AND AMMONIA SKID



Current View

VISUAL

Designer

Date
8/30/2016
Scale
Not to Scale
Drawing No.

Summary
SCR YARD AND AMMONIA SKID

Luminaire Schedule

Symbol	Label	Quantity	Manufacturer	Catalog Number	Description	Lamp	Number Lamps	Filename	Lumens Per Lamp	Light Loss Factor	Wattage
▭ ▫	H1P/LP 1	14	Holophane	G250HP00LNFXXX	MONGOOSE	250W CLEAR HPS	1	G250HP00LNFXXX.ies	28000	0.8	289
▭	H8	34	Lithonia Lighting	TWAC 100S	SPECIFICATION BUILDING MOUNTED LUMINAIRE, 100W HPS, W/CLEAR LAMP.	ONE 100-WATT CLEAR ED-17 HIGH PRESSURE SODIUM, HORIZONTAL POSITION.	1	TWAC_100S.ies	9500	0.8	135
○ ▫ ○	H39/LP 2	10	Holophane	SMST15AHP00XXPF	SOMERSET	150W CLEAR HPS	1	SMST15AHP00XXPF.ies	16000	0.8	376

Statistics

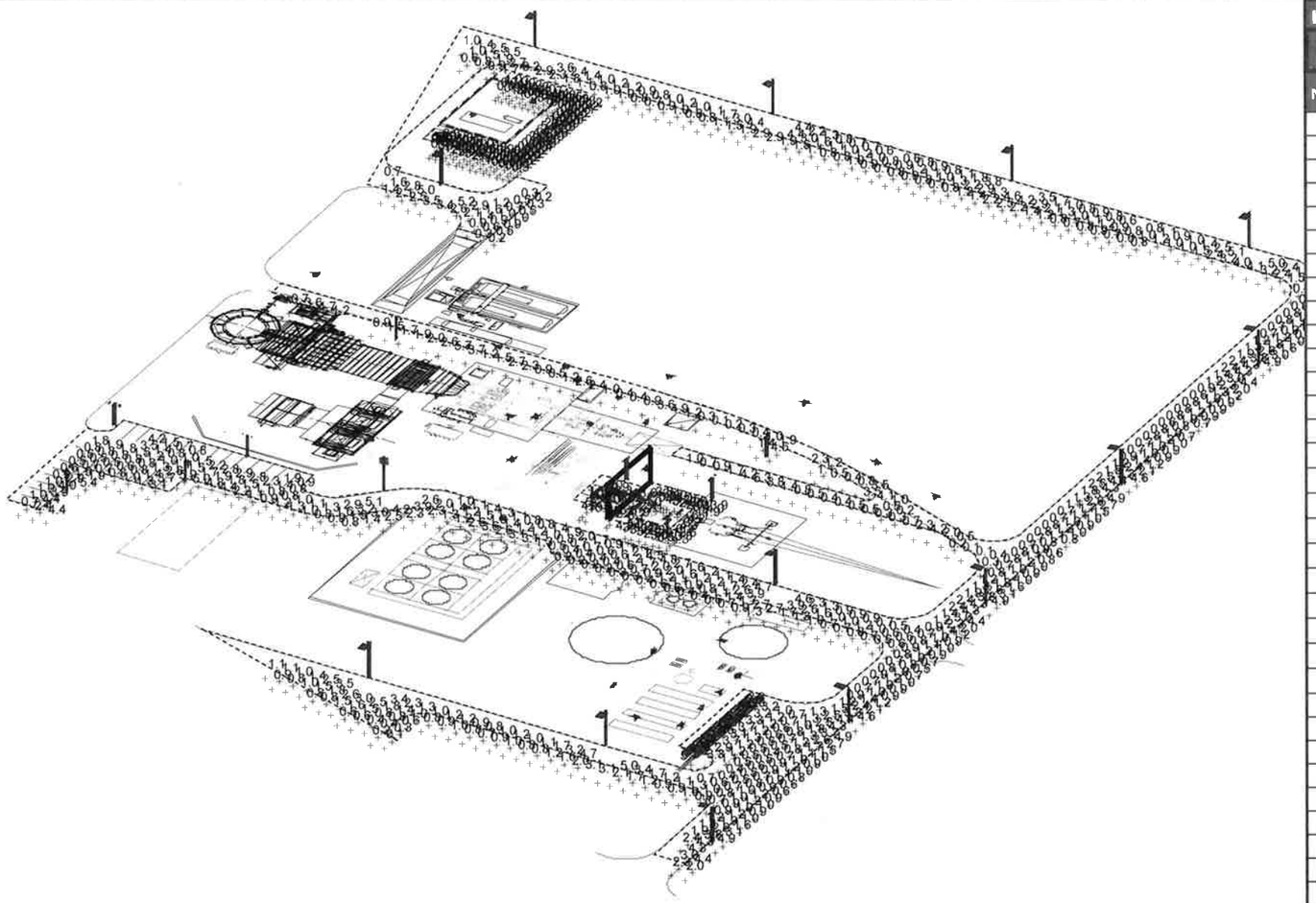
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
DEMIN TRAILER ENTRANCE	+	5.1 fc	6.6 fc	2.8 fc	2.4:1	1.8:1
Fuel Gas	+	1.7 fc	6.1 fc	0.1 fc	61.0:1	17.0:1
GSU	+	5.2 fc	14.3 fc	1.7 fc	8.4:1	3.1:1
ROADWAY	+	1.6 fc	6.1 fc	0.1 fc	61.0:1	16.0:1
UAT AREA	+	9.1 fc	17.1 fc	4.0 fc	4.3:1	2.3:1

VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

ROADWAY AREA PLAN



South East View

Luminaire Locations

		Location						Aim		
No.	Label	X	Y	Z	MH	Orientation	Tilt	X	Y	Z
1	H1P/LP1	870406.70	282653.80	41.00	25.00	180.00	0.00	870406.70	282652.30	16.00
12	H1P/LP1	871011.40	282532.10	41.00	25.00	270.00	0.00	871009.90	282532.10	16.00
20	H1P/LP1	870581.70	282655.40	41.00	25.00	180.00	0.00	870581.70	282653.90	16.00
21	H1P/LP1	870756.70	282657.70	41.00	25.00	180.00	0.00	870756.70	282656.20	16.00
22	H1P/LP1	870931.70	282659.40	41.00	25.00	180.00	0.00	870931.70	282657.90	16.00
23	H1P/LP1	871011.40	282357.10	41.00	25.00	270.00	0.00	871009.90	282357.10	16.00
24	H1P/LP1	871011.40	282182.10	41.00	25.00	270.00	0.00	871009.90	282182.10	16.00
25	H1P/LP1	871011.40	282007.10	41.00	25.00	270.00	0.00	871009.90	282007.10	16.00
26	H1P/LP1	871011.40	281832.10	41.00	25.00	270.00	0.00	871009.90	281832.10	16.00
29	H1P/LP1	870891.60	281904.60	41.00	25.00	180.00	0.00	870891.60	281903.10	16.00
30	H1P/LP1	870716.60	281904.60	41.00	25.00	180.00	0.00	870716.60	281903.10	16.00
31	H1P/LP1	870442.20	282471.50	41.00	25.00	180.00	0.00	870442.20	282470.00	16.00
32	H1P/LP1	870881.90	282137.60	41.00	25.00	180.00	0.00	870881.90	282136.10	16.00
34	H1P/LP1	870606.10	282114.90	41.00	25.00	150.46	0.00	870606.90	282113.60	16.00
8	H39/LP2	870490.40	282061.80	31.00	15.00	270.00	0.00			
9	H39/LP2	870430.10	282015.00	31.00	15.00	0.00	0.00			
10	H39/LP2	870792.70	282211.30	31.00	15.00	0.00	0.00			
11	H39/LP2	870792.40	282154.60	31.00	15.00	0.00	0.00			
13	H39/LP2	870415.20	282101.60	31.00	15.00	270.00	0.00			
15	H39/LP2	870508.10	282109.40	31.00	15.00	270.00	0.00			
16	H39/LP2	870796.10	282274.60	31.00	15.00	0.00	0.00			
17	H39/LP2	870733.30	282204.90	31.00	15.00	0.00	0.00			
18	H39/LP2	870733.10	282162.30	31.00	15.00	0.00	0.00			
19	H39/LP2	870515.60	282286.40	31.00	15.00	270.00	0.00			
1	H8	870933.10	282000.70	31.00	15.00	90.00	0.00	870933.10	282000.70	16.00
2	H8	870933.10	281928.30	31.00	15.00	90.00	0.00	870933.10	281928.30	16.00
3	H8	870870.70	282000.90	31.00	15.00	270.00	0.00	870870.70	282000.90	16.00
4	H8	870870.70	281950.90	31.00	15.00	270.00	0.00	870870.70	281950.90	16.00
5	H8	870675.50	282099.50	31.01	50.00	0.00	0.00	870675.50	282099.50	-18.99
6	H8	870702.80	282099.50	31.01	50.00	0.00	0.00	870702.80	282099.50	-18.99
7	H8	870590.80	282287.30	31.00	15.00	0.00	0.00	870590.80	282287.30	16.00
8	H8	870640.80	282287.30	31.00	15.00	0.00	0.00	870640.80	282287.30	16.00
9	H8	870720.90	282251.30	31.00	15.00	90.00	0.00	870720.90	282251.30	16.00
10	H8	870587.70	282214.40	31.00	15.00	180.00	0.00	870587.70	282214.40	16.00
11	H8	870573.60	282224.90	31.00	15.00	270.00	0.00	870573.60	282224.90	16.00
12	H8	870573.60	282278.10	31.00	15.00	270.00	0.00	870573.60	282278.10	16.00
13	H8	870656.10	282276.20	31.00	15.00	90.00	0.00	870656.10	282276.20	16.00
14	H8	870641.40	282214.40	31.00	15.00	180.00	0.00	870641.40	282214.40	16.00
19	H8	870691.10	282232.50	31.00	15.00	180.00	0.00	870691.10	282232.50	16.00
20	H8	870690.10	282269.90	31.00	15.00	0.00	0.00	870690.10	282269.90	16.00
23	H8	870656.10	282222.40	31.00	15.00	90.00	0.00	870656.10	282222.40	16.00
25	H8	870443.50	282309.70	31.00	15.00	180.00	0.00	870443.50	282309.70	16.00
26	H8	870750.10	282200.30	31.00	15.00	90.00	0.00	870750.10	282200.30	16.00
27	H8	870750.10	282164.70	31.00	15.00	90.00	0.00	870750.10	282164.70	16.00
30	H8	870902.30	282034.80	31.00	15.00	0.00	0.00	870902.30	282034.80	16.00
32	H8	870903.30	281922.50	31.00	15.00	180.00	0.00	870903.30	281922.50	16.00
34	H8	870549.50	282309.70	31.00	15.00	180.00	0.00	870549.50	282309.70	16.00
36	H8	870810.30	282300.00	47.00	15.00	187.28	0.00	870810.30	282300.00	32.00
37	H8	870928.70	282261.70	31.00	15.00	202.28	0.00	870928.70	282261.70	16.00
38	H8	870703.90	282309.70	31.00	15.00	180.00	0.00	870703.90	282309.70	16.00
39	H8	870874.20	282281.30	31.00	15.00	202.28	0.00	870874.20	282281.30	16.00
40	H8	870933.10	281976.80	31.00	15.00	90.00	0.00	870933.10	281976.80	16.00
41	H8	870933.10	281953.40	31.00	15.00	90.00	0.00	870933.10	281953.40	16.00
42	H8	870578.10	282143.60	31.00	15.00	270.00	0.00	870578.10	282143.60	16.00
43	H8	870669.80	282168.00	31.00	15.00	90.00	0.00	870669.80	282168.00	16.00
44	H8	870454.10	282569.80	31.00	15.00	90.00	0.00	870454.10	282569.80	16.00
47	H8	870427.10	282604.80	31.00	15.00	0.00	0.00	870427.10	282604.80	16.00
48	H8	870428.60	282535.20	31.00	15.00	180.00	0.00	870428.60	282535.20	16.00

VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

ROADWAY AREA PLAN

Luminaire Schedule

Symbol	Label	Quantity	Manufacturer	Catalog Number	Description	Lamp	Number Lamps	Filename	Lumens Per Lamp	Light Loss Factor	Wattage
▭	H8	12	Lithonia Lighting	TWAC 100S	SPECIFICATION BUILDING MOUNTED LUMINAIRE, 100W HPS, W/CLEAR LAMP.	ONE 100-WATT CLEAR ED-17 HIGH PRESSURE SODIUM, HORIZONTAL POSITION.	1	TWAC_100S.ies	9500	0.8	135
○ □	H16	12	Holophane	PWM050HPXGB00FDZXX	PWM MEDIUM PETROLUX III	50W CLEAR HPS	1	PWM050HPXGB00FDZXX.ies	4000	0.8	63

Luminaire Locations

		Location			Aim					
No.	Label	X	Y	Z	MH	Orientation	Tilt	X	Y	Z
1	H8	870702.80	282098.70	31.00	15.00	0.00	0.00	870702.80	282098.70	16.00
2	H8	870678.10	282098.70	31.00	15.00	0.00	0.00	870678.10	282098.70	16.00
3	H8	870675.40	282002.30	31.00	15.00	180.00	0.00	870675.40	282002.30	16.00
4	H8	870704.00	282002.30	31.00	15.00	180.00	0.00	870704.00	282002.30	16.00
5	H8	870661.70	282035.90	31.00	15.00	270.00	0.00	870661.70	282035.90	16.00
6	H8	870661.70	282065.70	31.00	15.00	270.00	0.00	870661.70	282065.70	16.00
7	H8	870661.70	282087.80	31.00	15.00	270.00	0.00	870661.70	282087.80	16.00
8	H8	870661.70	282013.00	31.00	15.00	270.00	0.00	870661.70	282013.00	16.00
9	H8	870716.90	282035.80	31.00	15.00	90.00	0.00	870716.90	282035.80	16.00
1	H16	870675.40	282002.30	46.34	10.00	0.00	0.00	870675.40	282003.60	36.34
2	H16	870704.00	282002.30	46.34	10.00	0.00	0.00	870704.00	282003.60	36.34
6	H16	870661.80	282087.80	46.34	10.00	90.00	0.00	870663.10	282087.80	36.34
8	H16	870675.40	282098.40	46.34	10.00	180.00	0.00	870675.40	282097.10	36.34
9	H16	870702.60	282098.40	46.34	10.00	180.00	0.00	870702.60	282097.10	36.34
10	H8	870716.80	282065.90	31.00	15.00	90.00	0.00	870716.80	282065.90	16.00
11	H8	870716.70	282088.10	31.00	15.00	90.00	0.00	870716.70	282088.10	16.00
12	H8	870716.90	282013.50	31.00	15.00	90.00	0.00	870716.90	282013.50	16.00
10	H16	870716.60	282088.10	46.34	10.00	270.00	0.00	870715.30	282088.10	36.34
20	H16	870661.80	282065.70	46.34	10.00	90.00	0.00	870663.10	282065.70	36.34
21	H16	870716.60	282065.90	46.34	10.00	270.00	0.00	870715.30	282065.90	36.34
24	H16	870661.80	282035.70	46.34	10.00	90.00	0.00	870663.10	282035.70	36.34
25	H16	870716.60	282036.00	46.34	10.00	270.00	0.00	870715.30	282036.00	36.34
26	H16	870661.80	282013.20	46.34	10.00	90.00	0.00	870663.10	282013.20	36.34
27	H16	870716.60	282013.40	46.34	10.00	270.00	0.00	870715.30	282013.40	36.34

Statistics

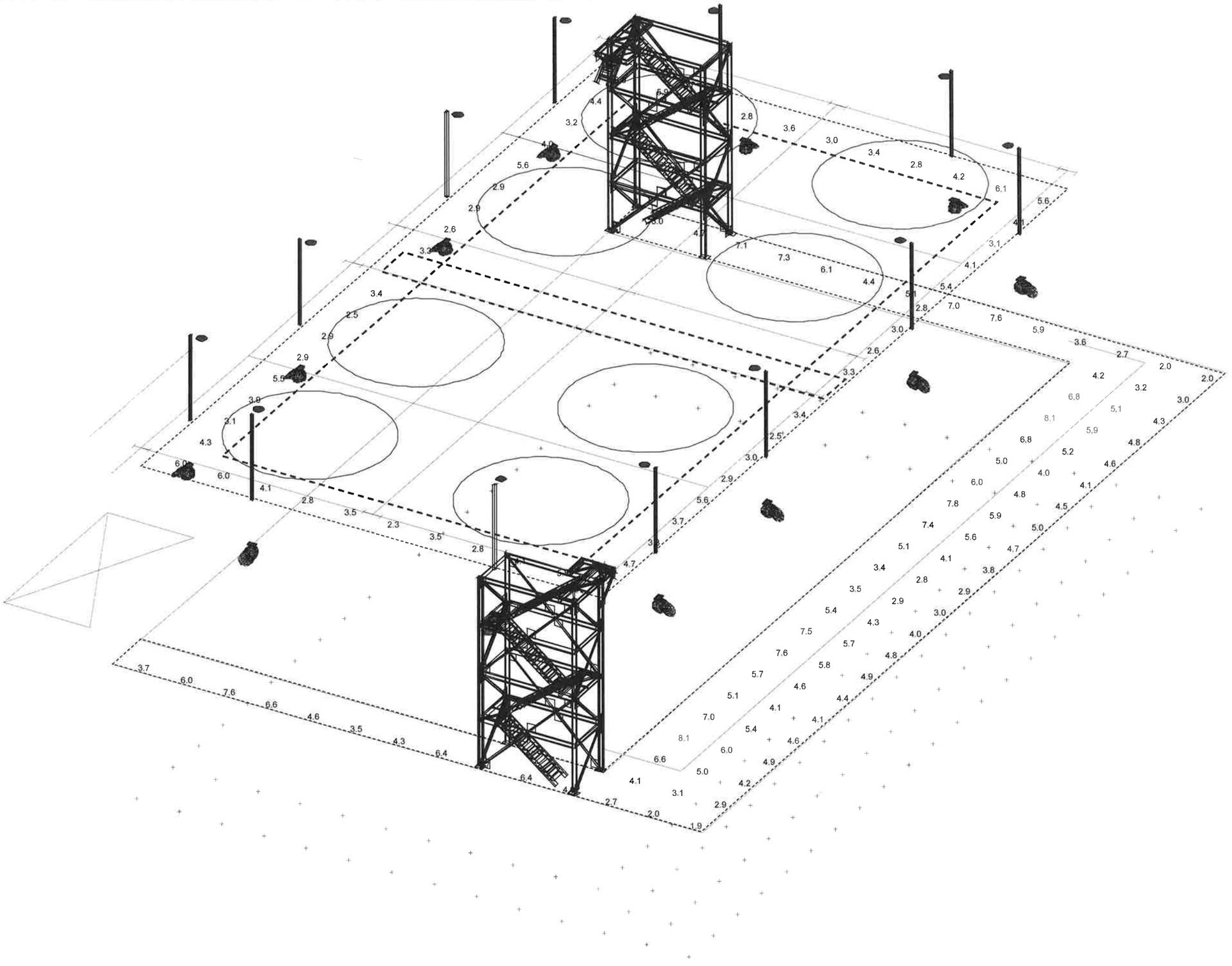
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
GROUND	+	4.9 fc	8.1 fc	1.9 fc	4.3:1	2.6:1
ROOF	+	3.9 fc	6.2 fc	2.3 fc	2.7:1	1.7:1

VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

Summary
COOLING TOWER



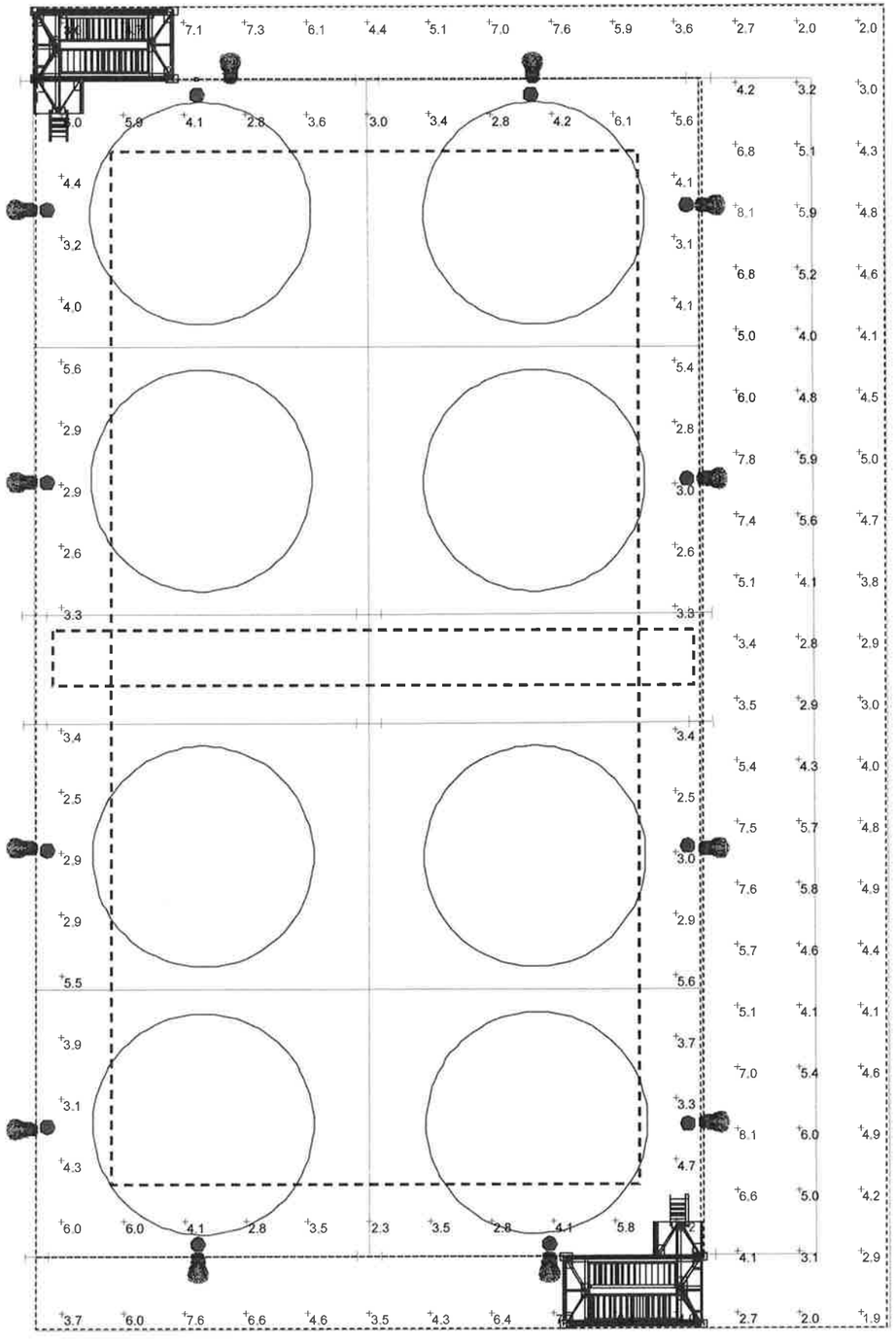
South East View

VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

Summary
COOLING TOWER



Plan View
Scale - 1" = 12'

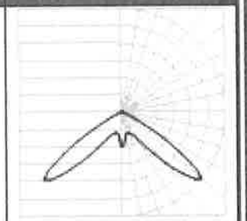
VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

Summary
COOLING TOWER

Luminaire Schedule

Symbol	Label	Image	QTY	Catalog Number	Description	Lamp	Number Lamps	Lumens per Lamp	LLF	Wattage	
	B		8	P3M070HPXGB00FDZXX	P3M MEDIUM PETROLUX III	70W CLEAR HPS	1	6400	0.8	91	 Max: 1966cd

Luminaire Locations

		Location						Aim		
No.	Label	X	Y	Z	MH	Orientation	Tilt	X	Y	Z
3	B	-625.43	9037.01	10.40	0.00	0.00	0.00	-625.43	9037.01	10.40
4	B	-616.89	9037.01	15.62	0.00	0.00	0.00	-616.89	9037.01	15.62
5	B	-625.66	9032.57	30.36	0.00	0.00	0.00	-625.66	9032.57	30.36
7	B	-570.36	8924.15	10.40	0.00	180.00	0.00	-570.36	8924.15	10.40
8	B	-578.90	8924.15	15.62	0.00	180.00	0.00	-578.90	8924.15	15.62
9	B	-570.13	8928.78	30.36	0.00	180.00	0.00	-570.13	8928.78	30.36
10	B	-625.43	9037.01	20.72	0.00	0.00	0.00	-625.43	9037.01	20.72
11	B	-570.36	8924.15	20.71	0.00	180.00	0.00	-570.36	8924.15	20.71

Statistics

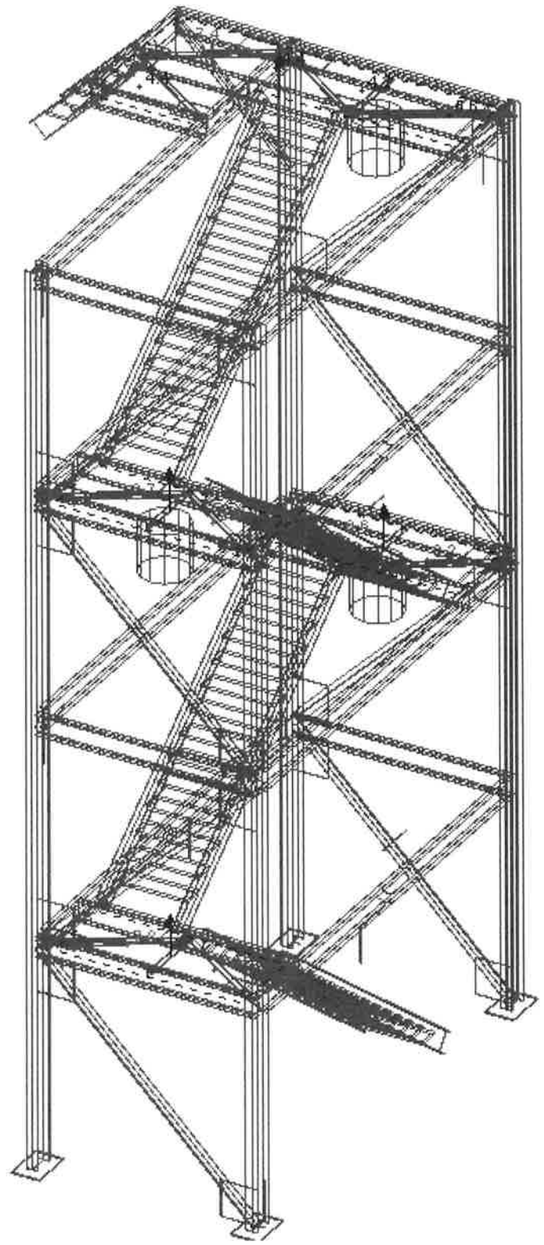
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
Calc Zone #8	+	5.0 fc	7.4 fc	4.1 fc	1.8:1	1.2:1
Calc Zone #9	+	6.4 fc	6.6 fc	6.2 fc	1.1:1	1.0:1
Calc Zone #10	+	2.8 fc	2.9 fc	2.7 fc	1.1:1	1.0:1
Calc Zone #11	+	7.7 fc	7.8 fc	7.5 fc	1.0:1	1.0:1

VISUAL

Designer

Date
9/9/2016
Scale
Not to Scale
Drawing No.

Summary
CT STAIR



Current View

VISUAL

Designer

Date
9/9/2016
Scale
Not to Scale
Drawing No.

Summary
CT STAIR

Luminaire Schedule

Symbol	Label	Quantity	Manufacturer	Catalog Number	Description	Lamp	Number Lamps	Filename	Lumens Per Lamp	Light Loss Factor	Wattage
	H1P/LP1	1	Holophane	G250HP00LNFXXX	MONGOOSE	250W CLEAR HPS	1	G250HP00LNFXXX.ies	28000	0.8	289
	H8	1	Lithonia Lighting	TWAC 100S	SPECIFICATION BUILDING MOUNTED LUMINAIRE, 100W HPS, W/CLEAR LAMP.	ONE 100-WATT CLEAR ED-17 HIGH PRESSURE SODIUM, HORIZONTAL POSITION.	1	TWAC_100S.ies	9500	0.8	135
	H39/LP2	1	Holophane	SMST15AHP00XXPF	SOMERSET	150W CLEAR HPS	1	SMST15AHP00XXPF.ies	16000	0.8	188
	H16	1	Holophane	PWM050HPXGB0045FXX	PWM MEDIUM PETROLUX III	50W CLEAR HPS	1	PWM050HPXGB0045FXX.ies	4000	0.8	63

Luminaire Locations

					Aim		
No.	Label	MH	Orientation	Tilt	X	Y	Z
2	H1P/LP1	25.00	0.00	0.00	870501.80	282574.20	16.00
1	H39/LP2	15.00	0.00	0.00	870601.60	282428.50	19.21
1	H8	15.00	0.00	0.00	870601.60	282576.00	16.00
5	H16	8.00	0.00	0.00	870501.70	282428.70	16.00

Statistics

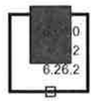
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
H1P	+	6.1 fc	6.2 fc	6.0 fc	1.0:1	1.0:1
H8	+	6.1 fc	6.2 fc	6.0 fc	1.0:1	1.0:1
H16	+	3.5 fc	3.8 fc	3.2 fc	1.2:1	1.1:1
H39	+	7.6 fc	7.9 fc	7.1 fc	1.1:1	1.1:1

VISUAL

Designer

Date
8/31/2016
Scale
Not to Scale
Drawing No.

ROADWAY AREA PLAN



Plan View
Scale - 1" = 16'

VISUAL

Designer

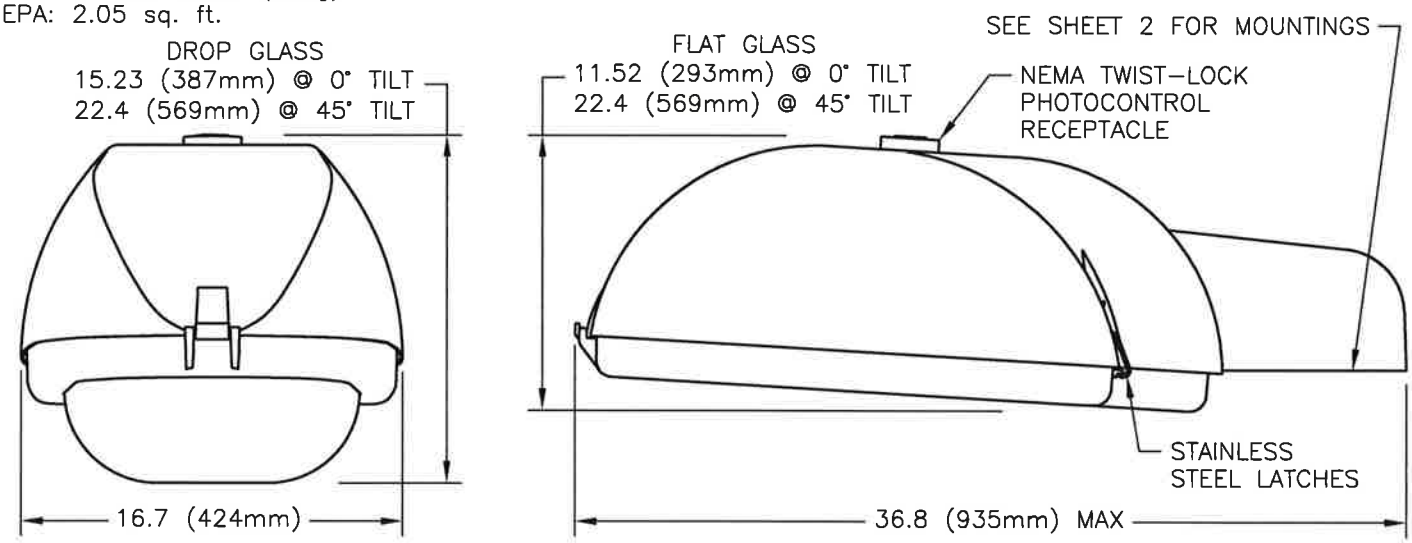
Date
8/31/2016
Scale
Not to Scale
Drawing No.

ROADWAY AREA PLAN

Fixture Specifics

UL/CUL LISTED
MAX AMBIENT: 40°C
MAX WEIGHT: 50lbs (23kg)
EPA: 2.05 sq. ft.

MONGOOSE®



G 250HP12LWFHGPR LAMP

CATALOG NUMBER

SOURCE AND WATTAGE

100HP	100W HPS
15AHP	150W HPS
200HP	200W HPS
250HP	250W HPS
25LHP	250W HPS
400HP	400W HPS
40LHP	400W HPS
175MH	175W MH *
175PM	175W PM
250MH	250W MH *
400MH	400W MH *
40LMH	400W MH *
250PM	250W PM
320PM	320W PM
400PM	400W PM
40LPM	400W LPM

VOLTAGE

12	120V
20	208V
24	240V
27	277V
48	480V
34	347V
MT	MULTIVOLT 120,208,240,277V
MA	MULTIVOLT PRE-WIRED (120V)
MB	MULTIVOLT PRE-WIRED (208V)
MC	MULTIVOLT PRE-WIRED (240V)
MD	MULTIVOLT PRE-WIRED (277V)
VT	MULTIVOLT 120, 277, 347V (NOT AVAILABLE IN 200W HPS OR 175W PM)

* NOT AVAILAIBLE FOR SHIPMENT IN THE US AFTER 12-31-08 DUE TO EISA 2007 LEGISLATION

TILT RANGE

L	LOW TILT, 0°-18°
H	HIGH TILT, 27°-45°

OPTICS

DC	MEDIUM ROADWAY, CLEAR DROP GLASS
DR	MEDIUM ROADWAY, GLASS REFRACTOR
FC	FORWARD THROW, CLEAR DROP GLASS
FF	FORWARD THROW, FLAT GLASS
NC	NARROW ROADWAY, CLEAR DROP GLASS
ND	NARROW FLOOD
NF	NARROW ROADWAY, FLAT GLASS
NR	NARROW ROADWAY, GLASS REFRACTOR
SC	SQUARE, CLEAR DROP GLASS
SF	SQUARE, FLAT GLASS
WC	WIDE ROADWAY, CLEAR DROP GLASS
WD	WIDE FLOOD
WF	WIDE ROADWAY, FLAT GLASS
WR	WIDE ROADWAY, GLASS REFRACTOR

MOUNTING

A	ARCHITECTURAL
H	HORIZONTAL
V	VERTICAL

FINISH

G	GRAY
K	BLACK
N	GREEN
W	WHITE
Z	BRONZE

OPTIONS

B	TERMINAL BLOCK & NEMA DECAL
C	NEMA DECAL
P	PROTECTED STARTER
R	NEMA TWIST-LOCK PHOTOCONTROL RECEPTACLE
T	SPADE TERMINATION FOR BALLAST LEADS
3	3" TO 2" TENON ADAPTER
6	6' PIGTAIL

ACCESSORIES

F1	SINGLE FUSING (120, 240, 277 & 347V)
F2	DOUBLE FUSING (208, 240 & 480V)
LAMP	
BKT-5-G	GALVANIZED WOOD POLE BRACKET
BR-1091-XX	3" TO 2" TENON ADAPTER

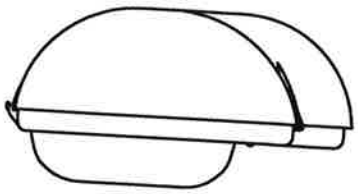
HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An AcuityBrands Company

ORDER NO: _____

TYPE: H1P

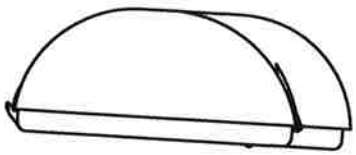
DRAWING NO. _____
CAD MODEL: MONGOOSE.DWG
DATE: 4/9/13

MONGOOSE®



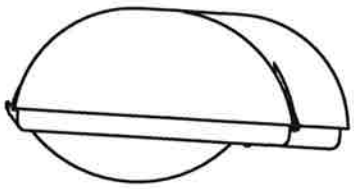
OPTIC TILT RANGE

DC	HIGH
DR	HIGH
FC	LOW
NC	HIGH
NR	ALL
SC	LOW
WC	HIGH
WR	ALL



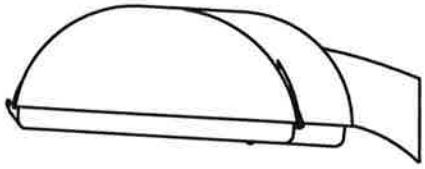
OPTIC TILT RANGE

FF	LOW
ND	HIGH
NF	LOW
SF	LOW
WD	HIGH
WF	LOW

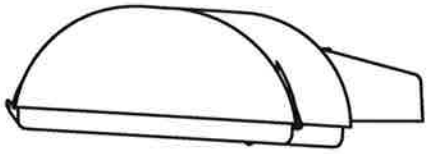


OPTIC TILT RANGE

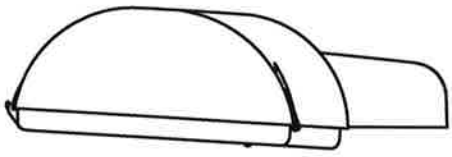
NC	LOW
WC	LOW



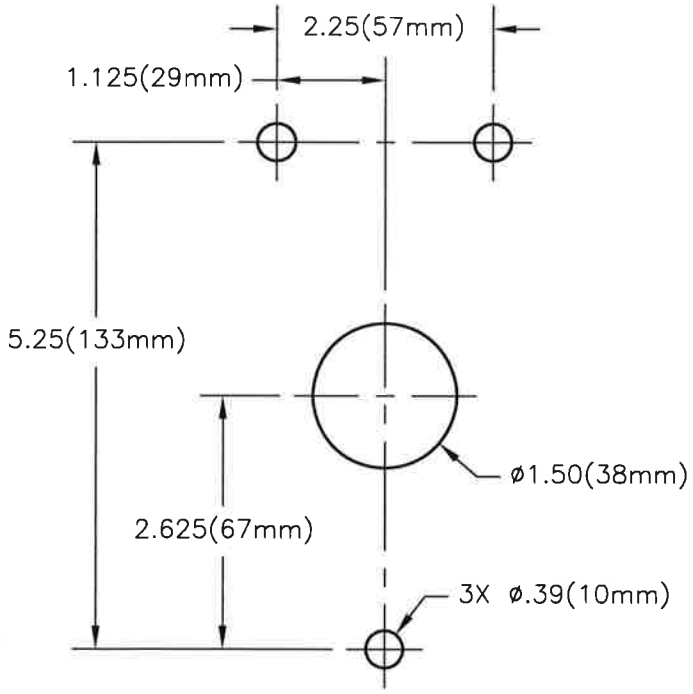
"A" MOUNTING
ATTACHES TO A SQUARE POLE OR TENON ADAPTOR USING PATTERN BELOW



"H" MOUNTING
ATTACHES TO A 2" HORIZONTAL TENON



"V" MOUNTING
ATTACHES TO A 2" VERTICAL TENON



"A" MOUNTING PATTERN

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An AcuityBrands Company

ORDER NO: _____

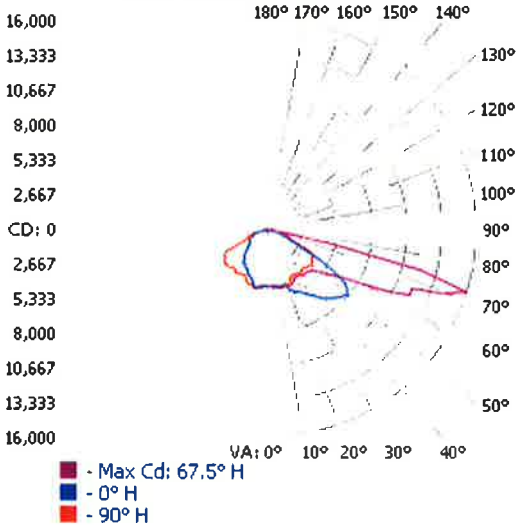
TYPE: H1P

DRAWING NO. _____
CAD MODEL: MONGOOSE.DWG
DATE: 1-5-09
Sheet 2

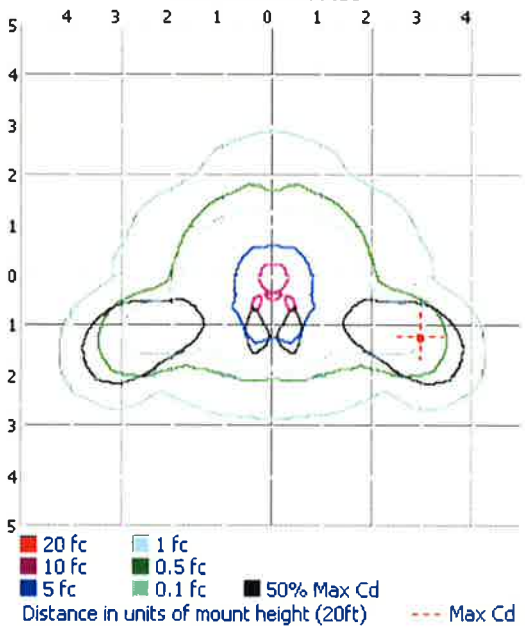
OUTDOOR PHOTOMETRIC REPORT
CATALOG: G250HP00LWFXXX

TEST #:	49395
TEST LAB:	ACUITY BRANDS LIGHTING GRANVILLE LAB
TEST DATE:	1/31/2008
CATALOG:	G250HP00LWFXXX
DESCRIPTION:	MONGOOSE
SERIES:	MONGOOSE
LAMP CATALOG:	LU250 - ED-18
LAMP:	250W CLEAR HPS
LAMP OUTPUT:	1 LAMP, RATED LUMENS/LAMP: 28000
INPUT WATTAGE:	289
LUMINOUS OPENING:	RECTANGLE (L: 18", W: 13.2")
TER VALUE:	65 (BF = 1)
TER CATEGORY:	ROADWAY - TYPE III
Max Cd:	15,915.0 AT HORIZONTAL: 67.5°, VERTICAL: 72.5°
CUTOFF CLASS:	FULL CUTOFF
ROADWAY CLASS:	MEDIUM, TYPE III
EFFICIENCY:	73.2%

Polar Candela Distribution



Isofootcandle Plot



OUTDOOR PHOTOMETRIC REPORT
CATALOG: G250HP00LWFXXX

AcuityBrands.

ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Luminaire
0-30	3,770.3	13.5%	18.4%
0-40	6,709.6	24%	32.8%
0-60	14,501.9	51.8%	70.8%
60-90	5,982.5	21.4%	29.2%
70-100	2,326.9	8.3%	11.4%
90-120	0	0%	0%
0-90	20,484.4	73.2%	100%
90-180	0	0%	0%
0-180	20,484.4	73.2%	100%

LUMENS PER ZONE

Zone	Lumens	% Total	Zone	Lumens	% Total
0-10	421.7	2.1%	90-100	0	0%
10-20	1,273.9	6.2%	100-110	0	0%
20-30	2,074.7	10.1%	110-120	0	0%
30-40	2,939.3	14.3%	120-130	0	0%
40-50	3,682.5	18.0%	130-140	0	0%
50-60	4,109.8	20.1%	140-150	0	0%
60-70	3,655.6	17.8%	150-160	0	0%
70-80	2,223.3	10.9%	160-170	0	0%
80-90	103.6	0.5%	170-180	0	0%

ROADWAY SUMMARY

Cutoff Classification:	FULL CUTOFF
Distribution:	TYPE III, MEDIUM
Max Cd, 90 Deg Vert:	0
Max Cd, 80 to <90 Deg:	1,029.0

	Lumens	% Lamp
Downward Street Side:	13,679.3	48.9%
Downward House Side:	6,804.3	24.3%
Downward Total:	20,483.6	73.2%
Upward Street Side:	0	0%
Upward House Side:	0	0%
Upward Total:	0	0%
Total Lumens:	20,483.6	73.2%

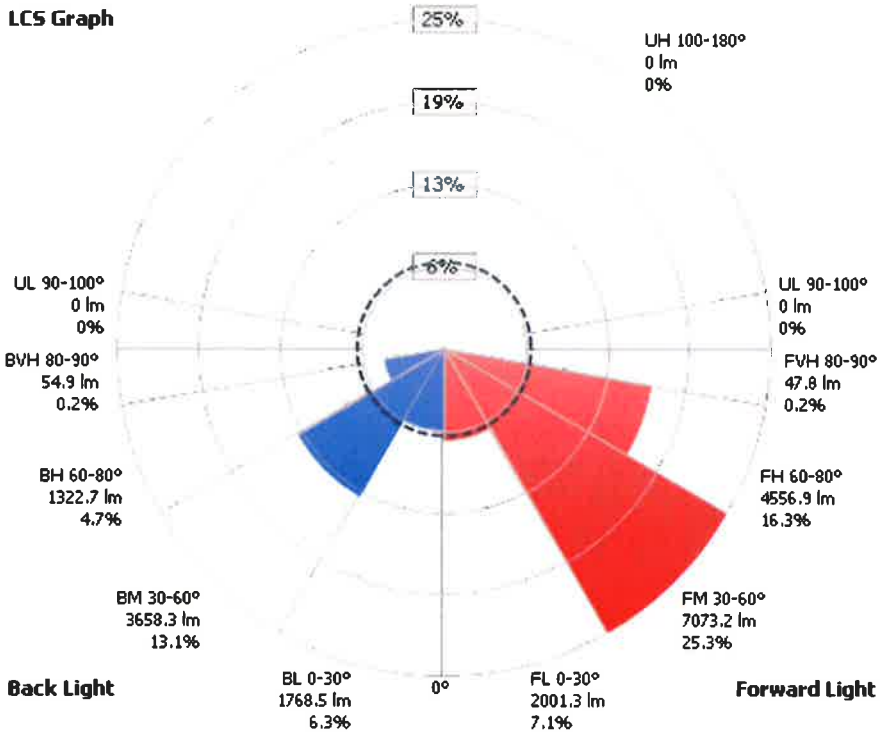
LCS TABLE

BUG RATING	**B3 - U0 - G3**	
FORWARD LIGHT	LUMENS	LUMENS %
Low(0-30):	2,001.3	7.1%
Medium(30-60):	7,073.2	25.3%
High(60-80):	4,556.9	16.3%
Very High(80-90):	47.8	0.2%
BACK LIGHT		
Low(0-30):	1,768.5	6.3%
Medium(30-60):	3,658.3	13.1%
High(60-80):	1,322.7	4.7%
Very High(80-90):	54.9	0.2%
UPLIGHT		
Low(90-100):	0	0%
High(100-180):	0	0%
TRAPPED LIGHT:	7,516.4	26.8%

OUTDOOR PHOTOMETRIC REPORT
CATALOG: G250HP00LWFXXX

AcuityBrands

LCS Graph



Scale = Max LCS %

Trapped Light: 7516.4lm, 26.8%

OUTDOOR PHOTOMETRIC REPORT
CATALOG: G250HP00LWFXXX

AcuityBrands.

CANDELA TABLE - TYPE C

	0	15	25	35	45	55	65	75	85	90	105	115	125	135	145	155	165	175	180
0	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307	4307
5	4382	4382	4388	4396	4403	4411	4413	4405	4405	4405	4399	4396	4396	4396	4396	4392	4392	4390	4390
10	4351	4353	4383	4434	4467	4470	4457	4448	4453	4457	4455	4455	4457	4457	4457	4453	4455	4450	4448
15	4509	4519	4558	4592	4549	4475	4489	4521	4524	4530	4549	4560	4564	4573	4572	4568	4564	4555	4553
20	4885	4893	4872	4828	4764	4690	4641	4628	4613	4614	4605	4597	4584	4567	4546	4522	4499	4478	4467
25	5291	5302	5318	5296	5384	5201	4933	4722	4678	4588	4501	4424	4353	4292	4244	4200	4167	4131	4103
30	5619	5651	5747	6064	6630	6058	4841	4393	4338	4243	4177	4147	4128	4121	4106	4087	4062	4025	3987
35	6211	6285	6621	7147	7936	6054	4923	4495	4441	4347	4299	4269	4269	4267	4244	4207	4177	4155	4129
40	6851	6984	7533	8590	7740	5619	5262	4712	4647	4492	4402	4342	4273	4194	4119	4069	4053	4037	4009
45	7393	7633	8540	9709	7073	5953	5753	5156	4960	4666	4491	4363	4274	4198	4135	4086	4086	4109	4129
50	7794	8090	9455	8885	5879	5720	6412	6004	5731	5325	5025	4776	4606	4432	4338	4294	4261	4263	4263
55	7119	7398	9332	7068	4825	5387	7116	7070	6837	6546	6224	5898	5582	5203	4883	4597	4430	4299	4208
60	4353	4555	6675	5050	4566	5150	8018	8468	8487	8483	8375	8158	7695	7066	6318	5605	5035	4512	4196
65	1826	1925	2686	2678	3485	4564	9914	11715	11894	12071	11929	11470	10573	9394	7926	6355	4859	3445	2576
70	1144	1134	1213	1448	1904	2996	9380	12985	13393	14044	14282	14317	13597	12369	10495	8162	5726	3446	2205
75	481	450	359	474	310	982	7840	11429	11837	12172	12037	11440	9995	8271	6460	4823	3190	1960	1332
80	67	67	68	80	117	209	611	1002	1029	1004	934	867	753	654	550	478	421	382	358
85	26	30	24	28	32	41	56	66	66	68	68	66	66	64	64	66	64	66	66
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

LITHONIA LIGHTING

Catalog Number	TWAC 100S 120CWIPE DBL LPI
Notes	
Type	H8

FEATURES & SPECIFICATIONS

INTENDED USE — For entrances, stairwells, corridors and other pedestrian areas.

CONSTRUCTION — Rear housing is rugged, corrosion-resistant, die-cast aluminum. Front cover is one-piece UV-resistant injection molded polycarbonate, internally painted. Captive external hardware is specially treated for corrosion resistance and includes slotted hex-head and tamperproof fasteners.

Finish: Dark Bronze (DDB) corrosion resistant polyester powder.

OPTICS — One-piece die-formed reflector is diffused aluminum. Refractor is clear UV stabilized polycarbonate, providing IES cutoff distribution and maximum lateral light output. Front cover is sealed and gasketed to inhibit the entrance of outside contaminants.

ELECTRICAL — Ballast: Metal halide: high reactance, high power factor. HPS: 35S, 50S, 70S, 120V are reactor, normal power factor. 100S 120V is reactor, high power factor. High reactance, high power factor (XHP), optional for 50S, 70S and 100S, 120V. 208, 240, 277, 347 and TB are standard XHP. Ballasts are 100% factory tested. UL listed 660W, 600V and 4kV pulse rated.

All components are heat-sinked directly to the cast housing for maximum heat dissipation.

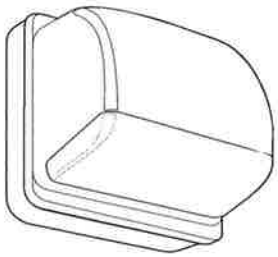
Socket: Porcelain, horizontally oriented medium-base socket with copper alloy, nickel-plated screw shell and center contact.

INSTALLATION — Mount to any vertical surface or to a 4" round square outlet box. Back access through gasketed slot. Top wiring access through 1/2" threaded conduit entry. (Through-wiring requires use of a conduit tee).

LISTINGS — UL listed for wet locations. IP65 rated. UL Listed to US and Canadian safety standards (see Options). NOM Certified.

WARRANTY — 1-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms and conditions.aspx

Note: Specifications subject to change without notice.



Cutoff Mini Wall Packs

TWAC

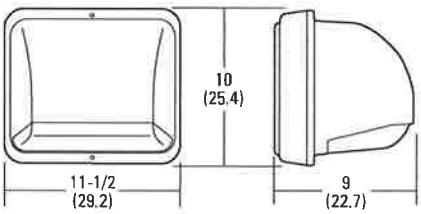
METAL HALIDE: 50-100W
HIGH PRESSURE SODIUM: 30-100W

Specifications

Height: 10 (25.4)
Width: 11-1/2 (29.2)
Depth: 8-15/16 (22.7)
*Weight: 10 lbs. (4.53 kg)

All dimensions are inches (centimeters) unless otherwise indicated.

* Weight as configured in example below.



ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**

Example: TWAC 50M 120 LPI

TWAC						
Series	**Wattage**	**Voltage**	**Ballast**	**Options**	**Finish**	**Lamp**[11]
TWAC	Metal halide **50M** **70M** **100M** High pressure sodium 35S[1] 50S **100S**	**120** 208[2] 240[2] **277** **347** **TB**[3] 230SOHZ[4]	**(blank) Magnetic** XHP High reactance, high power factor[5] CWI Constant wattage isolated	Shipped installed in fixture SF Single fuse (120, 277, 347V)[6] DF Double fuse (208, 240V)[6] EC Emergency circuit[7] DC12 Emergency circuit 12 volt (35 watt lamp included)[8] DC2012 Emergency circuit 12 volt (20 watt lamp included) 2DC12 Emergency circuit 12 volt (2 35 watt lamp included)[8] 2DC2012 Emergency circuit 12 volt (2 20 watt lamp included)[8] QRS Quartz restrike system[7] **CSA Listed and labeled to comply with Canadian Standards** NOM NOM Certified[4] PE Photocell[6] Shipped separately[9] WG Wire guard	**(blank) Dark bronze** DNA Natural aluminum DBL Black DMB Medium bronze DWH White DSS Sandstone CRT Non-stick protective coating[10] Super Durable Finishes DDBXD Dark bronze DBLXD Black DNAXD Natural aluminum DWHXD White DDBTXD Textured dark bronze DBLBXD Textured black DNATXD Textured natural aluminum DWHGXD Textured white	**LPI Lamp included** **L/LP Less lamp**

Notes

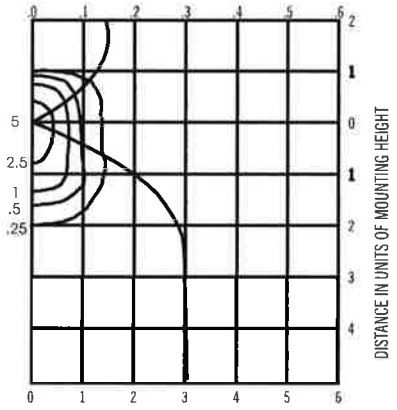
1 120V only.
2 Must specify CWI in Canada.
3 Optional multi-tap ballast (120, 208, 240, 277V). In Canada (120, 277, 347V) ships as 120/347.
4 Consult factory for available wattages.
5 Optional for 120V HPS only (n/a 35S).
6 Not available with TB.
7 Maximum allowable wattage lamp included.
8 Not available with QRS, EC or NOM.
9 May be ordered as an accessory as TWAWG U.
10 Finish applied to housing only.
11 Must be specified.

TWAC Metal Halide, High Pressure Sodium Wall Mounted

TWAC 50M

Test No. LTL8360

COEFFICIENT OF UTILIZATION

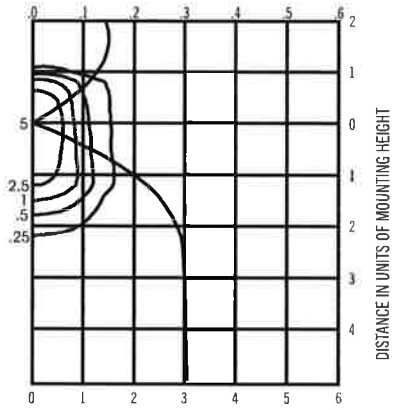


50W Metal Halide lamp, 8500 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

TWAC 70M

Test No. LTL8338

COEFFICIENT OF UTILIZATION

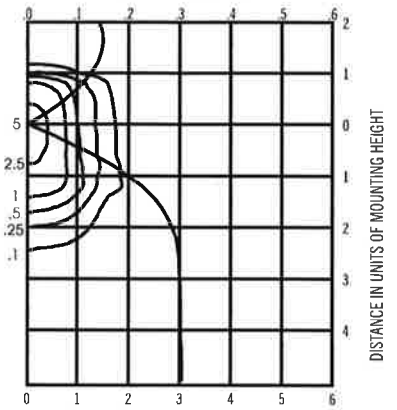


70W Metal Halide lamp, 5200 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

TWAC 100M

Test No. LTL8359

COEFFICIENT OF UTILIZATION

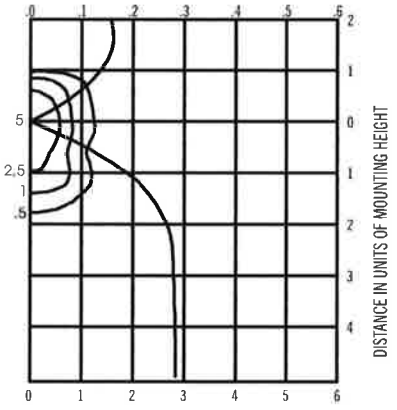


100W Metal Halide lamp, 8500 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

TWAC 35S

Test No. LTL8358

COEFFICIENT OF UTILIZATION

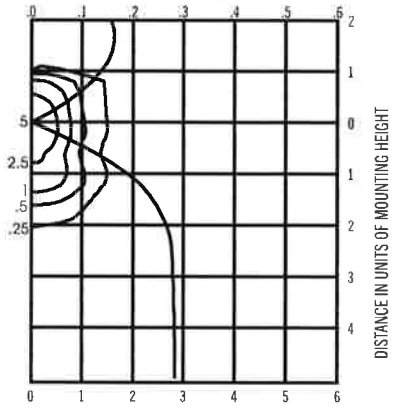


35W High Pressure Sodium lamp, 4000 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

TWAC 50S

Test No. LTL8357

COEFFICIENT OF UTILIZATION

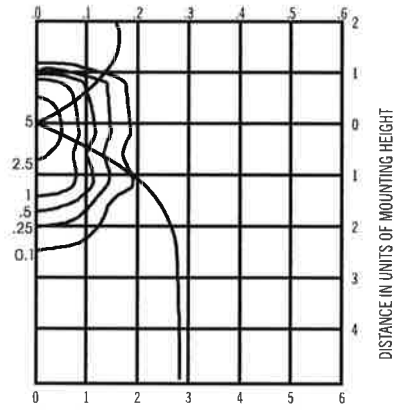


50W High Pressure Sodium lamp, 6300 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

TWAC 100S

Test No. LTL8337

COEFFICIENT OF UTILIZATION



100W High Pressure Sodium lamp, 9500 rated lumens. Footcandle values based on 20' mounting height, Distribution , cutoff.

Mounting Height Correction Factor
(Multiply the fc level by the correction factor)

8 ft. = 6.25
10 ft.= 4.00
12 ft.= 2.78
15 ft.= 1.78

$$\left(\frac{\text{Existing Mounting Height}}{\text{New Mounting Height}}\right)^2 = \text{Correction Factor}$$

Notes

1 Photometric data for other distributions can be accessed at www.lithonia.com.

2 Tested to current IES and NEMA standards under stabilized laboratory conditions. Various operating factors can cause differences between laboratory data and actual field measurements. Dimensions and specifications on this sheet based on the most current available data and are subject to change without notice.

