Melrose Substation Wave Trap Project

204 Howard Street
Melrose, Massachusetts

PREPARED FOR

New England Power Company
40 Sylvan Road
Waltham, MA 02451

PREPARED BY

1 Cedar Street, Suite 400
Providence, RI 02903
401.272.8100

January 2021

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Table of Contents

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Request for Determination of Applicability Forms

› WPA Form 1

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Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

Melrose
City/Town

WPA Form 1- Request for Determination of Applicability

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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.

1. Applicant:

New England Power Company (NEP) — Name
Kevin.OBrion@nationalgrid.com — E-Mail Address
40 Sylvan Road — Mailing Address
Waltham — City/Town
MA — State
02451 — Zip Code
(781) 907-5145 — Phone Number
Fax Number (if applicable)

2. Representative (if any):

VHB — Firm
Adam Rosenblatt — Contact Name
ARosenblatt@VHB.com — E-Mail Address
1 Cedar Street #400 — Mailing Address
Providence — City/Town
RI — State
02903 — Zip Code
401-457-2072 — Phone Number
Fax Number (if applicable)

B. Determinations

1. I request the Melrose Conservation Commission make the following determination(s). Check any that apply:

☐ a. whether the **area** depicted on plan(s) and/or map(s) referenced below is an area subject to jurisdiction of the Wetlands Protection Act.

☐ b. whether the **boundaries** of resource area(s) depicted on plan(s) and/or map(s) referenced below are accurately delineated.

☒ c. whether the **work** depicted on plan(s) referenced below is subject to the Wetlands Protection Act.

☒ d. whether the area and/or work depicted on plan(s) referenced below is subject to the jurisdiction of any **municipal wetlands ordinance** or **bylaw** of:

Melrose
Name of Municipality

☐ e. whether the following **scope of alternatives** is adequate for work in the Riverfront Area as depicted on referenced plan(s).

C. Project Description

1. a. Project Location (use maps and plans to identify the location of the area subject to this request):

204 Howard Street	Melrose
Street Address	City/Town
12	65/67
Assessors Map/Plat Number	Parcel/Lot Number

b. Area Description (use additional paper, if necessary):

Existing substation yard

c. Plan and/or Map Reference(s):

Melrose Substation Wave Trap Project	1/3/2022
Title	Date
Title	Date
Title	Date

2. a. Work Description (use additional paper and/or provide plan(s) of work, if necessary):

See attached project narrative

C. Project Description (cont.)

b. Identify provisions of the Wetlands Protection Act or regulations which may exempt the applicant from having to file a Notice of Intent for all or part of the described work (use additional paper, if necessary).

310 CMR 10.02 (2)(b)2.K. Installation of new equipment within existing or approved electric or gas facilities when such equipment is contained entirely within the developed/disturbed existing fenced yard

3. a. If this application is a Request for Determination of Scope of Alternatives for work in the Riverfront Area, indicate the one classification below that best describes the project.

- ☐ Single family house on a lot recorded on or before 8/1/96
- ☐ Single family house on a lot recorded after 8/1/96
- ☐ Expansion of an existing structure on a lot recorded after 8/1/96
- ☐ Project, other than a single-family house or public project, where the applicant owned the lot before 8/7/96
- ☐ New agriculture or aquaculture project
- ☐ Public project where funds were appropriated prior to 8/7/96
- ☐ Project on a lot shown on an approved, definitive subdivision plan where there is a recorded deed restriction limiting total alteration of the Riverfront Area for the entire subdivision
- ☐ Residential subdivision; institutional, industrial, or commercial project
- ☐ Municipal project
- ☐ District, county, state, or federal government project
- ☐ Project required to evaluate off-site alternatives in more than one municipality in an Environmental Impact Report under MEPA or in an alternatives analysis pursuant to an application for a 404 permit from the U.S. Army Corps of Engineers or 401 Water Quality Certification from the Department of Environmental Protection.

b. Provide evidence (e.g., record of date subdivision lot was recorded) supporting the classification above (use additional paper and/or attach appropriate documents, if necessary.)

D. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Request for Determination of Applicability and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge.

I further certify that the property owner, if different from the applicant, and the appropriate DEP Regional Office were sent a complete copy of this Request (including all appropriate documentation) simultaneously with the submittal of this Request to the Conservation Commission.

Failure by the applicant to send copies in a timely manner may result in dismissal of the Request for Determination of Applicability.

Name and address of the property owner:

New England Power Company (NEP)
Name

40 Sylvan Road
Mailing Address

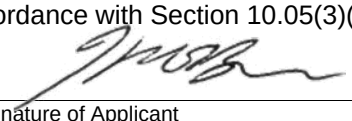
Waltham
City/Town

MA
State

02451
Zip Code

Signatures:

I also understand that notification of this Request will be placed in a local newspaper at my expense in accordance with Section 10.05(3)(b)(1) of the Wetlands Protection Act regulations.



