FIVE-YEAR REVIEW REPORT FOR
Plymouth Harbor, Cannon Engineering Corporation (CEC) Superfund Site
Plymouth County, Plymouth, Massachusetts

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7/3/18
Date

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LIST OF ABBREVIATIONS & ACRONYMS

ADAFs	Age Dependent Pontency Adjustment Factors
ARAR	Applicable or Relevant and Appropriate Requirement
AST	Aboveground Storage Tank
ATSDR	Agency for Toxic Substances and Disease Registry
CEC	Cannon Engineering Corporation
COC	Contaminant of Concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cPAH	Carcinogenic Polynuclear Aromatic Hydrocarbons
CSF	Cancer Slope Factor
DL	Detection Limit
EA	Endangerment Assessment
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
FYR	Five-Year Review
ICs	Institutional Controls
MADEQE	Massachusetts Department of Environmental Quality Engineering
MassDEP	Massachusetts Department of Environmental Protection (formerly MADEQE)
MCL	Maximum Contaminant Level
Nobis	Nobis Engineering, Inc.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NUS	NUS Corporation
O&M	Operations and Maintenance
PAH	Polynuclear Aromatic Hydrocarbons (also called Polycyclic Aromatic Hydrocarbons)
PCB	Polychlorinated biphenyl
ppb	Parts per billion
RPFs	Relative Potency Factors
ppm	Parts per million
RPM	Remedial Project Manager
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RfDs	USEPA Risk Reference Doses
RI	Remedial Investigation
RSLs	Risk Screening Levels
ROD	Record of Decision
RP	Responsible Parties
SARA	Superfund Amendments and Reauthorization Act
Site	Plymouth Harbor, Cannon Engineering Superfund Site
SPs	Settling Parties
TBC	To be considered
µg/L	Micrograms per liter
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is still and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the sixth FYR for the Plymouth Harbor, Cannon Engineering Corporation (CEC) Superfund (Site). The triggering action for this policy review was the completion of the fifth Five-Year Review that was finalized and signed on July 3, 2013. This FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

The Plymouth Harbor FYR was led by Derrick Golden, EPA's Remedial Project Manager (RPM) for the Site. This report was also reviewed by the EPA case team and the Massachusetts Department of Environmental Protection (MassDEP). This FYR began on December 12, 2017, when the RPM provided a Site history during a meeting with the EPA case team. Participants of the EPA case team included: Kate Melanson, EPA Community Involvement Coordinator; Bart Hoskins, EPA Ecological Risk Assessor; Courtney Carroll, EPA Human Health Risk Assessor; and John Hultgren, EPA Enforcement Counsel. Paul Craffey, MassDEP Project Mananger, assisted the EPA case team in the review. The current Site property owner is New Millennium Ventures, LLC, which is owned by various partners including Joseph Jannetty. New Millennium Ventures, LLC was notified of the initiation of the FYR on Jannuary 22, 2018, when EPA conducted a telephone interview with Mr. Jannetty. A summary of this interview is included in Section IV of this report.

Site Background

The Site is located within Cordage Park, a business and industrial park situated adjacent to Plymouth Harbor in Plymouth, Massachusetts. See Figure 1. The Site consists of a 2.597-acre property identified by the Town of Plymouth Tax Assessor's Office by Parcel ID 001-000-001C-000. The lot is bordered by a tidal stream and boat storage operation to the east and southeast, an industrial plant to the south and southwest, a cleared area to the west, a former fish processing plant to the northwest, and Plymouth Harbor to the north. See Figure 2, which depicts the location of the former above ground storage tanks, before they were removed. The area to the northwest of the Site formerly contained industrial buildings associated with the Plymouth Cordage Co. New Millennium Ventures, LLC currently owns the Site property. Joseph Jannetty, a partner of Millennium Ventures, LLC, is also a principal of other companies that own adjacent properties to the Site, including: Cordage Development, LLC, (owner of the lot identified by Parcel ID: 001-000-001E-000) ; and Cordage Park Manager Corporation, which owns JD Cordage, LLC (owner of the lot identified by Parcel ID: 001-000-001E-000). Mr. Jannetty has expressed an interest in redeveloping the adjacent properties along with the Site property at some point in the future. See Figure 1.

The Plymouth Harbor, Cannon Engineering Corporation Site is one of four separate, but related sites which form the Cannons Engineering Corporation Superfund Sites. The other sites are the Cannons Engineering Corporation Bridgewater Site in Bridgewater, Massachusetts; the Tinkham's Garage Site in Londonderry, New Hampshire; and the Gilson Road Site in Nashua, New Hampshire. All four sites are being handled under one enforcement effort.