3 For electrical characteristics, consult outdoor technical data specification sheets on www.lithonia.com.

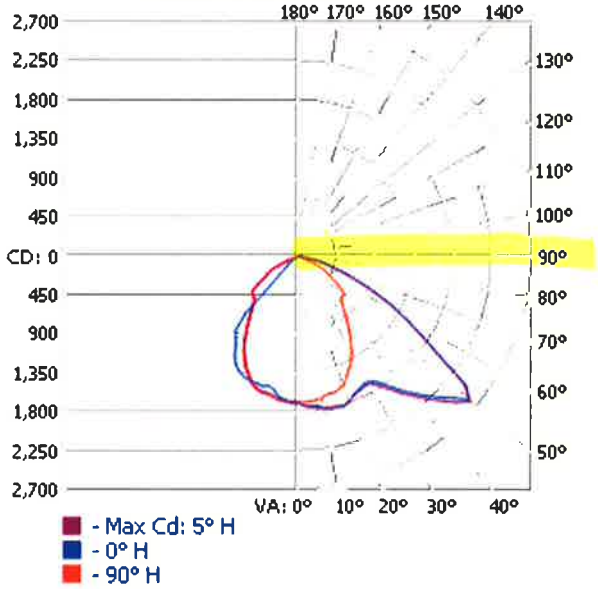
4 Actual performance may differ as a result of end-user environment and application.

OUTDOOR: One Lithonia Way Conyers, GA 30012 Phone: 770.922.9000 Fax: 770-918-1209 www.lithonia.com

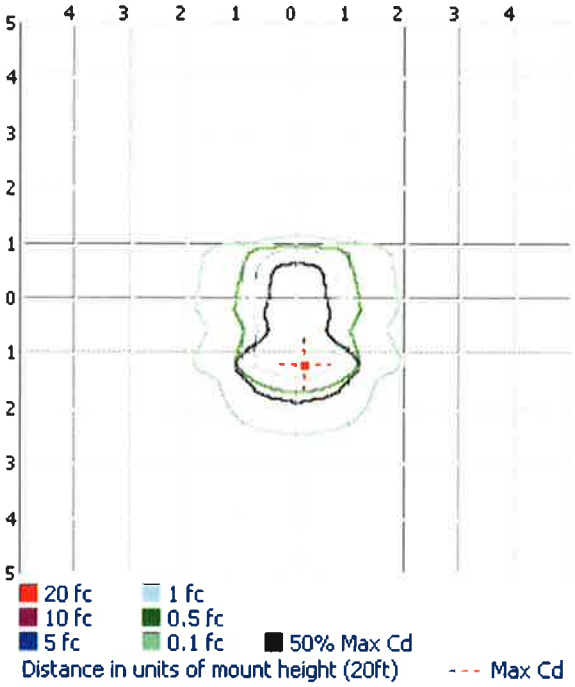
OUTDOOR PHOTOMETRIC REPORT
CATALOG: TWAC 100S

TEST #:	LTL8337
TEST LAB:	ACUITY BRANDS LIGHTING CONYERS LAB
TEST DATE:	2/20/2014
CATALOG:	TWAC 100S
DESCRIPTION:	SPECIFICATION BUILDING MOUNTED LUMINAIRE, 100W HPS, W/CLEAR LAMP.
SERIES:	TWAC
LAMP CATALOG:	LU100/MED
LAMP:	ONE 100-WATT CLEAR ED-17 HIGH PRESSURE SODIUM, HORIZONTAL POSITION.
LAMP OUTPUT:	1 LAMP, RATED LUMENS/LAMP: 9500
INPUT WATTAGE:	135
LUMINOUS OPENING:	RECTANGLE W/LUMINOUS SIDES (L: 5.28", W: 10.32", H: 1.44")
Max Cd:	2,604.0 AT HORIZONTAL: 5°, VERTICAL: 50°
CUTOFF CLASS:	CUTOFF
ROADWAY CLASS:	VERY SHORT, TYPE III
EFFICIENCY:	44.5%

Polar Candela Distribution



Isofootcandle Plot



OUTDOOR PHOTOMETRIC REPORT
CATALOG: TWAC 100S

AcuityBrands

ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Luminaire
0-30	1,330.2	14%	31.5%
0-40	2,156.3	22.7%	51%
0-60	3,746.2	39.4%	88.6%
60-90	473.8	5%	11.2%
70-100	117.5	1.2%	2.8%
90-120	7.5	0.1%	0.2%
0-90	4,220.0	44.4%	99.8%
90-180	7.8	0.1%	0.2%
0-180	4,227.8	44.5%	100%

LUMENS PER ZONE

Zone	Lumens	% Total	Zone	Lumens	% Total
0-10	160.5	3.8%	90-100	4.2	0.1%
10-20	465.5	11.0%	100-110	1.4	0%
20-30	704.1	16.7%	110-120	1.8	0%
30-40	826.2	19.5%	120-130	0.3	0%
40-50	848.0	20.1%	130-140	0.1	0%
50-60	741.9	17.5%	140-150	0	0%
60-70	360.5	8.5%	150-160	0.0	0%
70-80	92.6	2.2%	160-170	0.0	0%
80-90	20.7	0.5%	170-180	0.0	0%

ROADWAY SUMMARY

Cutoff Classification:		CUTOFF
Distribution:		TYPE III, VERY SHORT
Max Cd, 90 Deg Vert:		39.0
Max Cd, 80 to <90 Deg:		165.0
	Lumens	% Lamp
Downward Street Side:	2,712.5	28.6%
Downward House Side:	1,507.9	15.9%
Downward Total:	4,220.4	44.4%
Upward Street Side:	7.7	0.1%
Upward House Side:	0.1	0%
Upward Total:	7.8	0.1%
Total Lumens:	4,228.2	44.5%

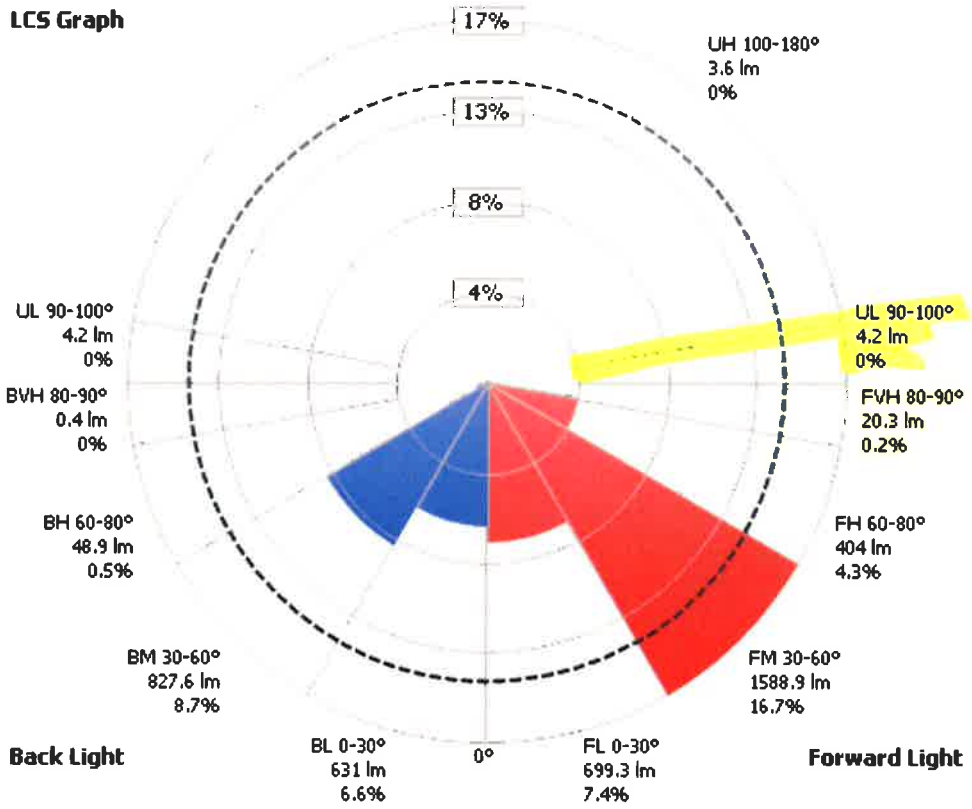
LCS TABLE

BUG RATING	**B2 - U1 - G1**	
FORWARD LIGHT	LUMENS	LUMENS %
Low(0-30):	699.3	7.4%
Medium(30-60):	1,588.9	16.7%
High(60-80):	404.0	4.3%
Very High(80-90):	20.3	0.2%
BACK LIGHT		
Low(0-30):	631.0	6.6%
Medium(30-60):	827.6	8.7%
High(60-80):	48.9	0.5%
Very High(80-90):	0.4	0%
UPLIGHT		
Low(90-100):	4.2	0%
High(100-180):	3.6	0%
TRAPPED LIGHT:	5,271.8	55.5%

OUTDOOR PHOTOMETRIC REPORT
CATALOG: TWAC 100S

AcuityBrands.

LCS Graph



Scale = Max LCS %

Trapped Light: 5271.8lm, 55.5%

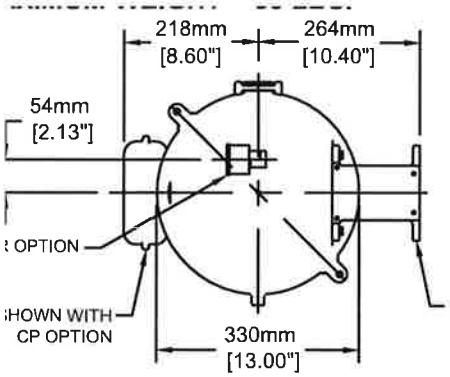
OUTDOOR PHOTOMETRIC REPORT
CATALOG: TWAC 100S

AcuityBrands.

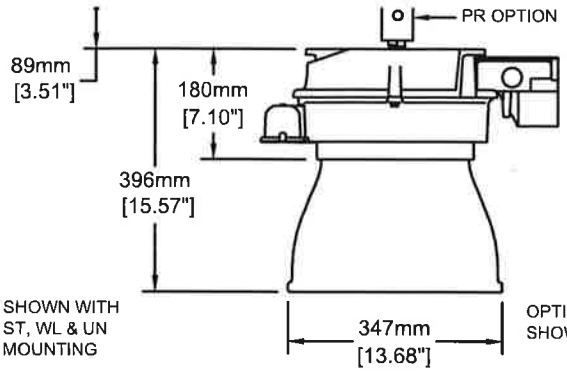
CANDELA TABLE - TYPE C

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685	1685
5	1735	1748	1745	1738	1724	1729	1724	1727	1728	1714	1726	1708	1703	1696	1690	1690	1680	1677	1685
10	1781	1783	1777	1763	1755	1754	1748	1749	1743	1727	1725	1705	1695	1684	1675	1669	1657	1650	1652
15	1803	1794	1788	1775	1765	1768	1764	1768	1770	1750	1751	1725	1707	1693	1678	1666	1650	1641	1631
20	1771	1761	1766	1768	1770	1780	1772	1761	1746	1728	1729	1704	1683	1663	1637	1615	1590	1573	1561
25	1686	1708	1704	1692	1695	1704	1693	1682	1701	1705	1667	1612	1587	1563	1532	1497	1461	1440	1426
30	1661	1694	1687	1673	1661	1652	1640	1621	1592	1546	1515	1508	1439	1410	1381	1346	1303	1271	1253
35	1825	1878	1856	1814	1764	1699	1606	1527	1453	1386	1330	1269	1269	1205	1185	1155	1105	1065	1042
40	2060	2106	2078	2022	1950	1862	1730	1584	1405	1217	1122	1043	1009	1007	952	947	920	875	847
45	2298	2363	2331	2260	2169	2055	1870	1670	1436	1224	1047	872	801	769	812	778	770	739	715
50	2566	**2604**	2581	2522	2419	2276	2074	1841	1562	1273	1038	832	665	640	662	709	734	713	699
55	2015	1972	1978	2021	2090	2137	2108	1960	1683	1349	1064	817	698	572	530	556	600	582	569
60	1457	1438	1427	1435	1439	1412	1327	1267	1266	1185	1020	849	692	470	350	330	374	401	398
65	990	956	954	965	980	968	868	735	550	404	492	720	596	388	296	271	282	290	241
70	599	577	577	583	583	553	469	374	267	194	154	143	295	299	211	140	104	81	53
75	324	310	310	309	301	270	216	166	125	99	84	73	65	67	64	41	30	25	24
80	165	157	155	151	148	120	94	77	60	54	45	37	30	24	24	22	16	14	14
85	76	72	73	66	60	50	41	33	27	24	20	16	10	10	10	10	10	6	6
90	39	36	35	33	30	23	20	17	15	13	8	7	5	4	4	5	5	1	2
95	17	19	19	16	13	10	8	5	4	5	4	2	1	0	0	0	1	1	0
100	4	7	8	5	5	4	5	3	2	2	0	0	3	0	0	0	0	0	0
105	8	7	10	8	4	3	4	1	1	1	0	0	0	0	0	0	0	0	0
110	15	16	16	13	10	6	2	1	0	0	0	0	0	0	0	0	0	0	0
115	19	17	16	15	10	6	1	0	0	0	0	0	0	0	0	0	0	0	0
120	11	9	9	8	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0
125	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

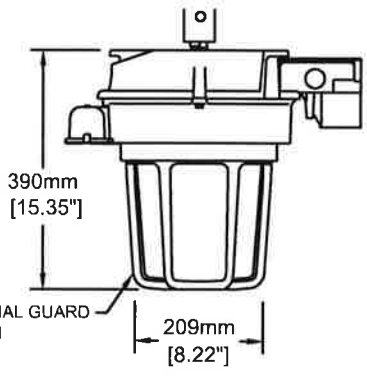
PETROLUX® III MEDIUM WET LOCATION



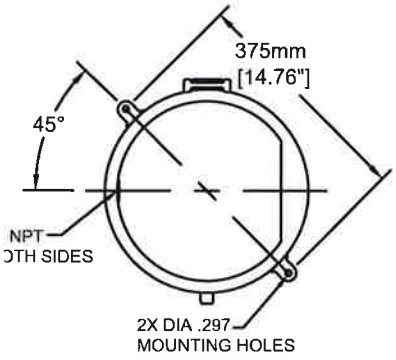
LUMINAIRE TOP VIEW



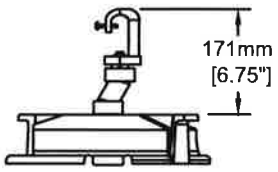
REFLECTOR LUMINAIRE



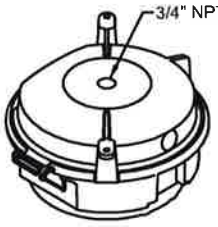
REFRACTOR LUMINAIRE



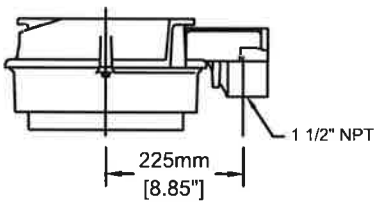
CE MOUNT



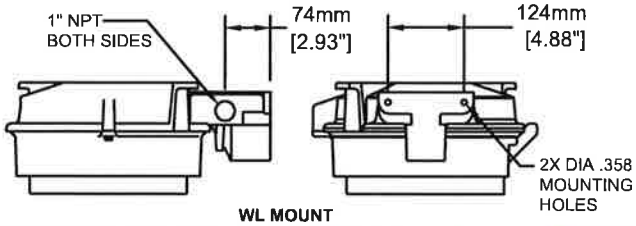
GH MOUNT



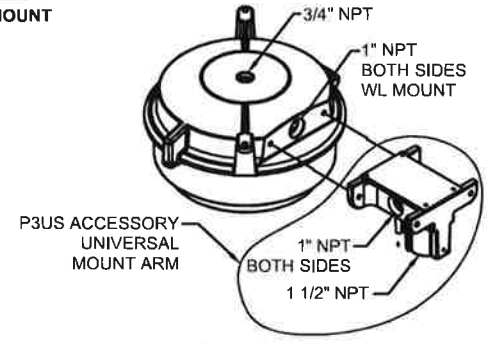
PD MOUNT



ST MOUNT



WL MOUNT



UN MOUNT

PWM 050 HP C GB 12 FDZ UN NA GD P3US LAMP

PWM 175 PM C GB MA 45F UN NA CP F1

LUMINAIRE
PWM = PETROLUX III MEDIUM, WET LOCATION

Step 2: WATTAGE
042 = 42W
050 = 50W
055 = 55W
057 = 57W
070 = 70W
085 = 85W
100 = 100W
150 = 150W [2]
175 = 175W [2]

Step 3: SOURCE
MH = METAL HALIDE
PM = PULSE METAL HALIDE
HP = HIGH PRESSURE SODIUM
CF = COMPACT FLUORESCENT
QL = INDUCTION

Step 4: BALLAST TYPE
P = HPF - HIGH REACTANCE AUTOTRANSFORMER
C = CWA - CONSTANT WATTAGE AUTOTRANSFORMER
I = CWI - CONSTANT WATTAGE ISOLATED SECONDARY
E = ELECTRONIC

Step 5: SOCKET
DB = MEDIUM BASE SOCKET
GB = MOGUL BASE SOCKET
PC = INDUCTION SOCKET
4P = CFL SOCKET

Step 6: VOLTAGE
12 = 120V
20 = 208V
24 = 240V
27 = 277V
34 = 347V
48 = 480V
MA = MULTI-TAP WIRED FOR 120V
MB = MULTI-TAP WIRED FOR 208V
MC = MULTI-TAP WIRED FOR 240V
MD = MULTI-TAP WIRED FOR 277V
MT = MULTI-TAP 120, 208, 240, 277V
VA = VARIABLE-TAP WIRED FOR 120V
VD = VARIABLE-TAP WIRED FOR 277V
VF = VARIABLE-TAP WIRED FOR 347V
VT = VARIABLE-TAP 120, 277, 347V
AV = VOLTAGE SENSING (120 THRU 277V)
QV = VOLTAGE SENSING (200 THRU 277V)

Step 7: OPTICS
30C = 6630 ENCLOSED REFLECTOR
45F = 4545 REFRACTOR WITH FORWARD THROW REFLECTOR
541 = 4541 LONG AND NARROW REFRACTOR
545 = 4545 SYMMETRIC REFRACTOR
FDZ = FDZ ENCLOSED POLYMERIC REFLECTOR

Step 8: MOUNTING
CE = CEILING
GH = GASKETED HOOK
PD = PENDANT
ST = STANCHION
UN = UNIVERSAL. FOR WALL/STANCHION CAPABILITY, MUST ORDER P3US (UNIVERSAL MOUNT ARM) ACCESSORY
WL = WALL

Step 9: CORD AND PLUG LENGTH
03 = 3FT
06 = 6FT
10 = 10FT
NA = NO CORD

OPTIONS
SEE SHEET 2

HOLOPHANE® LEADER IN LIGHTING SOLUTIONS

ORDER #: H16
TYPE:
DRAWN: DAY
DATE: 2/27/13

OPTIONS
CP = EXTERNAL CAPACITOR MODULE
EG = INGRESS/EGRESS MARKER DECAL
EM = STANDBY LIGHTING
ER = EMERGENCY LIGHTING
F1 = SINGLE FUSING
F2 = DOUBLE FUSING
GD = OPTIC GUARD
PR = SWIVEL PHOTOCONTROL OPTION [3]
PS = PROTECTED STARTER
SP = SAMPLE PACK FOR GROUND TRANSPORT
NE = NEMA DECAL

ACCESSORIES
LAMP = SHIP APPROPRIATE LAMP
F1 = SINGLE FUSE
F2 = DOUBLE FUSE
CDCW-L5-15-3 = 120V CORD & WATERTIGHT CONNECTOR ASSEMBLY
CDCW-L6-15-3 = 208 & 240V CORD & WATERTIGHT CONNECTOR ASSEMBLY
CDCW-L7-15-3 = 277V CORD & WATERTIGHT CONNECTOR ASSEMBLY
541A-REPL = REPLACEMENT LONG & NARROW REFRACTOR
545A-REPL = REPLACEMENT SYMMETRIC OR FORWARD THROW REFRACTOR
FDZ-REPL = REPLACEMENT FDZ REFLECTOR
30C-REPL = REPLACEMENT 30C REFLECTOR
PWMGA = OPTIC GUARD FOR REFRACTORS
PWMGC = OPTIC GUARD FOR REFLECTORS
PS-55 = REPLACEMENT PROTECTED STARTER
09189-X = SAFETY CHAIN KIT
P3US = UNIVERSAL MOUNT ARM. COMPATIBLE WITH UN (UNIVERSAL) MOUNTING ONLY

1. STANDARD FIXTURE COLOR IS WHITE
2. 175W PULSE MH AND 150W ELECTRONIC PULSE MH BALLASTS ARE EISA 2007 COMPLIANT Ⓔ
3. WET LISTED ONLY

Specifications

GENERAL DESCRIPTION

- UL 1598 Listed for Wet Locations
- NEMA Type 4X
- IP66 Ingress Protection

UL1598 Maximum Ambient Temperature

55, 85W QL	42, 57, 70W CFL	50, 70, 100, 150W HPS	70, 100, 150W MH		150W MH Electronic	175W PMH		
				With EM or ER Option		Without CP Option	With CP Option	
40°C	50°C	55°C	55°C	45°C	40°C	With or without EM or ER Option	With EM or ER Option	Without EM or ER Option
						55°C	55°C	60°C

3. WITH PR OPTION, MAXIMUM AMBIENT = 40°C. PR OPTION NOT AVAILABLE WITH QL OR 150W MH ELECTRONIC SOURCE AND WATTAGE.

OPTICS

The optical assembly, when secured to the electrical housing, shall provide a totally enclosed and gasketed luminaire.