Signature of Applicant

1/12/2022
Date

Signature of Representative (if any)

1/12/2022
Date

Request for Determination of Applicability Site Plans

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Attachment A – Request for Determination of Applicability Narrative

- Introduction
- Site Description
- Work Description
- Mitigation Measures
- Regulatory Compliance
- Summary

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Attachment A – Request for Determination of Applicability Narrative

This Request for Determination of Applicability (RDA) is filed pursuant to the Massachusetts Wetlands Protection Act (MGL Chapter 131, Section 40) (hereafter MWPA) and its implementing regulations (310 CMR 10.00) (Regulations) and also serves as an RFD (Request for Determination) as defined in the City of Melrose General Wetlands Protection Bylaw[1] (Bylaw).

Introduction

The New England Power Company (NEP) proposes to install Wave Trap structures within the Melrose Substation. The substation property is located at 204 Howard Street in Melrose, Massachusetts on Assessor's Map 12, Parcels 65 and 67.

The Project involves the installation of two new Wave Trap structures on existing foundations. An administrative approval letter from the Melrose Conservation Commission was issued for this work on April 28, 2021. Additionally, NEP proposes to construct a new pier foundation in line with the existing foundations to support a third Wave Trap structure.

The purpose of this Project is to improve communications between the electric transmission system operation center, this substation, and the next in-line

1 Adopted May 7, 2007 and amended as noted.

substations. All the new equipment will be installed inside of the existing fenced substation yard.

This Request for Determination of Applicability is filed to obtain consent to conduct activities within the 100-foot Buffer Zone to Bordering Vegetated Wetland (BVW) under the Bylaw.This is because the new structure proposed within the Buffer Zone is specifically exempted from the requirement to obtain a permit under the Wetland Protection Regulations, specifically 310 CMR 10.02 (2)(b)2.K. *Installation of new equipment within existing or approved electric or gas facilities when such equipment is contained entirely within the developed/disturbed existing fenced yard*.

This RDA is also being submitted as a Request for Determination (RFD) pursuant to the Melrose Bylaw which does not provide an exemption for new work within an existing utility facility that is located within the jurisdictional area of the Melrose Conservation Commission.

The benefits from this project include improved operations and reliability of the electric grid in Melrose as well as an increased capacity of integrating renewable energy into the electric power supply.

No direct impact to wetland resource areas is proposed by this Project. Indirect impacts will be minimized during construction through the implementation of an erosion and sedimentation control plan. This plan includes provisions to minimize the areas of disturbance open at one time, the installation of temporary perimeter structural controls to prevent sediment from leaving the site, appropriate dewatering and concrete washout practices, and implementing good housekeeping measures.

Site Description

The Project area is located within the Melrose Substation at 204 Howard Street in Melrose, MA. The Melrose Substation yard is approximately 2.10 acres in area and occupies a portion of three lots owned by NEP. Access to the substation is provided by a paved driveway off Howard Street. The abutting properties to the north and west are vacant lots owned by NEP. The abutting lots to the east and south of the substation opposite of Howard Street are residential properties. The vacant lot to the north is dominated by a wooded swamp wetland.

The substation was originally constructed on a fill section building pad and is elevated above the surrounding wetland by approximately two to four feet. The Web Soil Survey identifies the substation yard as Udorthents, wet substratum, abutting larger map units consisting of Swansea muck, 0 to 1 percent slopes and Urban land. A soil and wetland investigation performed on September 17, 2020 found that the soils present at the site are generally consistent with the NRCS soil map unit description

According to the MassGIS layers from the MassMapper mapping tool, the Project does not occur within priority or estimated habitat for rare species as designated by the Massachusetts Natural Heritage and Endangered Species Program (NHESP).

There are no certified or potential vernal pools or Outstanding Resource Waters within the Project area.

Wetland resource areas on/near the site are described below.

Wetland Resource Areas

Wetland resource areas on the property were delineated on September 17, 2020 by VHB wetland scientists in accordance with methods developed by the MassDEP (1995) and the U.S. Army Corps of Engineers (2012). The following section of this narrative describe the wetlands and identifies resource areas that are regulated under the MWPA Regulations (310 CMR 10.00) and Melrose Bylaw.

Bordering Vegetated Wetland

BVW 1

This wetland is north of the substation yard and its proximate edge has been delineated by flags 1-100 to 1-140.

The wetland is a palustrine forested wetland with a shrub border. Forested parts of the wetland are dominated by a red maple (*Acer rubrum*) canopy. The shrub stratum in areas cleared of trees to accommodate overhead electric conductors is dominated by alder (*Alnus incana*), glossy buckthorn (*Frangula alnus*), silky willow (*Salix sericea*) and multiflora rose (*Rosa multiflora*). The portion of the wetland that transitions where present, the herbaceous stratum consists of cinnamon fern (*Osmundastrum cinnamomeum*), sensitive fern (*Onoclea sensibilis*), skunk cabbage (*Symplocarpus foetidus*), spotted Joe-Pye weed (*Eutrochium maculatum*), jewelweed (*Impatiens capensis*) and/or swamp dewberry (*Rubus hispidus*). Hydrologic indicators included soil saturation four inches below the surface, water-stained leaves, and a thin muck surface. Soils examined in the wetland were very poorly drained with a mucky surface.