Former Land Use

In the past, the Site and surrounding areas were used for commercial/industrial purposes, including for rope manufacturing. Three above-ground storage tanks (ASTs) were constructed on the Site property in the 1920s. Until 1974, the ASTs were used for storage of No. 6 Marine Fuel and Bunker C Oil for the Cordage Park complex. Tank Nos. 1 and 2 each had a capacity of approximately 250,000 gallons; Tank No. 3 had a capacity of approximately 500,000 gallons. From 1976 until 1980, CEC used Tank Nos. 1 and 2 for storage of motor oils, solvents, lacquers, organic and inorganic chemicals, cyanide and plating waste, clay and filter media containing chemicals, plating sludge, oil solids, and pesticides. Tank No. 3 was not used by CEC and remained empty. CEC terminated operations at the Site in 1980 in response to an Order of Revocation from Massachusetts Department of Environmental Quality Engineering (MADEQE), now known as the Massachusetts Department of Environmental Protection (MassDEP). Approximately 500,000 gallons of liquid hazardous wastes in Tank Nos. 1 and 2 were abandoned at the facility when CEC ceased operations.

Current Land Use

A copy of the Town of Plymouth Official Zoning Map, adopted in 2012, was obtained from Plymouth Town Hall and indicates that the Site lies within an area zoned LI/WF (Light Industrial/Waterfront). See Appendix A. This land use description allows for "a mix of uses including commercial/industrial uses of light intensity, clean operational nature; residential uses; and compatible industrial uses" (Plymouth, 2012). The properties in the vicinity of the Site presently remain in commercial/industrial use.

A number of beaches and tourist areas are nearby. For example, Plymouth (Long) Beach is approximately two miles southeast of the Site and Duxbury Beach is approximately four miles northeast of the Site. In addition, Plymouth Harbor, abutting the Site to the north, is used for boating and other recreational activities. The Plymouth Rock historic area is located approximately one mile southeast of the Site.

The Site is located in a medium yield non-potential drinking water source area and is adjacent to Plymouth Harbor. The property which comprises the Site is currently a vacant overgrown lot, which has not been redeveloped.

Additional detailed background information and numerous historical reports for the Site can be viewed on the following EPA website: www.epa.gov/superfund/cannon

Reasonably Anticipated Future Land Use

In January of 2018, EPA conducted a phone interview with Joeseph Jannetty, a partner of the company, Millennium Ventures, LLC, which currently owns the Site property. Mr. Jannetty indicated that he and his partners were considering redeveloping the Site at some time in the future in conjunction with but

after the redevelopment of other adjacent properties to the Site. Although no definitive reuse plans have been made, Mr. Jannetty indicated that future reuse of the Site may include a boat storage facility or a parking area. Mr. Janetty also indicated that additional clean fill would likely need to be brought in to raise the grade at the Site if and when the property is redeveloped.

Mr. Janetty is aware of the land use restrictions that are in place for the Site. During the interview, EPA informed Mr. Jannetty that, per the Declaration of Restrictions, certain uses of the Site are restricted, namely single-family or multiple-family residences, school facilities, hotels, motels, or recreational or community facilities, and that redevelopment for any listed restricted use can only be considered after performance of a human health risk assessment and the concurrence of EPA and MassDEP.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Plymouth Harbor/Cannon Engineering Corp. (CEC) Superfund Site (Site)		
EPA ID: MAD980525232		
Region: 1	**State:** MA	**City/County:** Plymouth/Plymouth
SITE STATUS		
NPL Status: Deleted		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA *[If "Other Federal Agency", enter Agency name]*:		
Author name (Federal or State Project Manager): Derrick Golden – Remdial Project Manaager		
Author affiliation: USEPA-Region 1		
Review period: 12/12/2017 - 7/2/2018		
Date of site inspection:2/28/2018		
Type of review: Policy		
Review number: 6		
Triggering action date: 7/3/2013		
Due date *(five years after triggering action date)*: 7/3/2018		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

In the Record of Decision (ROD) for the Site, EPA identified polynuclear aromatic hydrocarbons (PAHs) and lead in soil as the Contaminants of Concern (COCs) at the Site. Sampling of groundwater and sediments determined that these two media did not present a concern.

Data from the 1985 Remedial Investigation (RI) indicated that potential receptors for contaminants at the Site to be individuals who work in the vicinity of the Site and may breathe contaminated soil particles and individuals who traverse the Site and come into direct contact with contaminated soil.

Ecological risks did not drive any response actions. The site itself offers little terrestrial habitat, so the principal media of ecological concern would be off-site surface water and/or sediment. Several contaminants were found in on-site soils and in off-site surface water and sediment, however these occurences are un-related based on data presented in the 1989 Endangerment Assessment. The Endangerment Assessment concluded that the near absence of site contaminants in groundwater, and the lack of a soil concentration gradient from on-site soil to a nearby tidal stream, indicate that site contaminants did not migrate off-site.