HOUSING

All castings shall be low copper aluminum alloy and painted with polyester powder paint. The top cover shall be secured to the ballast housing with stainless steel hardware including a stainless steel insert.

MOUNTING

Luminaire shall provide single mounting option which allows for Pendant, Wall & Stanchion mountings when used in conjunction with universal arm accessory.

Reference HL-2410 for additional information related to specification and operating temperature codes suitable for hazardous locations.

PETROLUX® III MEDIUM WET LOCATION

HOLOPHANE LEADER IN LIGHTING SOLUTIONS

ORDER #:
TYPE: H/G
DRAWN: DAY
DATE: 2/27/13

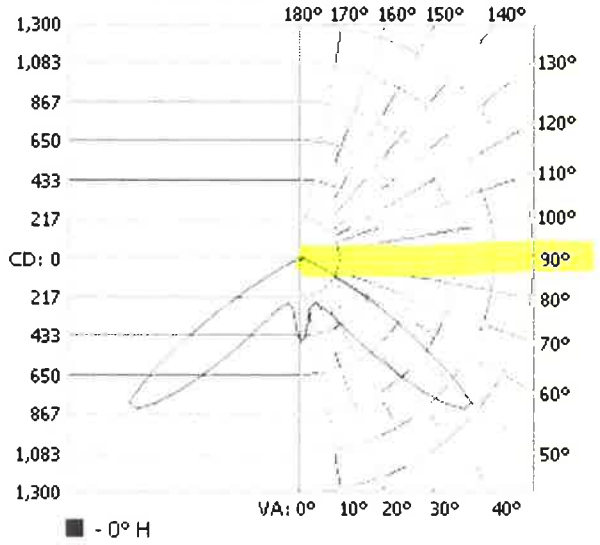
INDOOR PHOTOMETRIC REPORT
CATALOG: P3M050HPXGB00FDZXX

AcuityBrands.

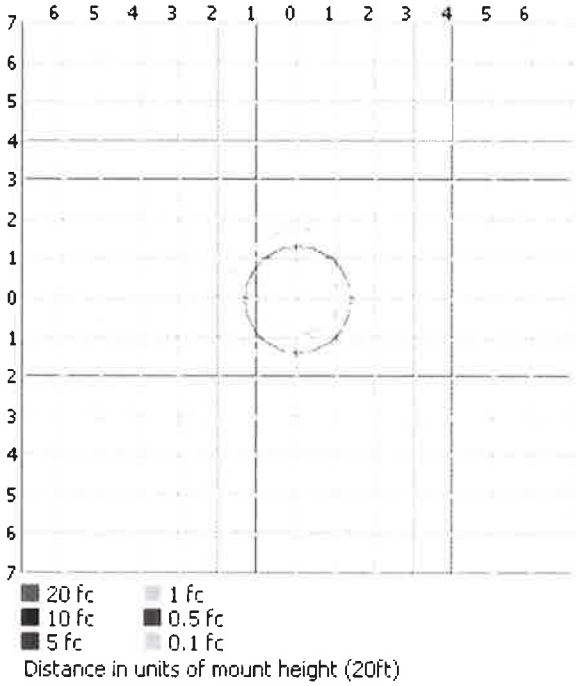
HOLOPHANE

TEST #:	105594
TEST LAB:	ACUITY BRANDS LIGHTING GRANVILLE LAB
TEST DATE:	2/21/2011
CATALOG:	P3M050HPXGB00FDZXX
DESCRIPTION:	P3M MEDIUM PETROLUX III
SERIES:	PETROLUX III P3M
LAMP CATALOG:	LU50 - ED-23.5
LAMP:	50W CLEAR HPS
LAMP OUTPUT:	1 LAMP, RATED LUMENS/LAMP: 4000
BALLAST / DRIVER:	EC-3343-D, HIGH REACTANCE MTB
INPUT WATTAGE:	63
LUMINOUS OPENING:	CIRCULAR (DIA: 13.56")
CIE CLASS:	DIRECT
Max Cd:	1,244.3 AT HORIZONTAL: 0°, VERTICAL: 50°
SPACING CRITERION:	@ 0 = 0.62 / @ 90 = 0.62
EFFICIENCY:	59.5%

Polar Candela Distribution



Isofootcandle Plot



INDOOR PHOTOMETRIC REPORT
CATALOG: P3M050HPXGB00FDZXX

AcuityBrands.

ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Luminaire
0-30	260.7	6.5%	11%
0-40	638.4	16%	26.8%
0-60	2,201.6	55%	92.6%
60-90	176.8	4.4%	7.4%
70-100	29.8	0.7%	1.3%
90-120	0	0%	0%
0-90	2,378.4	59.5%	100%
90-180	0	0%	0%
0-180	2,378.4	59.5%	100%

LUMENS PER ZONE

Zone	Lumens	% Total	Zone	Lumens	% Total
0-10	32.2	1.4%	90-100	0	0%
10-20	76.0	3.2%	100-110	0	0%
20-30	152.6	6.4%	110-120	0	0%
30-40	377.6	15.9%	120-130	0	0%
40-50	859.6	36.1%	130-140	0	0%
50-60	703.6	29.6%	140-150	0	0%
60-70	147.1	6.2%	150-160	0	0%
70-80	25.4	1.1%	160-170	0	0%
80-90	4.3	0.2%	170-180	0	0%

AVERAGE LUMINANCE (CD/M2)

	0
0	4905
45	17270
55	14487
65	3124
75	867
85	443

COEFFICIENTS OF UTILIZATION - ZONAL CAVITY METHOD

Effective Floor Cavity Reflectance: 20%

RCC %:	*80*				*70*				*50*			*30*			*10*			*0*
RW %:	70	50	30	0	70	50	30	0	50	30	20	50	30	20	50	30	20	0
RCR: 0	.71	.71	.71	.71	.69	.69	.69	.59	.66	.66	.66	.63	.63	.63	.61	.61	.61	.59
1	.65	.63	.60	.58	.64	.61	.59	.52	.59	.57	.56	.57	.55	.54	.54	.53	.52	.51
2	.59	.55	.51	.47	.58	.53	.50	.43	.51	.48	.46	.49	.47	.45	.48	.46	.44	.42
3	.54	.47	.42	.39	.52	.46	.42	.36	.45	.41	.37	.43	.40	.37	.41	.39	.36	.35
4	.48	.41	.36	.32	.47	.40	.35	.30	.39	.34	.31	.37	.34	.30	.36	.33	.30	.29
5	.44	.36	.30	.26	.42	.35	.30	.25	.34	.29	.26	.33	.28	.25	.31	.28	.25	.24
6	.40	.31	.26	.22	.39	.31	.25	.21	.30	.25	.21	.29	.24	.21	.28	.24	.21	.20
7	.36	.28	.22	.18	.35	.27	.22	.18	.26	.21	.18	.25	.21	.18	.24	.21	.18	.16
8	.33	.25	.19	.15	.32	.24	.19	.15	.23	.19	.15	.23	.18	.15	.22	.18	.15	.14
9	.31	.22	.17	.13	.30	.22	.17	.13	.21	.16	.13	.20	.16	.13	.20	.16	.13	.12
10	.28	.20	.15	.11	.27	.19	.15	.11	.19	.14	.11	.18	.14	.11	.18	.14	.11	.10

INDOOR PHOTOMETRIC REPORT
CATALOG: P3M050HPXGB00FDZXX

AcuityBrands.

CANDELA TABLE - TYPE C

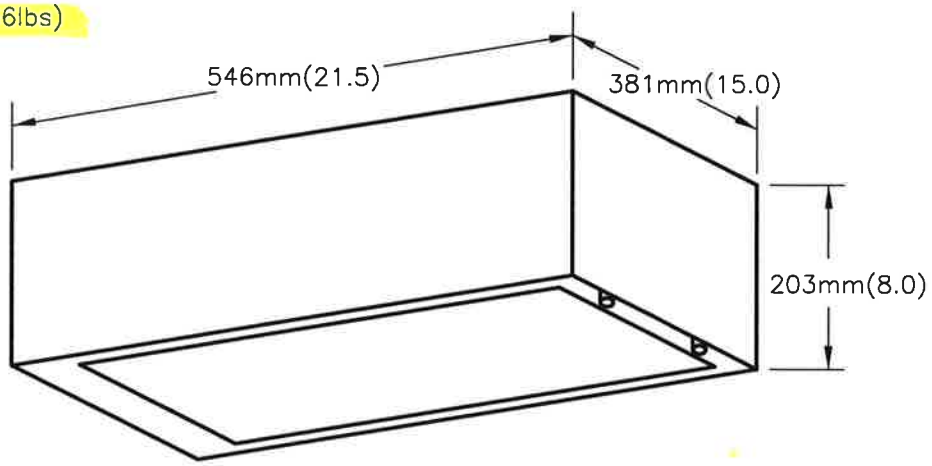
	0
0	457
5	370
10	279
15	262
20	280
25	316
30	401
35	576
40	839
45	1138
50	1244
55	774
60	349
65	123
70	51
75	21
80	9
85	4
90	0
95	0
100	0
105	0
110	0
115	0
120	0
125	0
130	0
135	0
140	0
145	0
150	0
155	0
160	0
165	0
170	0
175	0
180	0

SOMERSET ®
SERIES LUMINAIRES

U.L. LISTED
1572 WET LOCATION
C.S.A. CERTIFIED

MAX WEIGHT: 16kg (36lbs)

EPA: 1.43 sq. ft.



S M S T 15AHP12GRPF PS SMSTARM GR LAMP

SOMERSET SERIES

LAMP AND WATTAGE

- ☐ 100HP = 100W HPS
- ☒ 15AHP = 150W 55V HPS
- ☐ 250HP = 250W HPS
- ☐ 400HP = 400W HPS
- ☐ 150MH = 150W METAL HALIDE
- ☐ *175MH = 175W METAL HALIDE
- ☐ *250MH = 250W METAL HALIDE
- ☐ *400MH = 400W METAL HALIDE
- Ⓔ ☐ 175PM = 175W PULSE METAL HALIDE
- Ⓔ ☐ 250PM = 250W PULSE METAL HALIDE
- Ⓔ ☐ 350PM = 350W PULSE METAL HALIDE
- Ⓔ ☐ 400PM = 400W PULSE METAL HALIDE

VOLTAGE

- ☒ 12=120V
- ☐ 20=208V
- ☐ 24=240V
- ☐ 27=277V
- ☐ 34=347V
- ☐ 48=480V
- ☐ MT=MULTIVOLT 120, 208, 240 & 277V
- ☐ VT=MULTIVOLT 120, 277 & 347V 250HP, 400HP, 250MH & 400MH

COLOR

- ☐ BZ = BRONZE
- ☐ BK = BLACK
- ☒ GR = GRAY
- ☐ WH = WHITE

OPTICAL

- ☐ CL = CLEAR
- ☐ PM = PRISMATIC
- ☐ CF = CLEAR FORWARD THROW
- ☒ PF = PRISMATIC FORWARD THROW

(* NOT AVAILABLE FOR SHIPMENT IN US DUE TO EISA 2007 LEGISLATION)

OPTIONS (ADD TO CATALOG NUMBER):

- ☒ PS = PROTECTED STARTER (HPS UNITS ONLY)

ACCESSORIES (SHIP SEPARATE):

- ☒ LAMP
- ☐ F1 = SINGLE FUSING (120, 240, 277, VOLT) TO BE FIELD INSTALLED
- ☐ F2 = DOUBLE FUSING (208, 240, 480, VOLT) TO BE FIELD INSTALLED
- ☒ SMSTARM** = ARM MOUNT
- ☐ SMSTPB** = PIPE ADAPTOR BRACKET
- ☐ SMSTWB** = WALL BRACKET
- ☐ SMSTWS** = WALL BRACKET WITH ARM

(** ADD COLOR TO ACCESSORY)

- ☐ BK = BLACK
- ☐ BZ = BRONZE
- ☒ GR = GRAY
- ☐ WH = WHITE

NOTE: HOUSING/DOOR ASSEMBLY AND ELECTRICAL ASSEMBLIES SHIP SEPARATELY.

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An AcuityBrands Company

ORDER NO: _____

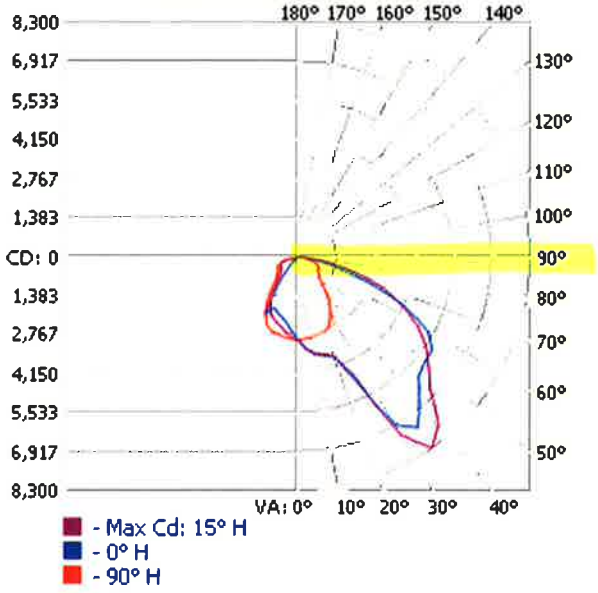
TYPE: H39

DRAWING NO. FM-1607
CAD MODEL: SMST.DWG
DATE: 5/25/10
Sheet 1 of 1

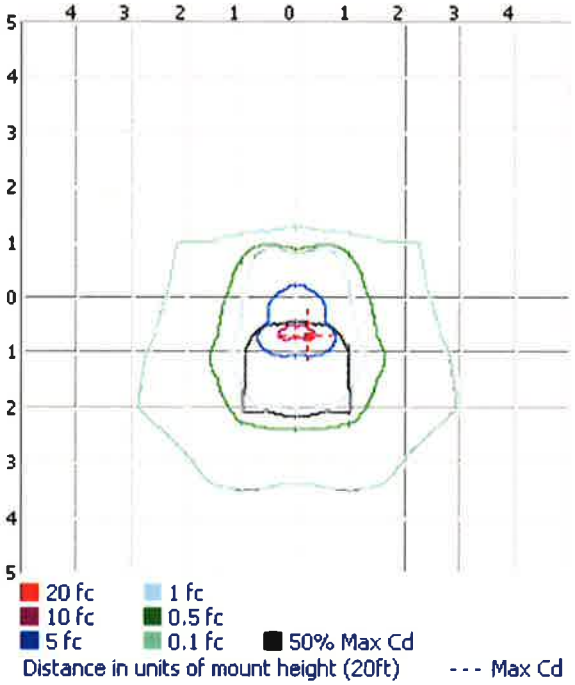
OUTDOOR PHOTOMETRIC REPORT
CATALOG: SMST15AHP00XXPF

TEST #:	43422
TEST LAB:	ACUITY BRANDS LIGHTING GRANVILLE LAB
TEST DATE:	1/31/2008
CATALOG:	SMST15AHP00XXPF
DESCRIPTION:	SOMERSET
SERIES:	SOMERSET
LAMP CATALOG:	LU150/MED - ED-17
LAMP:	150W CLEAR HPS
LAMP OUTPUT:	1 LAMP, RATED LUMENS/LAMP: 16000
INPUT WATTAGE:	188
LUMINOUS OPENING:	POINT
TER VALUE:	54 (BF = 1)
TER CATEGORY:	AREA & SITE LIGHT - TYPE III
Max Cd:	8,270.0 AT HORIZONTAL: 15°, VERTICAL: 35°
CUTOFF CLASS:	FULL CUTOFF
ROADWAY CLASS:	VERY SHORT, TYPE III
EFFICIENCY:	68.3%

Polar Candela Distribution



Isofootcandle Plot



OUTDOOR PHOTOMETRIC REPORT
CATALOG: SMST15AHP00XXPF

ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Luminaire
0-30	2,456.5	15.4%	22.5%
0-40	4,511.7	28.2%	41.3%
0-60	8,327.9	52%	76.2%
60-90	2,597.3	16.2%	23.8%
70-100	1,140.1	7.1%	10.4%
90-120	0	0%	0%
0-90	10,925.2	68.3%	100%
90-180	0	0%	0%
0-180	10,925.2	68.3%	100%

LUMENS PER ZONE

Zone	Lumens	% Total	Zone	Lumens	% Total
0-10	278.9	2.6%	90-100	0	0%
10-20	809.7	7.4%	100-110	0	0%
20-30	1,367.9	12.5%	110-120	0	0%
30-40	2,055.2	18.8%	120-130	0	0%
40-50	2,081.6	19.1%	130-140	0	0%
50-60	1,734.5	15.9%	140-150	0	0%
60-70	1,457.3	13.3%	150-160	0	0%
70-80	894.1	8.2%	160-170	0	0%
80-90	246.0	2.3%	170-180	0	0%

ROADWAY SUMMARY

Cutoff Classification:	FULL CUTOFF
Distribution:	TYPE III, VERY SHORT
Max Cd, 90 Deg Vert:	0
Max Cd, 80 to <90 Deg:	1,508.0

	Lumens	% Lamp
Downward Street Side:	8,576.5	53.6%
Downward House Side:	2,349.0	14.7%
Downward Total:	10,925.5	68.3%
Upward Street Side:	0	0%
Upward House Side:	0	0%
Upward Total:	0	0%
Total Lumens:	10,925.5	68.3%

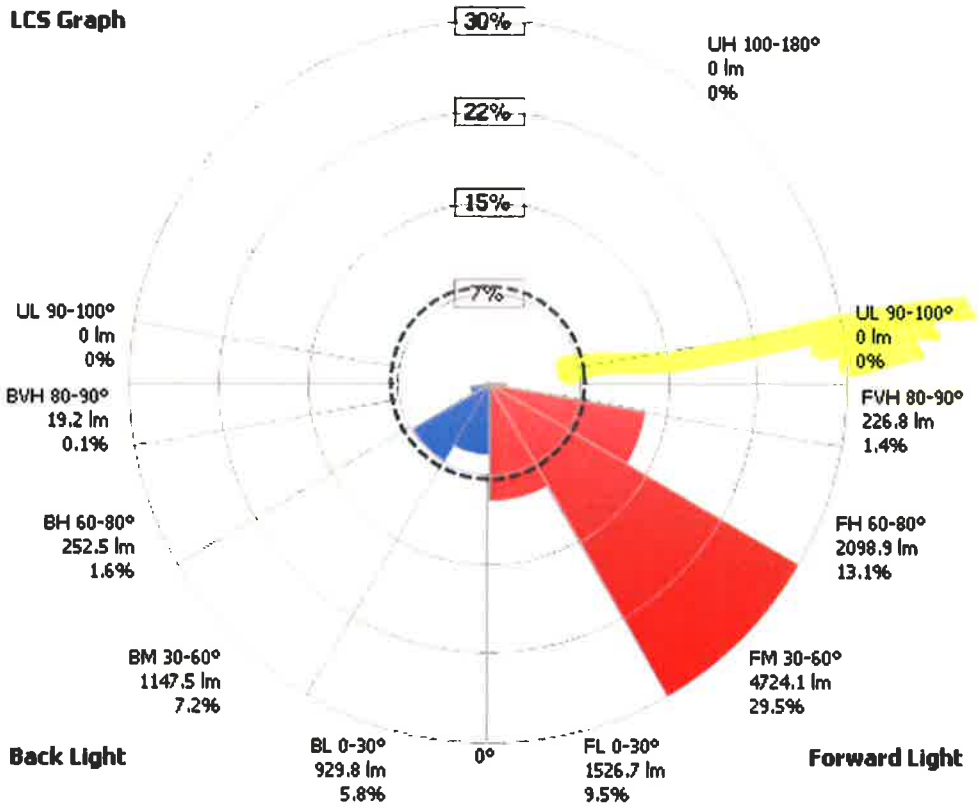
LCS TABLE

BUG RATING	**B2 - U0 - G3**	
FORWARD LIGHT	LUMENS	LUMENS %
Low(0-30):	1,526.7	9.5%
Medium(30-60):	4,724.1	29.5%
High(60-80):	2,098.9	13.1%
Very High(80-90):	226.8	1.4%
BACK LIGHT		
Low(0-30):	929.8	5.8%
Medium(30-60):	1,147.5	7.2%
High(60-80):	252.5	1.6%
Very High(80-90):	19.2	0.1%
UPLIGHT		
Low(90-100):	0	0%
High(100-180):	0	0%
TRAPPED LIGHT:	5,074.5	31.7%

OUTDOOR PHOTOMETRIC REPORT
CATALOG: SMST15AHP00XXPF

AcuityBrands.