The vegetation in the adjacent upland area was comprised of red maple, white ash (*Fraxinus americana*), witch hazel (*Hamamelis virginiana*), wintergreen (*Gaultheria procumbens*), New York fern (*Parathelypteris noveboracensis*), and interrupted fern (*Osmunda claytoniana*). For most of the delineation, the wetland edge followed the limit of fill materials in place for several decades.

BVW 2

This wetland is northeast of the substation yard and its proximate edge has been delineated by flags 2-100 to 2-111. It is separated from Wetland 1 by old fill deposits which may include the remnant of a former cart path or road. A hydrologic connection is provided to BVW 1 by a culvert.

The cover type of Wetland 2 is primarily palustrine emergent wetland as tall woody vegetation is controlled to maintain safe clearance distances to overhead conductors. Dominant species include: soft rush (*Juncus effusus*); cinnamon fern (*Osmundastrum cinnamomeum*); sensitive fern (*Onoclea sensibilis*); and sedges

(Carex spp.). Hydrologic indicators observed included soil saturation four inches below the soil surface, water-stained leaves, a depressed, concave geomorphic position, and a thin muck surface. Soils examined in the wetland were very poorly drained (low chroma matrix immediately below a dark surface) with a mucky surface.

Bordering Land Subject to Flooding

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) (Map No. 25017C0431E, Effective Date June 6, 2010) the substation yard is within the one-percent annual chance flood hazard zone (Zone A) with no defined base flood elevation determined. Zone A as defined by the FEMA FIRM is designated as bordering land subject to flooding (BLSF) in accordance with 10.57(2)(a)(3) of the WPA regulations.

Since the FEMA base flood elevation was not determined, NEP commissioned Kleinschmidt, an engineering consulting firm, to complete a Flood Study Analysis of the substation property in October 2013. The consultant collected site specific topographic and hydrologic data for the purpose of modeling statistical flood heights at the substation. The results of the analysis indicated that the flood heights generated by the 100-year and even the 500-year flood event would submerge the surrounding wetland areas without reaching the elevation the existing substation yard. This study determined that the Melrose Substation yard is above the 100-year and 500-year flood elevation and therefore not within Border Land Subject to Flooding.. This analysis is provided as Attachment B of this submittal.

Buffer Zone

The WPA Regulations (310 CMR 10.02(2)(b)) establish a 100-foot Buffer Zone from the limits of the BVW. BVW is also assigned a 100-foot Buffer Zone per the Melrose Bylaw. The one-hundred-foot Buffer Zone to BVW extends into the northern half of the substation. The proposed Project work will take place in the one-hundred-foot Buffer Zones to BVW. However, the work will only occur in the previously developed area interior of the substation compound perimeter fence. No activities are proposed in undeveloped or otherwise vegetated Buffer Zone.

Work Description

The Project consists of installing one wave trap and one new foundation at the Melrose Substation. All the new equipment will be installed inside of the existing fenced substation yard.

The new concrete pier foundation for the wave trap will be installed in the northerly portion of the substation yard in line with two existing foundations. The proposed pier foundation is approximately between 10 to 20 feet inside the perimeter fence. The foundation will measure approximately 6 feet deep and 3.5 feet in diameter and will be installed within the existing crushed stone surface. Crushed stone or sand

will be installed at the base of the foundation. Upon completion of Project, the crushed stone surface will be refurbished inside the perimeter fence.

Excavated material will be temporarily stockpiled within the substation and shall be contained by staked straw wattle as depicted on the Site Plans. Any excess excavated soil will be spread and stabilized inside the substation fence.

Work related to the installation of the proposed wave wraps will take place within the 100-foot Buffer Zone associated with BVW. That work is described below.

Work in Resource Areas

BVW

There is no work proposed within BVW. The proposed work will take place within the fenced Substation yard.

BLSF

The proposed work will take place within an area designated as a Zone A flood zone without the flood elevation determined by the FEMA and therefore is considered BLSF according to 310 CMR 10.57(2)(a)(3): *The boundary of Bordering Land Subject to Flooding is the estimated maximum lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm. Said boundary shall be that determined by reference to the most recently available flood profile data prepared for the community within which the work is proposed under the National Flood Insurance Program (NFIP, currently administered by the Federal Emergency Management Agency, successor to the U.S. Department of Housing and Urban Development). Said boundary, so determined, shall be presumed accurate.*

However, it should be noted that the FIRM map does not provide an actual elevation. According to the results of the Flood Study Analysis performed by a professional engineer and summarized in the Site Description section, the BLSF does not reach the elevation of the substation yard. The results of this site specific analysis refute the assumption of presence of BLSF within the work area as provided for in the next sentence in 310 CMR 10.57(2)(a)(3):

This presumption is rebuttable and may be overcome only by credible evidence from a registered professional engineer or other professional competent in such matters.