LCS Graph



Scale = Max LCS %

Trapped Light: 5074.5lm, 31.7%

OUTDOOR PHOTOMETRIC REPORT
CATALOG: SMST15AHP00XXPF

CANDELA TABLE - TYPE C

	0	15	25	35	45	55	65	75	85	90	105	115	125	135	145	155	165	175	180
0	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942	2942
5	3278	3282	3268	3247	3217	3175	3127	3100	3087	3074	3059	3044	3030	3015	2998	2982	2965	2948	2932
10	3501	3505	3472	3419	3387	3356	3307	3263	3241	3219	3188	3158	3128	3097	3060	3024	2987	2950	2914
15	3630	3626	3566	3568	3523	3477	3380	3336	3315	3293	3258	3224	3189	3154	3103	3052	3002	2951	2892
20	3782	3792	3754	3724	3720	3605	3470	3398	3361	3325	3287	3248	3210	3172	3112	3052	2992	2932	2858
25	4924	4980	4594	4072	3748	3624	3479	3365	3308	3251	3199	3148	3096	3044	2980	2917	2854	2790	2715
30	6880	7062	7267	5647	4187	3679	3338	3178	3097	3017	2940	2862	2785	2708	2635	2562	2490	2417	2348
35	7391	7634	**8270**	8028	6359	4149	3150	2925	2812	2700	2594	2488	2381	2275	2207	2139	2071	2003	1945
40	6639	6849	7741	8049	7805	5679	3086	2582	2329	2077	1984	1892	1800	1707	1652	1596	1540	1485	1444
45	6017	5913	6613	7248	7063	5866	2893	2234	1904	1574	1502	1430	1359	1287	1251	1216	1180	1144	1112
50	5830	5616	6034	6124	5993	4744	2253	1806	1582	1358	1316	1274	1233	1191	1157	1122	1088	1054	1014
55	5785	5735	5524	5310	4732	3656	2056	1688	1503	1319	1260	1202	1144	1085	1046	1006	967	928	890
60	5303	5274	4871	5103	3824	2747	2123	1735	1541	1347	1279	1211	1143	1075	1034	994	953	912	872
65	4166	4123	4054	4419	3293	2325	2144	1811	1644	1478	1375	1272	1169	1066	1015	964	912	861	826
70	2561	2681	3162	3327	2625	2083	2174	1860	1703	1546	1401	1256	1112	967	907	848	788	728	699
75	1340	1409	2027	2265	1720	1750	1922	1591	1426	1260	1142	1024	906	788	724	660	597	533	501
80	601	680	1014	1307	998	1441	1508	1163	990	818	730	643	556	468	416	364	313	261	246
85	150	184	407	348	522	797	593	422	336	251	216	182	147	112	101	90	80	69	63
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FEATURES & SPECIFICATIONS

Catalog Number	SSA2566G D1 K8 GR 4
Order Number	Type LP1

SSA

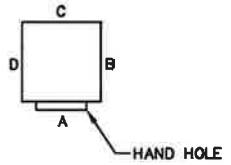
SQUARE STRAIGHT ALUMINUM POLES

CONSTRUCTION - Welds conform to applicable AWS structural welding code. Pole shaft is one piece, 6005, 6061, or 6063 aluminum alloy, heat treated to a T6 temper. Pole base shall be 356 or A356 aluminum alloy, heat treated to a T6 temper after welding. Hand hole is 2" x 4" minimum, cover and fasteners are included. Nut covers shall be provided as standard. Finish shall match pole. Removable pole cap shall be provided with each drill pattern type pole. Non-structural fasteners shall be stainless steel.

FINISH – Anodize, painted, or satin brush finish. Painted poles shall be semi-gloss powder paint.

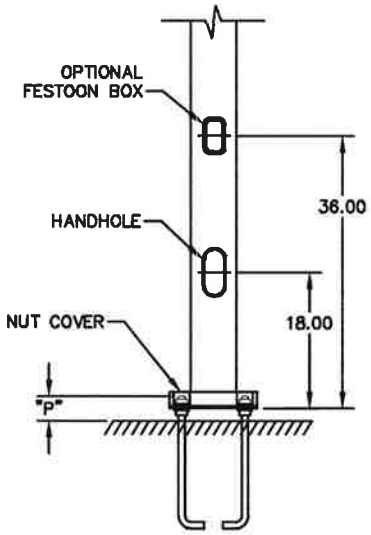
GROUNDING – Grounding provision shall be immediately accessible through hand hole, 3/8-16 threads.

ANCHOR BOLTS – Steel anchor bolts shall be per AASHTO M314 or ASTM F 1554 - Grade 55, hot dip galvanize. Nuts and washers shall be per AASHTO M314-90 or ASTM F 1554 – hot dip galvanized.



POLE TOP STYLE		ORIENTATION
D1	1 UNIT	C
D2	2 UNITS @ 180	B,D
D3	3 UNITS @ 90	B,C,D
D4	4 UNITS @ 90	A,B,C,D
D5	2 UNITS @ 90	B,C

DRILL PATTERN ORIENTATION



POLE ORDERING DATA

How to construct a catalog number for SSA poles:

EXAMPLE SSA2555G D1 R3 BZ 1 Fill in Catalog Number SSA2566G D1 K8 GR 4

1 2 3 4 5

STEP	CATALOG NUMBER	DESCRIPTION
1. BASE POLE	(SEE SHEET 2)	SQUARE STRAIGHT ALUMINUM

2. POLE TOP STYLE		
	D1	DRILLING FOR 1 UNIT
	D2	DRILLING FOR 2 UNITS @ 180
	D3	DRILLING FOR 3 UNITS @ 90
	D4	DRILLING FOR 4 UNITS @ 90
	D5	DRILLING FOR 2 UNITS @ 90
	P2	TENON, 2.38 O.D. X 4" LG.
	P3	TENON, 3.50 O.D. X 6" LG.
	P4	TENON, 4.00 O.D. X 6" LG.
	P5	TENON 2.88 O.D. X 4" LG.

3. POLE TOP DRILL PATTERN		
	H1	PARKPACK, HORZ NO ARM
	H3	PARKPACK, HORZ WITH ARM
	J4	MIRROSTAR ONLY
	K8	MONGOOSE, SQ POSTOP ARM
	R2	MOD 600 & SOMERSET ONLY
	R3	MONGOOSE, ARCH ARM
	T3	POLESTAR ONLY
	W5	PARKPACK, VERT NO ARM
	ND	NO DRILL PATTERN
	AF1	AEL 53
	AF2	AEL 153
	AF3	AEL LS, LM
	AF5	AEL AVL W/A OPTION
	AF6	AEL ASA & AVL

4. FINISH		
	AK	BLACK ANODIZE
	AZ	BRONZE ANODIZE
	BK	BLACK PAINT
	BZ	BRONZE PAINT
	GN	GREEN PAINT
	GR	GRAY PAINT
	SB	SATIN BRUSH
	WH	WHITE PAINT

5. OPTIONS		
	1	FESTOON BOX
	3	TAMPER RESISTANT SCREWS
	4	VIBRATION DAMPENER

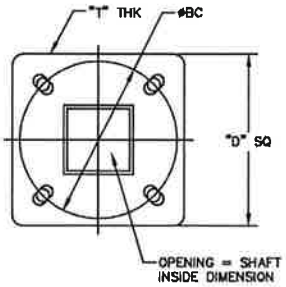
NOTES:
1. Pole top drill pattern types H1 - W5 are available on drilled pole tops only. ND is only available on tenon pole tops.
2. The Festoon Box is located on the same side as the hand hole, 36" above pole base. Receptacle / Cover are not included.

HOLOPHANE®

SSA Square Straight Aluminum Poles

Ref. Item No.	Base Pole Number	Nominal Pole Height	Nominal Shaft Size & Wall Thickness	EPA Vertical Offset from Top of Pole	NON-AASHTO Rating: 90 mph + 1.14 gust Max EPA	90 mph + 1.14 gust Max Wt.	100 mph + 1.14 gust Max EPA	100 mph + 1.14 gust Max Wt.	110 mph + 1.14 gust Max EPA	110 mph + 1.14 gust Max Wt.	Bolt Circle Dia.	Anchor Bolt Size
1	SSA0844C	08	4.0 Square x .125	0"	19.6	490	15.0	375	11.7	293	9.00	.75 x 17 + 3
				30"	14.6	365	11.4	385	8.8	220		
1	SSA1044C	10	4.0 Square x .125	0"	14.0	350	10.6	265	7.6	195	9.00	.75 x 17 + 3
				30"	11.3	283	8.4	210	6.2	155		
1	SSA1244C	12	4.0 Square x .125	0"	17.6	440	13.6	340	10.5	263	9.00	.75 x 17 + 3
				30"	11.5	288	8.7	218	6.7	168		
1	SSA1444C	14	4.0 Square x .125	0"	13.3	333	9.8	245	7.3	183	9.00	.75 x 17 + 3
				30"	8.8	220	6.5	163	4.8	120		
1	SSA1544C	15	4.0 Square x .125	0"	9.2	230	6.5	163	4.6	115	9.00	.75 x 17 + 3
				30"	7.6	190	5.4	135	3.8	95		
1	SSA1644C	16	4.0 Square x .125	0"	7.7	193	5.3	133	3.5	88	9.00	.75 x 17 + 3
				30"	6.4	160	4.4	110	2.9	73		
1	SSA1644G	16	4.0 Square x .188	0"	12.8	320	9.5	238	6.8	170	9.00	.75 x 17 + 3
				30"	10.8	270	7.9	198	5.8	145		
2	SSA1655G	16	5.0 Square x .188	0"	23.0	575	17.3	433	13.1	328	11.00	.75 x 17 + 3
				30"	19.3	483	14.5	363	11.0	275		
1	SSA1844C	18	4.0 Square x .125	0"	5.2	130	3.1	78	1.5	38	9.00	.75 x 17 + 3
				30"	4.4	110	2.6	65	1.3	33		
1	SSA1844G	18	4.0 Square x .188	0"	9.7	243	6.7	168	4.5	113	9.00	.75 x 17 + 3
				30"	8.2	205	5.7	143	3.8	95		
2	SSA1855G	18	5.0 Square x .188	0"	18.0	450	13.1	328	9.5	238	11.00	.75 x 17 + 3
				30"	15.4	385	11.2	280	8.1	203		
1	SSA2044C	20	4.0 Square x .125	0"	3.1	78	1.2	30	na	na	9.00	.75 x 17 + 3
				30"	2.7	68	1.1	28	na	na		
1	SSA2044G	20	4.0 Square x .188	0"	7.0	175	4.4	110	2.4	60	9.00	.75 x 17 + 3
				30"	6.1	153	3.8	95	2.1	53		
2	SSA2055G	20	5.0 Square x .188	0"	14.0	350	9.6	240	6.5	163	11.00	.75 x 17 + 3
				30"	12.2	305	8.4	210	5.6	140		
3	SSA2066G	20	6.0 Square x .188	0"	22.1	553	15.4	385	10.8	270	12.50	1.00 x 36 + 4
				30"	19.3	483	13.6	340	9.4	235		
3	SSA2066J	20	6.0 Square x .250	0"	31.0	775	23.0	575	16.7	418	12.50	1.00 x 36 + 4
				30"	27.3	683	20.0	500	14.7	368		
2	SSA2555G	25	5.0 Square x .188	0"	6.4	160	3.0	75	na	na	11.00	.75 x 17 + 3
				30"	5.6	140	2.7	68	na	na		
3	SSA2566G	25	6.0 Square x .188	0"	13.0	325	8.2	205	4.3	108	12.50	1.00 x 36 + 4
				30"	11.9	298	7.3	183	3.8	95		
3	SSA2566J	25	6.0 Square x .250	0"	18.1	453	11.7	293	7.0	175	12.50	1.00 x 36 + 4
				30"	16.2	405	10.5	263	6.3	158		
3	SSA3066G	30	6.0 Square x .188	0"	4.2	105	na	na	na	na	12.50	1.00 x 36 + 4
				30"	3.9	98	na	na	na	na		
3	SSA3066J	30	6.0 Square x .250	0"	11.1	278	6.0	150	2.2	55	12.50	1.00 x 36 + 4
				30"	10.0	250	5.4	135	2.0	50		
3	SSA3266J	32	6.0 Square x .250	0"	7.7	193	3.0	75	na	na	12.50	1.00 x 36 + 4
				30"	7.0	175	2.7	68	na	na		
3	SSA3566J	35	6.0 Square x .250	0"	4.9	123	na	na	na	na	12.50	1.00 x 36 + 4
				30"	4.4	110	na	na	na	na		

BASE DETAIL



Item No.	Bolt Circle Dia.	Min. Base Size "D"	Base Thk. "T"	Bolt Projection	Anchor Bolt Set	Bolt Circle Template
1	9.00	9.88	0.43	2.88 - 3.38	AB-26-4	TMP-41
2	11.00	11.25	0.50	3.00 - 3.50	AB-26-4	TMP-45
3	12.50	12.25	0.63	3.50 - 4.00	AB-27-4	TMP-48

Visit our web site at www.holophane.com

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An AcuityBrands Company

FEATURES & SPECIFICATIONS

Catalog Number	SSA1544C D2 R2 GR 4
Order Number	Type LP2

SSA

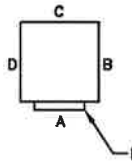
SQUARE STRAIGHT ALUMINUM POLES

CONSTRUCTION - Welds conform to applicable AWS structural welding code. Pole shaft is one piece, 6005, 6061, or 6063 aluminum alloy, heat treated to a T6 temper. Pole base shall be 356 or A356 aluminum alloy, heat treated to a T6 temper after welding. Hand hole is 2" x 4" minimum, cover and fasteners are included. Nut covers shall be provided as standard. Finish shall match pole. Removable pole cap shall be provided with each drill pattern type pole. Non-structural fasteners shall be stainless steel.

FINISH – Anodize, painted, or satin brush finish. Painted poles shall be semi-gloss powder paint.

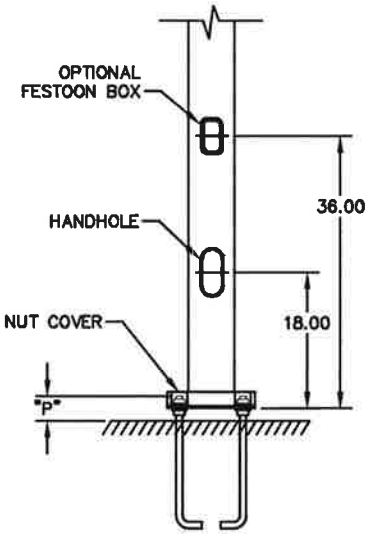
GROUNDING – Grounding provision shall be immediately accessible through hand hole, 3/8-16 threads.

ANCHOR BOLTS – Steel anchor bolts shall be per AASHTO M314 or ASTM F 1554 - Grade 55, hot dip galvanize. Nuts and washers shall be per AASHTO M314-90 or ASTM F 1554 – hot dip galvanized.



POLE TOP STYLE		ORIENTATION
D1	1 UNIT	C
D2	2 UNITS @ 180	B,D
D3	3 UNITS @ 90	B,C,D
D4	4 UNITS @ 90	A,B,C,D
D5	2 UNITS @ 90	B,C

DRILL PATTERN ORIENTATION



POLE ORDERING DATA

How to construct a catalog number for SSA poles:

EXAMPLE SSA2555G D1 R3 BZ 1 Fill in Catalog Number SSA1544C D2 R2 GR 4

1 2 3 4 5

STEP	CATALOG NUMBER	DESCRIPTION
1. BASE POLE	(SEE SHEET 2)	SQUARE STRAIGHT ALUMINUM

2. POLE TOP STYLE		
	D1	DRILLING FOR 1 UNIT
	D2	DRILLING FOR 2 UNITS @ 180
	D3	DRILLING FOR 3 UNITS @ 90
	D4	DRILLING FOR 4 UNITS @ 90
	D5	DRILLING FOR 2 UNITS @ 90
	P2	TENON, 2.38 O.D. X 4" LG.
	P3	TENON, 3.50 O.D. X 6" LG.
	P4	TENON, 4.00 O.D. X 6" LG.
	P5	TENON 2.88 O.D. X 4" LG.

3. POLE TOP DRILL PATTERN		
	H1	PARKPACK, HORZ NO ARM
	H3	PARKPACK, HORZ WITH ARM
	J4	MIRROSTAR ONLY
	K8	MONGOOSE, SQ POSTOP ARM
	R2	MOD 600 & SOMERSET ONLY
	R3	MONGOOSE, ARCH ARM
	T3	POLESTAR ONLY
	W5	PARKPACK, VERT NO ARM
	ND	NO DRILL PATTERN
	AF1	AEL 53
	AF2	AEL 153
	AF3	AEL LS, LM
	AF5	AEL AVL W/A OPTION
	AF6	AEL ASA & AVL

4. FINISH		
	AK	BLACK ANODIZE
	AZ	BRONZE ANODIZE
	BK	BLACK PAINT
	BZ	BRONZE PAINT
	GN	GREEN PAINT
	GR	GRAY PAINT
	SB	SATIN BRUSH
	WH	WHITE PAINT

5. OPTIONS		
	1	FESTOON BOX
	3	TAMPER RESISTANT SCREWS
	4	VIBRATION DAMPENER

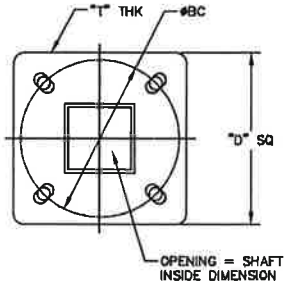
NOTES:
1. Pole top drill pattern types H1 - W5 are available on drilled pole tops only. ND is only available on tenon pole tops.
2. The Festoon Box is located on the same side as the hand hole, 36" above pole base. Receptacle / Cover are not included.

HOLOPHANE®

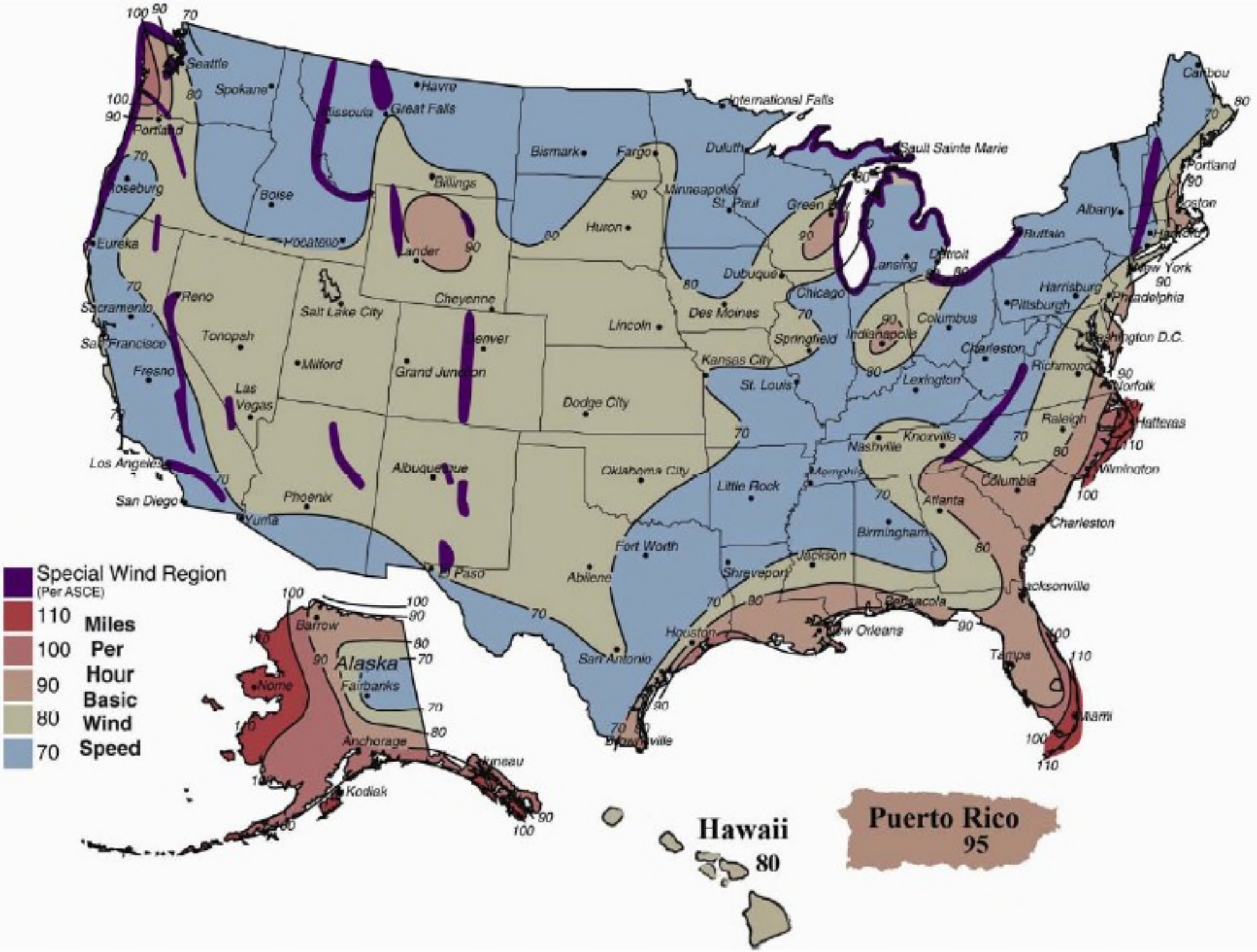
SSA Square Straight Aluminum Poles

Ref. Item No.	Base Pole Number	Nominal Pole Height	Nominal Shaft Size & Wall Thickness	EPA Vertical Offset from Top of Pole	NON-AASHTO Rating: 90 mph + 1.14 gust Max EPA	90 mph + 1.14 gust Max Wt.	100 mph + 1.14 gust Max EPA	100 mph + 1.14 gust Max Wt.	110 mph + 1.14 gust Max EPA	110 mph + 1.14 gust Max Wt.	Bolt Circle Dia.	Anchor Bolt Size
1	SSA0844C	08	4.0 Square x .125	0"	19.6	490	15.0	375	11.7	293	9.00	.75 x 17 + 3
				30"	14.6	365	11.4	385	8.8	220		
1	SSA1044C	10	4.0 Square x .125	0"	14.0	350	10.6	265	7.6	195	9.00	.75 x 17 + 3
				30"	11.3	283	8.4	210	6.2	155		
1	SSA1244C	12	4.0 Square x .125	0"	17.6	440	13.6	340	10.5	263	9.00	.75 x 17 + 3
				30"	11.5	288	8.7	218	6.7	168		
1	SSA1444C	14	4.0 Square x .125	0"	13.3	333	9.8	245	7.3	183	9.00	.75 x 17 + 3
				30"	8.8	220	6.5	163	4.8	120		
1	SSA1544C	15	4.0 Square x .125	0"	9.2	230	6.5	163	4.6	115	9.00	.75 x 17 + 3
				30"	7.6	190	5.4	135	3.8	95		
1	SSA1644C	16	4.0 Square x .125	0"	7.7	193	5.3	133	3.5	88	9.00	.75 x 17 + 3
				30"	6.4	160	4.4	110	2.9	73		
1	SSA1644G	16	4.0 Square x .188	0"	12.8	320	9.5	238	6.8	170	9.00	.75 x 17 + 3
				30"	10.8	270	7.9	198	5.8	145		
2	SSA1655G	16	5.0 Square x .188	0"	23.0	575	17.3	433	13.1	328	11.00	.75 x 17 + 3
				30"	19.3	483	14.5	363	11.0	275		
1	SSA1844C	18	4.0 Square x .125	0"	5.2	130	3.1	78	1.5	38	9.00	.75 x 17 + 3
				30"	4.4	110	2.6	65	1.3	33		
1	SSA1844G	18	4.0 Square x .188	0"	9.7	243	6.7	168	4.5	113	9.00	.75 x 17 + 3
				30"	8.2	205	5.7	143	3.8	95		
2	SSA1855G	18	5.0 Square x .188	0"	18.0	450	13.1	328	9.5	238	11.00	.75 x 17 + 3
				30"	15.4	385	11.2	280	8.1	203		
1	SSA2044C	20	4.0 Square x .125	0"	3.1	78	1.2	30	na	na	9.00	.75 x 17 + 3
				30"	2.7	68	1.1	28	na	na		
1	SSA2044G	20	4.0 Square x .188	0"	7.0	175	4.4	110	2.4	60	9.00	.75 x 17 + 3
				30"	6.1	153	3.8	95	2.1	53		
2	SSA2055G	20	5.0 Square x .188	0"	14.0	350	9.6	240	6.5	163	11.00	.75 x 17 + 3
				30"	12.2	305	8.4	210	5.6	140		
3	SSA2066G	20	6.0 Square x .188	0"	22.1	553	15.4	385	10.8	270	12.50	1.00 x 36 + 4
				30"	19.3	483	13.6	340	9.4	235		
3	SSA2066J	20	6.0 Square x .250	0"	31.0	775	23.0	575	16.7	418	12.50	1.00 x 36 + 4
				30"	27.3	683	20.0	500	14.7	368		
2	SSA2555G	25	5.0 Square x .188	0"	6.4	160	3.0	75	na	na	11.00	.75 x 17 + 3
				30"	5.6	140	2.7	68	na	na		
3	SSA2566G	25	6.0 Square x .188	0"	13.0	325	8.2	205	4.3	108	12.50	1.00 x 36 + 4
				30"	11.9	298	7.3	183	3.8	95		
3	SSA2566J	25	6.0 Square x .250	0"	18.1	453	11.7	293	7.0	175	12.50	1.00 x 36 + 4
				30"	16.2	405	10.5	263	6.3	158		
3	SSA3066G	30	6.0 Square x .188	0"	4.2	105	na	na	na	na	12.50	1.00 x 36 + 4
				30"	3.9	98	na	na	na	na		
3	SSA3066J	30	6.0 Square x .250	0"	11.1	278	6.0	150	2.2	55	12.50	1.00 x 36 + 4
				30"	10.0	250	5.4	135	2.0	50		
3	SSA3266J	32	6.0 Square x .250	0"	7.7	193	3.0	75	na	na	12.50	1.00 x 36 + 4
				30"	7.0	175	2.7	68	na	na		
3	SSA3566J	35	6.0 Square x .250	0"	4.9	123	na	na	na	na	12.50	1.00 x 36 + 4
				30"	4.4	110	na	na	na	na		

BASE DETAIL



Item No.	Bolt Circle Dia.	Min. Base Size "D"	Base Thk. "T"	Bolt Projection	Anchor Bolt Set	Bolt Circle Template
1	9.00	9.88	0.43	2.88 - 3.38	AB-26-4	TMP-41
2	11.00	11.25	0.50	3.00 - 3.50	AB-26-4	TMP-45
3	12.50	12.25	0.63	3.50 - 4.00	AB-27-4	TMP-48


Special Wind Region
(Per ASCE)
110 Miles
100 Per
90 Hour
80 Basic
70 Wind
Speed
Alaska
Hawaii
80
Puerto Rico
95
Seattle
Spokane
Portland
Eureka
Sacramento
San Francisco
Fresno
Los Angeles
San Diego
Reno
Las Vegas
Tonopah
Milford
Phoenix
Yuma
Albuquerque
El Paso
Boise
Pocatello
Salt Lake City
Grand Junction
Denver
Cheyenne
Billings
Great Falls
Havre
Missoula
Bismarck
Fargo
Huron
Lander
Dodge City
Lincoln
Omaha
Des Moines
Dubuque
Minneapolis
St. Paul
Duluth
International Falls
Sault Sainte Marie
Green Bay
Chicago
Lansing
Detroit
Buffalo
Albany
Portland
Boston
New York
Philadelphia
Harrisburg
Pittsburgh
Columbus
Springfield
Indianapolis
Kansas City
St. Louis
Lexington
Charleston
Richmond
Norfolk
Hatteras
Raleigh
Knoxville
Nashville
Memphis
Little Rock
Oklahoma City
Fort Worth
Abilene
Shreveport
Jackson
Atlanta
Birmingham
Columbia
Charleston
Wilmington
Jacksonville
Pensacola
New Orleans
Houston
San Antonio
Brownsville
Tampa
Miami
Barrow
Nome
Fairbanks
Anchorage
Kodiak
Juneau

SLIM18

12, 18 and 26 Watt SLIM wallpacks are ultra efficient and deliver impressive light distribution with a compact low-profile design that's super easy to install as a downlight or uplight.

Color: Bronze

Weight: 4.5 lbs

Project:	Type: V2
Prepared By:	Date:

Driver Info

Type:	Constant Current
120V:	0.18A
208V:	0.11A
240V:	0.09A
277V:	0.08A
Input Watts:	20W
Efficiency:	90%

LED Info

Watts:	18W
Color Temp:	5100K
Color Accuracy:	67 CRI
L70 Lifespan:	100000
Lumens:	2,096
Efficacy:	105 LPW

Technical Specifications

Listings

UL Listing:

Suitable for wet locations. Suitable for mounting within 1.2m (4ft) of the ground.

ADA Compliant:

SLIM™ is ADA Compliant.

Dark Sky Approved:

The International Dark Sky Association has approved this product as a full cutoff, fully shielded luminaire.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Cold Weather Starting:

The minimum starting temperature is -40°C/-40°F

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures

Thermal Management:

Superior heat sinking with internal Air-Flow fins.

Housing:

Precision die-cast aluminum housing.

Mounting:

Heavy-duty mounting bracket with hinged housing for easy installation.

Recommended Mounting Height:

Up to 14 ft.

Lens:

Tempered glass lens.

Reflector:

Specular thermoplastic.

Gaskets:

High-temperature silicone

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant.

LED Characteristics

LED:

Multi-chip, long-life LED.

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines for the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Electrical

Driver:

Constant Current, Class 2, 100-277V, 50/60 Hz., 4KV surge protection, 500mA, 100-240VAC 0.3-0.15 Amps, 277VAC 0.15 Amps, Power Factor 99%.

THD:

9.8% at 120V

Other

HID Replacement Range:

The SLIM18 can be used to replace 100W MH based on delivered lumens.

California Title 24:

SLIM18 complies with 2013 California Title 24 building and electrical codes as a residential outdoor fixture. See SLIM18/PC for a model that complies as a commercial outdoor non-pole-mounted fixture__≤__30 Watts.

Patents:

The design of the SLIM™ is protected by patents in U.S. Pat D681,864, and pending patents in Canada, China, Taiwan and Mexico.

SLIM18

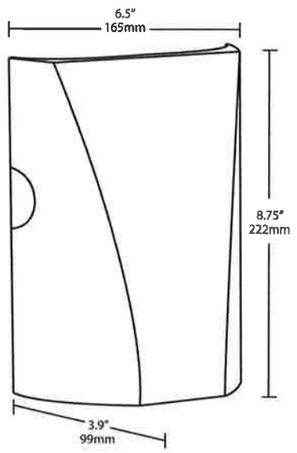
Technical Specifications (continued)

Optical

BUG Rating:

B1 U0 G0

Dimensions



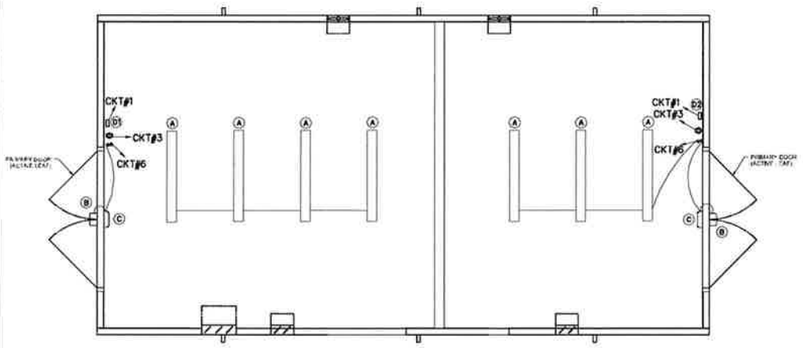
Features

- Full cutoff, fully shielded LED wallpack
- Can be used as a downlight or uplight
- Contractor friendly features for easy installation
- 100,000-hour LED Life
- 5-Year Warranty

Ordering Matrix

Family	Watts	Color Temp	Finish	Photocell	Dimming
SLIM					
	26 = 26W	= 5000K (Cool)	= Bronze	= No Photocell	= No Dimming
	18 = 18W	**Y** = 3000K (Warm)	**W** = White	**/PC** = 120V Button	**/D10** = Dimmable
	12 = 12W	**N** = 4000K (Neutral)		**/PC2** = 277V Button	

Fire Pump House

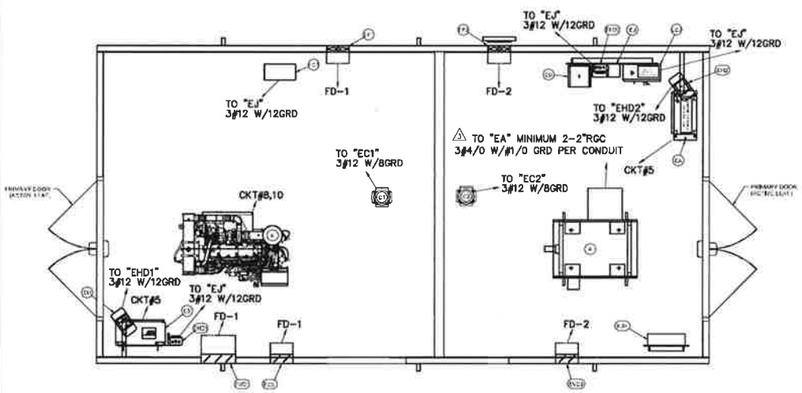


LIGHTING LAYOUT

LIGHTING LEGEND

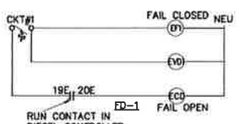
ITEM	QTY	DESCRIPTION	VOLT	PH	HZ	MFR	MODEL
A	7	4' FLOURESCENT STRIP FIXTURE	120	1	60	HAVELLS	VP4232UEB8
B	2	EXTERIOR LED WALL PACK	120	1	60	RAB	SLIM1B
C	2	EMERGENCY FIXTURE	120	1	60	DUALLITE	EZ2 SERIES
D-1,2	2	"FD-1,2 FAN/DAMPER THERMOSTAT	120	1	60	SUNNE	TF-115

V2

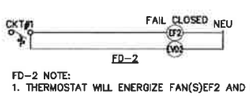


POWER LAYOUT COMPONENT LEGEND

ITEM	QTY	DESCRIPTION	MFR	MODEL
A	1	300HP ELECTRIC MOTOR 460V/3PH/60HZ	NIDEC	449T
B	1	DIESEL ENGINE W/2250 WATT JWH @220V	CUMMINS	CFP9E-F30
C	2	JOCKEY PUMP 7.5HP/460V/3PH/60HZ	GRUNDFOS	CR10-8
EA	1	ELEC MOTOR CTLR 460V/3PH/60HZ	METRON	MP300
EB	1	DIESEL CONTROLLER 120V/1PH/60HZ	METRON	FD4J-12
EC	2	JOCKEY PUMP CTRL 7.5HP/460V/3PH/60HZ	METRON	MP15-7,5
ECD	1	COMBUSTION DAMPER 12X12 (FAIL OPEN)	NAILOR	1020
ED	1	MPZ 5KVA/460-480/240-120/1PH/60HZ	SQD	MPZ5S40F
EF1	1	EXHAUST FAN 24"	QMARK	LPE-24S
EF2	1	EXHAUST FAN 12"	QMARK	LPE-12S
EH	2	5KW 460V HTR W/MT-1 THERMOSTAT	QMARK	MUH05-41
EH01,2	2	ENCLOSURE HEATER DISCONNECT	SQD	H361NRB
EJ	1	POWER DISTRIBUTION J-BOX (BP-P1614)	MIEGMANN	BM181408CH
EVD1	1	DAMPER 24" (FAIL CLOSED)	NAILOR	1020
EVD2	1	DAMPER 12" (FAIL CLOSED)	NAILOR	1020



FD-1 NOTE:
1. THERMOSTAT WILL ENERGIZE FAN(S)EF1 AND DAMPER(S)(EVD1).
2. DAMPER ECD WILL OPEN WHEN ENGINES STARTS. .



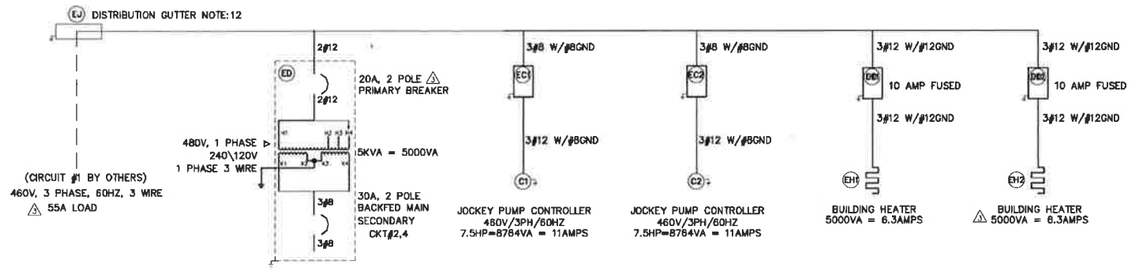
FD-2 NOTE:
1. THERMOSTAT WILL ENERGIZE FAN(S)EF2 AND DAMPER(S)(EVD2).