Therefore, the proponent contends that the Project will not affect BLSF. The full analysis is provided as Attachment B of this submittal.

Work in Buffer Zone

The wave trap structure and the new pier foundation will be installed within the 100-foot Buffer Zone to BVW. The new structure within the Buffer Zone are specifically exempted from the requirement to obtain a permit under 310 CMR 10.02 (2)(b)2.k because it occurs inside a developed portion of an existing fenced electrical

substation yard. The Melrose Bylaw does not provide a similar exemption for new work within the existing fenced limits of a substation facility that is within a 100-foot Buffer Zone.

The Melrose Conservation Commission does have authority under the RFD to determine that this work will have no effect on the interests protected by the MWPA and the Melrose Wetland Protection By-law by issuing negative determinations.

Mitigation Measures

Erosion and Sedimentation Controls

An erosion and sedimentation control plan will be implemented to minimize any temporary indirect impacts to wetland resource areas during construction. The plan incorporates Best Management Practices (BMPs) specified in guidelines developed by the MassDEP (1997) and the U.S. Environmental Protection Agency (EPA; 2007). Proper implementation of the erosion and sedimentation control program will:

- Minimize exposed soil areas through sequencing and temporary stabilization;
- Place structures to manage stormwater runoff and erosion; and
- Establish a permanent vegetative cover or other forms of stabilization as soon as practicable.

The following sections describe the controls that will be used and practices that will be followed during construction.

Non-Structural Practices

Non-structural practices to be used during construction include pavement sweeping of the driveways and surrounding street and dust control. These practices will be initiated as soon as practicable in appropriate areas at the Site.

Dust Control

The erosion and sediment control program includes provisions to minimize the generation of dust during dry and windy conditions. The yard is covered in crushed stone which should not generate dust. When necessary, exposed soil stockpiles will be wetted to prevent wind borne transport of fine-grained sediment. Enough water shall be applied to wet the upper 0.5 inches of soil. The water will be applied as a fine spray in order to prevent erosion. A water truck will be kept on call to facilitate this practice.

Pavement Sweeping

The proposed Project construction work will occur within the crushed stone area within the substation yard. The paved substation driveway and adjacent Howard Street will be swept as needed to prevent sediment tracking. The crushed stone in the yard will serve as an anti-tracking construction exit.

Structural Practices

Structural erosion and sedimentation controls to be used on the site include sediment control barriers, a temporary concrete washout area, and temporary dewatering basins.

Sediment Control Barriers

Prior to any ground disturbance, an approved perimeter sediment control barrier, such as staked straw wattle, will be installed at the down gradient limit of work along the perimeter substation fence in northeastern corner as depicted on the Site Plans. The perimeter control will be installed adjacent to the SPCC berm. The proposed stockpiling area shall be enclosed by a perimeter sediment control device.

If sediment has accumulated to a depth which impairs proper functioning of the barrier, it will be removed by hand or by machinery operating upslope of the barriers. This material will be either reused at the Site or disposed of at a suitable offsite location. Excess excavated soil will not be spread within wetland resource areas. Any damaged sections of the barrier will be repaired or replaced immediately upon discovery. Temporary non-biodegradable erosion control devices will be removed following the stabilization of disturbed areas.

Concrete Washout Area

A temporary concrete washout container will be established on the southern side of the substation yard. This area will be used to collect the washout debris from concrete mixing trucks. The wash will be collected and disposed of at a properly licensed facility.

Dewatering Basin

If necessary, sediment laden water that collects in excavated areas will be pumped into straw bale basins or filter bags located within the western side of the substation yard. The basin will consist of a ring of staked straw bales overlain by non-woven geotextile filter fabric and crushed stone. Discharge water will be pumped into the basin and allowed to drain through the fabric onto the flat surface of the substation yard and then sheet flow across uplands into the wetland. Dewatering filter bags may be used in place of straw bale basins and would be located in the same area. A maximum of one six-inch discharge hose will be allowed per filter bag. Unattended filter bags will be encircled with a straw wattle barrier. Filter bags used during construction will be bundled and removed for proper disposal.

Construction Monitoring

An environmental monitor will be retained during the construction process. The primary responsibility of the monitor will be to confirm compliance with federal, state, and local environmental permit requirements. At regular intervals and during periods of prolonged precipitation, the monitor will inspect the Project site to determine that environmental controls are functioning properly and to make recommendations for correction or maintenance, as necessary. In addition to

retaining the services of an environmental monitor, the construction contractor will be required to designate an individual to be responsible for the daily upkeep of environmental controls.

Regulatory Compliance

As demonstrated below, work in the 100-foot Buffer Zone associated with BVW is exempt in accordance with the MWPA regulations, though the local Melrose Bylaw does not specifically exempt the proposed Project. Additionally, while the Project is shown within the one-percent annual chance flood hazard zone (Zone A) with no defined base flood elevation determined on the latest FEMA FIRM; the presumption of BLSF has been refuted through a site specific flood study prepared by a professional engineer. The full results of the analysis are provided as Attachment B of this submittal.

Work in BLSF

According to the site specific flood study prepared for the substation, the proponent contends that no work will occur in BLSF.

Work in Buffer Zone under the MWPA

The new structure proposed within the Buffer Zone is specifically exempted from the requirement to obtain a permit under the Wetland Protection Regulations, specifically 310 CMR 10.02 (2)(b)2.K. Installation of new equipment within existing or approved electric or gas facilities when such equipment is contained entirely within the developed/disturbed existing fenced yard. The work proposed by NEP is completely consistent with this exemption.

Work in BLSF and Buffer Zone under the Bylaw Regulations

Section 231-3-B of the Melrose Bylaw provides an exemption stating that "*any existing structure may be repaired, maintained and improved but in no event made larger. Any nonconforming structure which is destroyed may be rebuilt on the same location but no larger than the original overall square footage."* The Project will not enlarge the fenced perimeter of the substation. Since new equipment will be added inside the compound the work may not be considered exempt under the Melrose General Wetlands Protection Bylaw.

Ground disturbance will occur within an approximately 25 square foot area of Buffer Zone associated with BVW. All activities will occur within the previously developed Buffer Zone inside of the fenced substation yard. The substation is surfaced with crushed stone. The crushed stone portions of the substation facilitate infiltration and prevent sediment transport. As identified in the Mitigation Measures section of this attachment, an erosion and sedimentation control plan will be implemented to prevent adverse impacts to the wetland resource areas during construction. There

will be no expansion of the substation and the yard will be resurfaced consistent with the present condition once the project is completed. The Applicant does not believe any of the interests protected by the Melrose General Wetlands Protection Bylaw will be negatively affected by the project.

Summary

The Applicant proposes to install a new wave trap structure and construct a new foundation in line with the existing foundations within the existing Melrose Substation yard.

This narrative attachment has demonstrated how the proposed activities comply with established exemptions in the MWPA Regulations and how this work will not affect any of the interests protected by the MWPA.

The proposed public utility work within the substation yard may not be specifically exempt under the Melrose General Wetlands Protection Bylaw since some new equipment is being added inside the compound. However, since no work is proposed within a resource area, no vegetated buffer zone will be altered, and all work will occur within the previously developed fenced limits of the substation compound, the applicant respectfully requests that the Commission find that these activities pose no risk to the interests that are afforded protection under the Bylaw.

The applicant respectfully requests that the Melrose Conservation Commission find the activities proposed so minor and the mitigation measures adequately protective of the interests identified in the MWPA and the Melrose General Wetlands Protection Bylaw and issue a Negative Determination of Applicability approving the work described in this RDA and RFD shown on the accompanying plan set.

References

Federal Emergency Management Agency. Flood Insurance Rate Map No. 25017C0431E, Effective Date June 6, 2010.

Massachusetts Department of Environmental Protection, Division of Wetlands and Waterways. 1995. Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act.

Massachusetts Department of Environmental Protection, 1997. Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials.

MassGIS OLIVER Mapping Tool. http://maps.massgis.state.ma.us/map_ol/oliver.php. Accessed December 7, 2021.

Melrose Conservation Commission. General Wetlands Protection Bylaw. Adopted May 7, 2007.

U.S. Army Corps of Engineers, Wetland Regulatory Assistance Program. 2012.Regional Supplement to the Corps of Engineers Wetland Delineation Manual: North Central and Northeast Region, Version 2.0.

U.S. Department of Agriculture, Natural Resources Conservation Service. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed December 7, 2021.

U.S. Environmental Protection Agency, 2007. Interim Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites. Office of Water. Report EPA 833-R-060-04.

Attachment B – Flood Study Analysis Prepared by Kleinschmidt

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NATIONAL GRID SUBSTATION FLOOD ANALYSIS

MELROSE 2 SUBSTATION
204 HOWARD STREET, MELROSE, MA 02176

Prepared for:

SGC Engineering, Inc.
Westbrook, Maine

Prepared by:

Kleinschmidt

Pittsfield, Maine
www.KleinschmidtUSA.com

October 2013

NATIONAL GRID SUBSTATION FLOOD ANALYSIS

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October 2013

NATIONAL GRID SUBSTATION FLOOD ANALYSIS

MELROSE 2 SUBSTATION
204 HOWARD STREET, MELROSE, MA 02176

SGC ENGINEERING, INC.

TABLE OF CONTENTS

LIST OF APPENDICES

NATIONAL GRID SUBSTATION FLOOD ANALYSIS

MELROSE 2 SUBSTATION
204 HOWARD STREET, MELROSE, MA 02176

SGC ENGINEERING, INC.

1.0 INTRODUCTION

The following report summarizes the hydrologic and hydraulic analyses performed by Kleinschmidt Associates (Kleinschmidt) for SGC Engineering, Inc. (SGC). This analysis was performed to determine what inundation may occur at the National Grid Melrose 2 substation (204 Howard Street Melrose, MA 02176) during 100- and 500-year flow conditions.