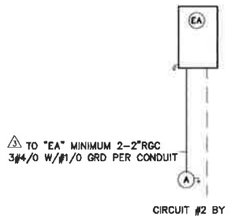
PANEL SCHEDULE	"ED"
LOCATION	PUMP HOUSE
ENCLOSURE	NEMA 3R\12
SURFACE, FLUSH, OR MCC	SURFACE
AIC RATING	10,000
PRIMARY MAIN BREAKER	22KAIC /15A

PANEL LEGEND

VOLTAGE	120\240 1PH, 3WIRE
MAINS AMPACITY	100A
MAIN C.B. SIZE (SECONDARY)	30A
TOTAL SPACES	12
NEUTRAL BUS	100%
ADDITIONAL BUS FOR ISOLATED GND?	NO

	VA	#P	BKR	FEEDER	NO	-A- VA	-B- VA	NO	FEEDER	BKR	#P	VA	DESCRIPTION
FAN/DAMPERS	399	1	20A	3#12	1	399		2	3#8	40A	1	–	MAIN BREAKER
RECEPTACLE(S)	360	1	20A	3#12	3		360	4	3#8	40A	1	–	MAIN BREAKER
"EB" FD4J-12	500	1	20A	3#12	5	928		6	3#12	20A	1	428	INTERIOR/EXTERIOR LIGHTING
SPARE	0	1	20A	–	7		1125	8	3#10	20A	1	1125	JACKET WATER HEATER
SPARE	0	1	20A	–	9	1125		10	3#10	20A	1	1125	JACKET WATER HEATER
SPACE	–	–	–	–	11		0	12	–	20A	1	–	SPARE
TOTAL VOLT-AMPERES PER PHASE						2452	1485						
TOTAL AMPERES PER PHASE						20	12						





CIRCUIT #2 BY OTHER

NOTES:

1. DESIGN AND INSTALLATION SHALL MEET AND/OR EXCEED THE REQUIREMENTS OF NFPA 70 AND NFPA 20.
2. ALL WIRE SHALL BE XHHW-2 UNLESS OTHERWISE NOTED.
3. ALL CONDUIT TO BE RIGID GALVANIZED AND FORM 85 FITTINGS.
4. SEAL TIGHT FLEXIBLE CONDUIT TO BE USED FOR DEVICE CONNECTIONS.
5. ONE GROUND PER CIRCUIT AND NO SHARED NEUTRALS.
6. SKID GROUNDING IS DRILL AND TAP METHOD TO NEAREST STRUCTURAL STEEL BY PES.
7. CUSTOMER TO INSTALL BONDING JUMPERS TO THE REBAR IN THE CONCRETE FOUNDATION, TO UNDERGROUND METAL WATER PIPES, AND TO ANY GROUND RODS INSTALLED. CONDUCTOR TO BE SIZED PER NEC 250.66 AND INSTALLED PER NEC 250.64 WITH CONNECTIONS AS PER NEC 250.68 AND 250.70.
8. THE SECONDARY 240/120VAC SIDE OF THE 5KVA TRANSFORMER NEUTRAL IS BONDED AND GROUNDED PER NEC 250.
9. ALL CONDUCTORS TO BE COPPER UNLESS OTHER WISE NOTED.
10. FIRE PUMP MOTOR CONTROLLER SUPPLY TO BE INSTALLED PER NEC 695.
11. GROUND TO STRUCTURAL STEEL OF THE SKID WITH UL LISTED GROUNDING CONNECTOR, OR A WELDED CONNECTION. CONDUCTOR IS SIZED PER NEC 250.68 AND 250.270.
12. TROFT/GUTTER WILL CONTAIN A THREE PHASE DISTRIBUTION BLOCK WITH #2/0 MAX LINE SIDE #2/0 MECHANICAL GROUND LUG ATTACHED TO INSIDE OF GUTTER. LOAD SIDE WILL CONTAIN 6 LUGS PER PHASE WITH MAX #4AWG.

POWER REQUIREMENTS (BY OTHERS)

CIRCUIT No.	VOLTAGE
1	460/3PH/60HZ/55A
2	460/3PH/60HZ/361AMPS

REV	BY	CHK	DATE	DESCRIPTION
03	KJB	HFR	3/22/16	CHANGED ENCLOSURE HEATER SIZE AND MOTOR CONDUCTORS
02	KJB	HFR	2/25/16	CHANGED VOLTAGE ON JACKET WATER HEATER
01	KJB	HFR	2/3/16	ADDED ADDITIONAL JOCKEY PUMP AND CONTROLLER

REVISION HISTORY

GRUNDFOS PEERLESS PUMP

ISO 9001 Certified
805 Rooney Road
Bellaire, TX 77401
Ph. 713-457-5601
Fax 713-890-5250

END USER	EDP EAGLE VALLEY CCGT PROJECT
BUYER	CRAIGTONE & WERSTER, INC.
P.O. NO:	152418-PO-0672-001
ITEM NO	
LOCATION:	MARTINSVILLE, INDIANA

PROJECT TITLE: IPL EAGLE VALLEY CCGT

DRAWING DOCUMENT TITLE: ELECTRICAL LAYOUT

DATE:	TOLERANCES	PROPRIETARY DATA
12/14/15	UNLESS OTHERWISE NOTED: FRACTIONAL ±1/64 DECIMAL X.X +/-0.1 X.XX +/-0.03 X.XXX +/-0.005 ANGLE ±1.0°	This material is the property of Peerless Engineered Systems Inc., and is not to be reproduced or employed for any manufacturing purpose except upon the explicit instruction of Peerless Engineered Systems Inc. or in the form or inclusion of this job ... is to be returned to Peerless Engineered Systems Inc., Brookshire, Texas.
DRAWN BY: KDB		
APPROVED HFR		
SHEET NO: 1 OF 1	SCALE: NTS	PEERLESS REFERENCE: 9927103854
DRAWING NO: 9927103854-03		REV: 03

9927103854-03 ELEV 03.dwg

Subject: Maintenance Manual

WP1H70/PC

Compact Wallpack. UV stabilized, vandal resistant prismatic polycarbonate refractor. Lamp supplied.

Color: Bronze

Weight: 9.3 lbs

Project:	Type:
Prepared By:	Date:

Lamp Info

Type:	ED17
Watts:	70W
Shape/Size:	N/A
Base:	N/A
ANSI:	N/A
Hours:	15,000
Lamp Lumens:	5,600
Efficacy:	60 LPW

Ballast Info

Type:	HX-NPF 120V
120V:	2.8/2.2A
208V:	N/A
240V:	N/A
277V:	N/A
Input Watts:	94W
Efficiency:	74%

Technical Specifications

Electrical

Photocell:

120V Button Photocell Included. Photocell is only compatible with 120V.

Listings

UL Listing:

Suitable for wet locations. HID fixtures can be wired with 90°C supply wiring if supply wires are routed 3" away from the ballast.

EISA 2007 Compliant:

This product complies with the new law for metal halide ballast efficiency. This law goes into effect January 1st, 2008. Pulse Start offers Longer Lamp Life, Faster Startup and Faster Restrike.

Construction

Housing:

Die cast aluminum, 1/2" NPS tapped top, both sides and back for conduit or photocontrol. Hinged refractor. Continuous one piece silicone rubber gasket.

Reflector:

Semi-Specular anodized aluminum, removable for installation. Symmetrical light pattern maximizes distance between fixtures.

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Conduit Openings:

Top, side, and back.

Template:

Drilling template for easy wall box mounting.

Other

Patents:

Pat. D440,683.

Country of Origin:

Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Recovery Act (ARRA) Compliant:

This product complies with the 52.225-21 "Required Use of American Iron, Steel, and Manufactured Goods-- Buy American Act-- Construction Materials (October 2010).

Trade Agreements Act Compliant:

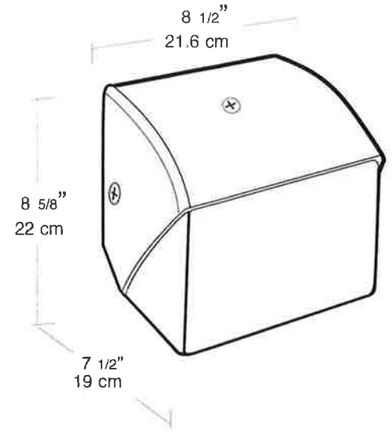
This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

GSA Schedule:

Suitable in accordance with FAR Subpart 25.4.

WP1H70/PC

Dimensions



Features

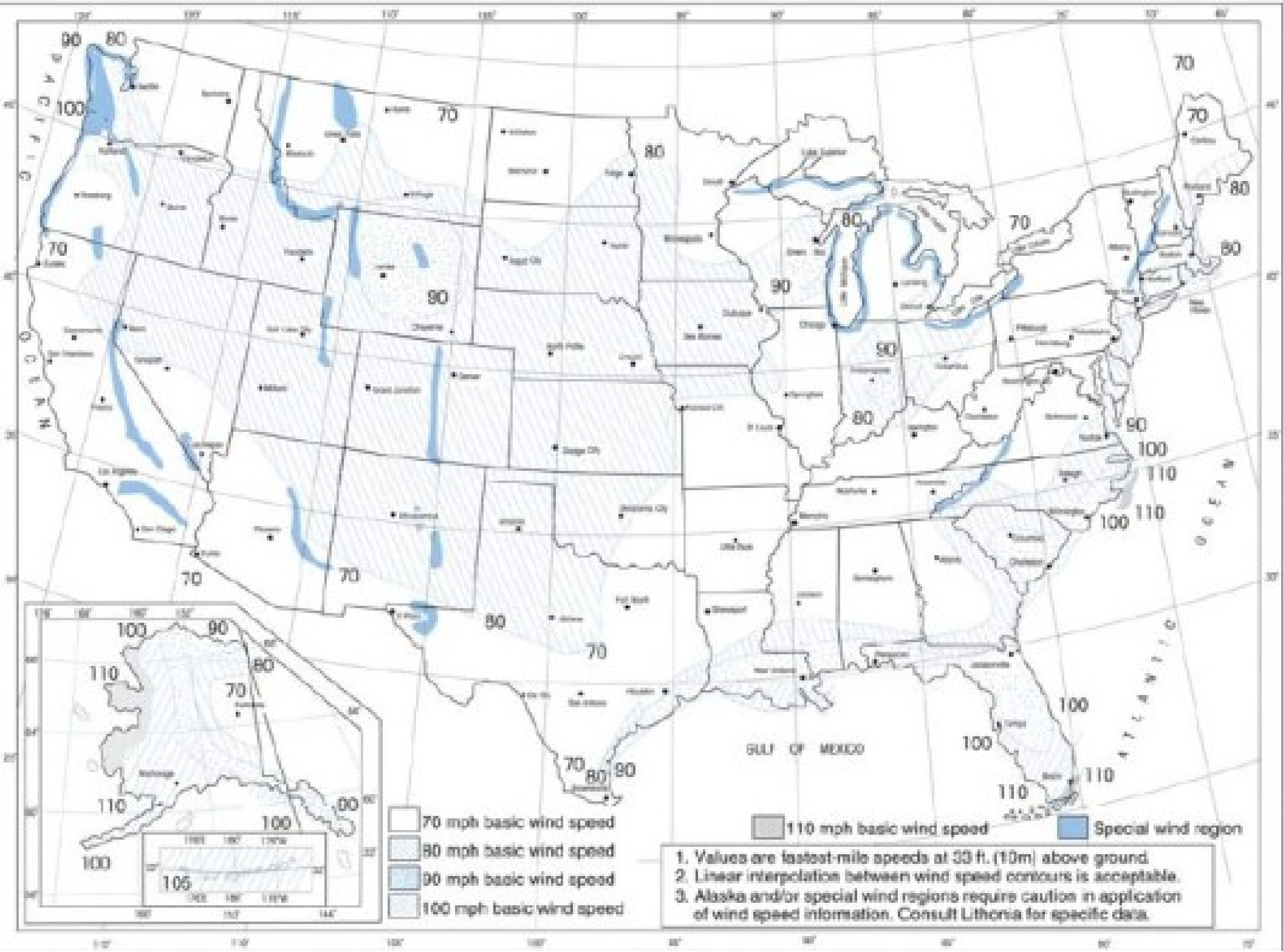
- Precision die cast aluminum housing with durable polyester powder coating
- Easy access conduit openings & ballasts for fast internal wiring
- Long life lamp included
- Silicone gasket remains in place during relamping
- Cutoff glare shield for "friendly" lighting
- Hinged door swings open and remains captive for easy relamping

Outline-Legend
L13513r13

ITEM No.	DEPT. No.	ATK. P/N P/N	QTY	UNITS	DESCRIPTION
19	60	16044	4	EA	**GFCI RECEPTACLE**: 20 AMP - 125V – COMMERCIAL GRADE - NEMA REF# 5-20R – WEATER RESISTANT - CSA/CUL/UL LISTED - **HUBBELL #GFTR0-I-IVORY** **** ONE RECEPTACLE WIRED TO PANEL IN MCC 01EB-MCC-1111 (# G) AND SURFACE MOUNTED NEXT TO LIGHT SWITCHES IN SEC. 1**** **** ONE RECEPTACLE WIRED TO PANEL IN MCC 02EB-MCC-2211 (# J) AND SURFACE MOUNTED NEXT TO LIGHT SWITCHES IN SEC. 4**** **** TWO RECEPTACLES WIRED TO SEPARATE CIRCUITS IN UPS PANEL (#26) AND SURFACE MOUNTED 48" ABOVE THE FLOOR ****
20					**EXTERIOR GFCI RECEPTACLE**: 20 AMP - 125VAC - COMMERCIAL GRADE - NEMA REF# 5-20R - WEATHER RESISTANT - MOUNTED IN A BELL BOX - WEATHERPROOF COVER - SURFACE MOUNTED 24" ABOVE FINISHED FLOOR;
	60	16044	6	EA	* RECEPTACLE - **PASS & SEYMOUR #2095TRWR-I**
	60	14903	6	EA	* BELL BOX WEATHER PROOF "**IN-USE**" COVER - **TAYMAC #MM410C**
21	60	17680	3	EA	**EXIT SIGN/EMERGENCY LIGHT**: 120V INPUT – 6VDC OUTPUT – COMPLIES WITH NEC AND OSHA. NICKEL CADMIUM BATTERY ILLUMINATES EXIT SIGN AND EMERGENCY LIGHT - EMERGENCY LIGHT CONSISTS OF TWO 3.6V, 0.78W LED DC LAMPS PROVIDE EMERGENCY ILLUMINATION. EXIT FACE ASSEMBLY – LETTERS 6" HIGH WITH 3/4" STROKE; RED FIBERGLASS COLOR PANEL – **COOPER LIGHTING #APC7R**
22	60	12082	2	EA	**LIGHTING (EXTERIOR):** 70W METAL HALIDE - 120VAC OPERATION- UL LISTED 1572 - SUITABLE FOR WET LOCATIONS - DIE CAST ALUMINUM CASTING HINGED REFRACTOR FRAME - CONTINUOUS SILICONE RUBBER GASKET -BRONZE ENAMEL FINISH - VANDAL RESISTANT PRISMATIC POLYCARBONATEREFRACTOR-BUILT IN PHOTO CONTROL – **RAB #WP1H70/-PC**
23					**FIRE DETECTION SYSTEM**: 50 POINT FIRE ALARM CONTROL PANEL – DIMENSIONS: 14.5"W X 22.5"H X 3.25"D
		22034	1	EA	* CYBERCAT 50 FIRE PANEL – **FIKE #10-070-R-1**
		22041	1	EA	* 7A BATTERY **SYSTEM - FIKE #10-2190-1**
		15042	1	EA	* DPDT RELAY FOR FUTURE USE – ALTRONIX **#RB1224**
23A					**SMOKE DETECTORS**:
		22036	2	EA	* PHOTOELECTRIC SMOKE DETECTOR – **FIKE #63-1052**
		22037	2	EA	* SENSOR BASE – **FIKE #63-1054**
23B					**HORN STROBES**:
		22038	2	EA	*INTERIOR ALARM HORN/STROBE – FIKE **#20-123-53**
		22039	2	EA	*EXTERIOR ALARM HORN/STROBE – **FIKE #20-1503**
23C					**MANUAL PULL STATIONS**:
		22040	2	EA	*MANUAL PULL STATION – **FIKE #20-1063**
24	70	10126	2	EA	**FIRE EXTINGUISHER:** ABC DRY CHEMICAL TYPE 20 LB CHARGE WALL MOUNTED **KIDDE #PRO20TCM** **GRAINGER #5T903**

Subject: Main PDC

Wind Map:


70 mph basic wind speed
80 mph basic wind speed
90 mph basic wind speed
100 mph basic wind speed
110 mph basic wind speed
Special wind region
1. Values are fastest-mile speeds at 33 ft. (10m) above ground.
2. Linear interpolation between wind speed contours is acceptable.
3. Alaska and/or special wind regions require caution in application of wind speed information. Consult Lithonia for specific data.
GULF OF MEXICO

ATTACHMENT 5.Q-1: PROPOSED TRAINING BUILDING ENERGY EFFICIENCY IMPROVEMENTS

Attachment 5.Q-1

Proposed Training Building LEED Certification Modifications

	Existing	Proposed	% Improvement	Comment
Training Building				
Measure/Area	100'X40'/ 4000 sq. ft.		For the most recent 24 month the average monthly building energy use has been 15,250 kwh/month	
Area Window/Area Wall	357 sq. ft./2194sq ft.			
Building Insulation				
Roof R-value	R-19	R-19 + R-19=R-38	Building thermal envelope is improved by 49%: Design energy will decrease approximately 25% for heating and 22% for cooling.	Install new 2 1/2" material insulation roof panels **(Note 1)**
Window U-value	1.xx	R-3.5		Install new integrated insulated low "e" windows **(Note 2)**
Walls R-value	R-13	R-13+R-22=R-35		Install 3" material insulation wall panels **(Note 3)**
HVAC Units **(Note 6)**				
Unit 1	30,000 btu/hr. Unit	30,000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Unit 2	36,000 btu/hr. unit	36000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Unit 3	36,000 btu/hr. unit	36000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Unit 4	36,000 btu/hr. unit	36000 btu/hr.		
AC(kW/ton)	1.26 kW/ton	0.99 kW/ton		
AC (EER) (code)	EER 9.5	12.1 EER (ASHRAE 90.1-2015)	28%	
Other				
End wall hollow metal doors		R-13		Install new exterior insulated doors with gasketing **(Note 4)**
Entrance doors and curtainwall		R-3.5		Install new energy efficient entrance doors and curtainwall **(Note 5)**
Sunshades				Add sunshades at windows
Lighting				Install new led lighting fixtures w/ motion controls & dimmers
Plumbing fixtures				Install new WaterSense plumbing fixtures

Note 1: Install New Centria's Vesapanel Roof Panels 2 1/2" thick, R-19.34 on top of existing roof. Verify existing structure to be able to support additional loading.

Note 2: Replace existing windows with Centria's Formavue 600 series integrated windows within the new horizontal wall panel system. Windows to have 1" insulated low "e" glass with solar reflective tinting in thermally broken frames.

Note 3: Install New Centria's Formawall Horizontal Dimension Series/Graphix Series Insulated Metal Panels 3" Thick R-22 Wrapping the exterior envelope of the building. Verify existing structure to be able to support additional loading.

Note 4: Install new Pioneer Insulated Hollow Metal doors with weather-stripping and gasketing, 2" thick R-13

Note 5: Install New fawner AA425 Thermal Entrance Doors and Kawneer Trifab Versa Glaze Thermal Framing System R-3.5

Note 6:

Better temperature and humidity control can be achieved by providing the AC indoor section supply fan with variable speed motor

Due to the unavailability of data, the existing AC units are estimated to have an EER value between 9 and 10 and are running on non- environmentally acceptable refrigerant

Capacities are nominal manufacturer standard capacities. The actual design loads represent 88% of the units capacity serving the building.

Energy design usage is decreased by 28% average across the entire year.

6.0 REFERENCES

FEMA, 2014. Flood Insurance Rate Map Number 25001CO319J.

Metcalf & Eddy, 2001. Pumping Test Results, Canal Electric Plant, Well No.4. 2001.

RE Chapman, 1966. Construction Record – Well No. 2. September 26, 1966.

RE Chapman, 1974. R.E. Chapman Company. Letter to Canal Electric Company and Montaup Electric Company. RE: Water Analysis – 8" Well #3. October 17, 1974.

Transportation Research Board, 2000. Highway Capacity Manual, *Special Report 209, Third Edition*, Transportation Research Board. National Research Council, Washington, DC, 2000.