All elevations in this report reference the NAVD88 vertical datum.

2.0 HYDROLOGIC AND HYDRAULIC ANALYSES

2.1 METHODS AND ASSUMPTIONS

Examination of the Melrose 2 substation showed that inundation of the substation may be possible if the storage capacity of the adjacent wetland area was exceeded during severe storm events and water flowed into the substation. This analysis determined whether the total inflow volume to the wetland that would occur during the 100- and 500-year storms would exceed the wetland's maximum storage. The contributing drainage area of the wetland was calculated using ESRI's ArcMap 10.1 ArcHydro Tools functionality. ArcMap was also used to determine the lowest elevation of the wetland and its total storage volume. In order to be conservative, the analysis assumed that no outflow from the wetland would occur during the 100- or 500-year floods.

The Soil Conservation Service (SCS) lag equation[1] was used to determine the time of concentration of the drainage area. All geometric inputs for the SCS lag equation method were determined using ArcMap. The time of concentration was used to determine appropriate 100- and 500-year rainfall intensities over the watershed. Flow into the wetland was determined using the rational method, Q = CiA, where Q is flow (cfs), C is a coefficient, i is rainfall intensity

[1] Mays, L.W. 2011. Water Resources Engineering. John Wiley & Sons, Inc.: Hoboken, NJ.

(inches per hour) and A is the area of the watershed (acres). With a known peak flow and duration of the storm, the total inflow volumes to the wetland during the 100- and 500-year flood events could be determined. These volumes were compared to the total storage volume of the wetland to determine whether or not the storage would be exceeded and the substation flooded.

2.2 DATA SOURCES

Data used in the development of the model were acquired from a number of sources. The following is a list of the items used in the development of the model:

- Topographic Data – MassGIS digital elevation model (DEM) data[2] was the basis of the watershed analysis in ArcMap. Elevations located in and around the substation were obtained from survey data of the substation.
- Precipitation Data – Precipitation data was obtained from Northeast Regional Climate Data Center[3].
- Runoff Coefficient – The runoff coefficient for the rational formula were estimated by assuming the mean basin slope of the watershed is less than 2% and the impervious cover is less than 25% in the watershed. The 100-year and 500-year runoff coefficients are 0.36 and 0.49, respectively.[4]

3.0 RESULTS

The total drainage area to the wetland was determined to be approximately 60 acres. An approximate depth of 3.3 feet was obtained by measuring from the minimum elevation of the wetland to the surface level of the substation, using the MassGIS DEM and survey data. At the minimum wetland elevation, the area of the wetland storage was determined to be approximately 8.75 acres, resulting in a storage volume of approximately 29 acre-feet assuming no outflow before flooding the substation area.

Based on the methodology described in Section 2.1, the time of concentration for the area was estimated to be 1.1 hours. The 100- and 500-year inflows to the wetland were determined using the 2 hour precipitation values of 3.39 inches and 5.09 inches, respectively, and the 6 hour precipitation values of 5.63 inches and 8.57 inches, respectively. The resulting 100-year 2 hour peak inflow was determined to be 30.4 cfs and the 100-year 6 hour inflow 16.9 cfs. The resulting

[2] Massachusetts Office of Geographic Information. 2005. 5m Digital Elevation Model (1:5,000).
[3] Northeast Regional Climate Center. 2013. "Extreme Precipitation in New York & New England: An interactive Web Tool for Extreme Precipitation Analysis". Retrieved from: http://precip.eas.cornell.edu/.
[4] McCuen, R.H. 1998. Hydrologic Analysis and Design. Prentice Hill: Upper Saddle River, NJ.

500-year 2 hour peak inflow was determined to be 75 cfs and the 500-year 6 hour inflow was determined to be 42 cfs. These inflows were multiplied by the duration of the respective storms to obtain approximations of the total inflow volume. The results indicated that the expected respective storm runoff volume would be between 5 and 21 acre-feet. As such, there would be sufficient volume to contain the 100-year and 500-year flood flows without inundating the substation.

APPENDIX A

MELROSE 2 DRAINAGE AREA FIGURE

Path: G:_Client_Data\NationalGrid\MA Substation Inundation_MXD\Melrose_Analysis.mxd

Scale: AS SHOWN	SGC Engineering, Inc. Westbrook, ME
Project No: 3236001.01	National Grid Flood Study
Filename: see margin	Melrose Substation
Drawn By: MPH	
Date Drawn: 09-20-2013	

Kleinschmidt
141 Main St., PO Box 650
Pittsfield, Maine 04967
Telephone: (207) 487-3328
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APPENDIX B

ANALYSIS CALCULATIONS

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Project No.: 3236001.01

Project:	By:	Date:
National Grid Substation Flood Analysis	MCS	9/12/2013
Subject:	Checked:	Date:
Melrose 2 - Tc and 100-year and 500-year Flows and Volumes	MPH	9/12/2013

Analysis Description

1 - The goal of this analysis is to determine the time of concentration (Tc) of the wetland area adjacent to the Melrose 2 substation. Using this Tc, the 100- and 500-year watershed flows are calculated. The flows depend upon the precipitation duration determined using the Tc.
2 - 100- and 500-year flows are calculated using the rational method, Q = CiA
3 - The watershed geometry, including slopes, flow lengths, and drainage area were determined using ESRI's ArcMap 10.1.
4 - The Tc is calculated using the SCS Lag Equation Method.

Analysis

Time of Concentration

SCS Lag Equation Method: $Tc = (100L^{0.8}(1000/CN - 9)^{0.7})/(1900*S^{0.5})$

L = hydraulic length of watershed, ft	L =	1000	ft
CN = watershed curve number	CN =	82	
S = watercourse slope, ft/ft	S =	0.0020	ft/ft

Tc =	66.7	minutes =	1.11	hours

<--Check 2 hour and 6 hour storms

100-Year Watershed Flow

Q = CiA

A = Area =	0.094	mi^2	=	60 acres
C = Runoff Coefficient	C =	0.3		
100-Year 2 Hour Precipitation, P =	3.39	in		
Intensity, i = P/t =	1.70	in/hr		
$Q_{100\text{-year 2hr}}$ =	30.51	cfs		

Total Inflow Volume, V = Q*duration of Storm

V = 5.04 acre-feet

100-year 6 hour Preicipitation, P =	5.63	in
Intensity, i = P/t =	0.94	in/hr
$Q_{100\text{-year 6hr}}$ =	16.89	

Total Inflow Volume, V = 8.38 acre-feet

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Project No.: 3236001.01

Project: National Grid Substation Flood Analysis

By: MPH Date: 9/17/2013

Subject: Melrose 2 - Tc and 100-year and 500-year Flows and Volumes

Checked: MCS Date: 9/17/2013

500-Year Watershed Flow

500-year 2 hour Preicipitation, P = 5.09 in

Intensity, i = P/t = 2.55 in/hr

C = 0.49

A = 60 acres

$Q_{100\text{-year 6hr}}$ = 74.823

Total Inflow Volume, V = 12.37 acre-feet

500-Year Watershed Flow

500-year 6 hour Preicipitation, P = 8.57 in

Intensity, i = P/t = 1.43 in/hr

C = 0.49

A = 60 acres

$Q_{100\text{-year 6hr}}$ = 41.993

Total Inflow Volume, V = 20.82 acre-feet

Wetland Storage Volume

Area = 8.75 acres

Depth = 3.3 ft

Volume = 28.9 acre-feet

Results of Analysis

The storage of the wetland area is approximately 29 acre-feet. No inflow volume exceeds the total storage capacit of the wetland area

100-Yr 2 hr Storm:	**5.04 acre-feet**	<	**28.9 acre-feet**
100-Yr 6 hr Storm:	**8.38 acre-feet**	<	**28.9 acre-feet**
500-Yr 2 hr Storm:	**12.37 acre-feet**	<	**28.9 acre-feet**
500-Yr 6 hr Storm:	**20.82 acre-feet**	<	**28.9 acre-feet**

References

1 - Mays, L.W. 2011. Water Resources Engineering. John Wiley & Sons, Inc.: Hoboken, NJ.

2 - Northeast Regional Climate Center. 2013. “Extreme Precipitation in New York & New England: An interactive Web Tool for Extreme Precipitation Analysis”. Retrieved from: http://precip.eas.cornell.edu/.

Extreme Precipitation Tables

Northeast Regional Climate Center

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

Smoothing	Yes
State	Massachusetts
Location	near 204 Howard Street, Melrose, MA 02176, USA
Longitude	71.051 degrees West
Latitude	42.469 degrees North
Elevation	74 feet
Date/Time	Mon, 9 Sep 2013 14:12:43 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.42	0.53	0.69	0.86	1.09	**1yr**	0.74	1.03	1.27	1.63	2.09	2.71	2.98	**1yr**	2.40	2.87	3.29	3.99	4.66	**1yr**
2yr	0.35	0.53	0.66	0.87	1.10	1.39	**2yr**	0.95	1.27	1.61	2.03	2.57	3.25	3.60	**2yr**	2.88	3.47	3.97	4.72	5.37	**2yr**
5yr	0.41	0.64	0.80	1.07	1.37	1.75	**5yr**	1.18	1.60	2.04	2.58	3.26	4.12	4.58	**5yr**	3.64	4.40	5.02	5.98	6.72	**5yr**
10yr	0.46	0.72	0.91	1.24	1.62	2.08	**10yr**	1.39	1.90	2.43	3.09	3.91	4.92	5.49	**10yr**	4.35	5.28	6.00	7.16	7.97	**10yr**
25yr	0.54	0.87	1.10	1.52	2.01	2.62	**25yr**	1.74	2.39	3.07	3.92	4.95	6.23	6.98	**25yr**	5.52	6.71	7.60	9.09	9.99	**25yr**
50yr	0.61	0.98	1.26	1.77	2.38	3.13	**50yr**	2.05	2.84	3.69	4.71	5.95	7.45	8.38	**50yr**	6.60	8.05	9.09	10.88	11.87	**50yr**
100yr	0.70	1.14	1.46	2.07	2.82	3.73	**100yr**	2.43	3.39	4.40	5.63	7.12	8.92	10.06	**100yr**	7.90	9.67	10.88	13.04	14.10	**100yr**
200yr	0.80	1.30	1.68	2.41	3.33	4.44	**200yr**	2.88	4.04	5.27	6.75	8.53	10.68	12.09	**200yr**	9.45	11.62	13.03	15.63	16.75	**200yr**
500yr	0.95	1.57	2.05	2.98	4.17	5.61	**500yr**	3.60	5.09	6.67	8.57	10.84	13.56	15.42	**500yr**	12.00	14.83	16.53	19.88	21.06	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.25	0.38	0.47	0.63	0.78	0.87	**1yr**	0.67	0.85	1.16	1.41	1.74	2.41	2.43	**1yr**	2.13	2.33	2.93	3.55	3.80	**1yr**
2yr	0.33	0.51	0.63	0.85	1.05	1.25	**2yr**	0.90	1.22	1.44	1.90	2.46	3.15	3.48	**2yr**	2.78	3.35	3.84	4.56	5.20	**2yr**
5yr	0.39	0.60	0.74	1.01	1.29	1.50	**5yr**	1.11	1.47	1.71	2.22	2.85	3.78	4.17	**5yr**	3.35	4.01	4.61	5.50	6.21	**5yr**
10yr	0.43	0.66	0.82	1.14	1.48	1.73	**10yr**	1.27	1.69	1.96	2.50	3.20	4.32	4.88	**10yr**	3.82	4.69	5.31	6.30	7.09	**10yr**
25yr	0.49	0.75	0.94	1.34	1.76	2.06	**25yr**	1.52	2.02	2.33	2.92	3.72	5.13	5.92	**25yr**	4.54	5.69	6.40	7.52	8.47	**25yr**
50yr	0.55	0.83	1.04	1.49	2.01	2.37	**50yr**	1.73	2.32	2.65	3.29	4.17	5.81	6.87	**50yr**	5.15	6.60	7.37	8.59	9.68	**50yr**
100yr	0.62	0.93	1.17	1.68	2.31	2.71	**100yr**	1.99	2.65	3.01	3.70	4.68	6.63	7.98	**100yr**	5.87	7.67	8.51	9.79	11.07	**100yr**
200yr	0.69	1.04	1.32	1.91	2.66	3.11	**200yr**	2.30	3.04	3.43	4.17	5.26	7.53	9.30	**200yr**	6.67	8.95	9.82	11.15	12.66	**200yr**
500yr	0.81	1.20	1.55	2.25	3.20	3.72	**500yr**	2.76	3.64	4.06	4.88	6.14	8.92	11.42	**500yr**	7.90	10.98	11.88	13.22	15.14	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.30	0.47	0.57	0.77	0.95	1.11	**1yr**	0.82	1.08	1.30	1.74	2.22	2.89	3.23	**1yr**	2.56	3.11	3.58	4.36	5.05	**1yr**
2yr	0.36	0.55	0.68	0.92	1.13	1.34	**2yr**	0.98	1.31	1.55	2.05	2.64	3.43	3.78	**2yr**	3.04	3.63	4.12	4.95	5.57	**2yr**
5yr	0.44	0.69	0.85	1.17	1.48	1.76	**5yr**	1.28	1.72	2.04	2.64	3.37	4.49	5.01	**5yr**	3.97	4.82	5.45	6.49	7.27	**5yr**
10yr	0.54	0.83	1.03	1.44	1.86	2.16	**10yr**	1.60	2.12	2.51	3.21	4.05	5.56	6.21	**10yr**	4.92	5.97	6.73	8.01	8.91	**10yr**
25yr	0.70	1.07	1.33	1.90	2.49	2.85	**25yr**	2.15	2.78	3.32	4.15	5.17	7.37	8.27	**25yr**	6.52	7.95	8.89	10.63	11.67	**25yr**
50yr	0.85	1.29	1.61	2.31	3.11	3.51	**50yr**	2.68	3.43	4.11	5.05	6.23	9.15	10.27	**50yr**	8.10	9.88	10.99	13.15	14.31	**50yr**
100yr	1.04	1.57	1.96	2.84	3.89	4.32	**100yr**	3.36	4.23	5.09	6.15	7.50	11.35	12.76	**100yr**	10.05	12.27	13.58	16.32	17.57	**100yr**
200yr	1.26	1.90	2.40	3.48	4.86	5.34	**200yr**	4.19	5.22	6.30	7.47	9.02	14.08	15.82	**200yr**	12.46	15.21	16.77	20.25	21.59	**200yr**
500yr	1.64	2.44	3.15	4.57	6.50	7.04	**500yr**	5.61	6.88	8.39	9.69	11.53	18.74	21.03	**500yr**	16.59	20.22	22.16	26.95	28.36	**500yr**

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