Response Actions

As noted above, in 1980 CEC terminated operations at the Site in response to an Order of Revocation from MADEQE, and abandoned approximately 500,000 gallons of liquid hazardous wastes in Tank Nos. 1 and 2 at the Site.

The Site was proposed to be listed on the NPL in 1982 and made final on the NPL in 1983. On September 22, 1983, Jetline Services, Inc., under contract to Salt Water Trust, the owner of the Site at that time, began pumping wastes from Tank No. 1. Drainage of Tank No. 2 was completed in January 1984 by EPA contractors. Tank No. 3 never contained hazardous materials.

On September 30, 1985, the United States Environmental Protection Agency (EPA) issued the ROD. Based on the conclusions of the RI and Feasibility Study (FS), EPA identified the following remedial action objectives (RAOs) in the ROD:

1. Minimize the potential for direct contact with surface soil; and

2. Minimize the potential for off-site migration of hazardous chemicals (USEPA, 1985).

The ROD required the completion of the following three tasks before the selection and implementation of a final remedy:

1. Dismantling and off-site disposal of the three ASTs and associated piping;

2. Supplemental sampling of all media to confirm the pattern of contamination identified in the RI and characterization of the areas beneath the three ASTs; and

3. Preparation of a site-specific floodplains assessment.

In the fall of 1987, the three ASTs and associated piping were inspected, decontaminated, demolished, and disposed of off-site. Both tanks were steam-cleaned after they were emptied and the wastes were hauled to a hazardous waste disposal facility in Niagara Falls. Also in the fall of 1987 the following activities were completed: (1) supplemental samples were collected from the soils under the dismantled ASTs and from surface and subsurface soil locations outside the tank berms; (2) five on-site groundwater monitoring wells were installed; (3) groundwater samples were collected; and (4) sediments located off-site in the tidal seep were sampled.

In 1988, EPA entered into a Consent Decree (CD) with certain Settling Parties (SPs). The CD required the SPs to excavate and dispose of highly contaminated soil within the bermed area where Tank No. 1 had been located, collect post-excavation samples, backfill each of the bermed areas and cover them with 6 to 12 inches of clean fill material. Pursuant to the CD, in September 1988, approximately 200 tons of stained surface and subsurface soil contaminated with oily and hazardous materials were excavated from the Tank No. 1 area and an additional 50 tons of contaminated soils were excavated from the top 6 to 12 inches inside each of the three bermed areas. The excavated soils from all of these areas were disposed of at a Subtitle C hazardous waste facility. Post-excavation soil grab samples were collected from the base and perimeter of the excavated areas, from the interior of the bermed areas, and from outside the bermed areas.

EPA completed an Endangerment Assessment (EA), dated April 6, 1989, using Site data collected during the response actions. In the EA, EPA concluded that use of the Site for commercial or industrial purposes, the likely future use, would not present any current or future unacceptable risks to human health or the environment and that "*regulated access is no longer required for the site.*" Based on the findings of the EA, EPA in consultation with MassDEP, concluded that no additional remedial actions, Explanation of Significant Differences, or ROD amendment were necessary for the Site.

In 1992, an Institutional Control (IC), identified as a Declaration of Restrictions, was recorded on the Site property deed. See Appendix B. The Declaration of Restrictions does not limit redevelopment on the Site property for commercial or industrial uses, but otherwise limits redevelopment with respect to certain restricted uses, namely single or multi-unit residential, school facilities, hotel/motel, community-related, and recreational uses. The Declaration of Restrictions specifies that a risk assessment must be performed prior to redevelopment of the Site for any of the listed restricted uses. EPA, in consultation with MassDEP, would use the results of an acceptable CERCLA risk assessment to determine if the proposed restricted use would pose an unacceptable risk from exposure to contaminated Site soil. If the proposed restricted use poses an unacceptable risk, the proposed redevelopment would only be allowed after a response action was performed to reduce the risk to an acceptable level.

The ROD did not include any Applicable Relevant of Appropriate Requirements (ARARs) and/or criteria "To Be Considered" (TBCs) because it preceded the Superfund Amendments and Reauthorization Act of 1986 (SARA), which mandated identification of and compliance with ARARs. Clean up levels in the ROD are based on EPA's acceptable risk range.

EPA completed Five-Year Reviews in 1992, 1998, 2003, 2008 and 2013 because hazardous substances, pollutants, or contaminants remained at the Site above levels that allow for unlimited use and unrestricted exposure.

All of these reviews concluded that the Site still remains protective of both human health and the environment. No ROD amendments or Explanation of Significant Differences were issued for this Site.

Status of Implementation

All remedial actions for the Site been completed. In May 1992, EPA issued a Final Close Out Report for the Site, and in November 1993, EPA delisted the Site from the NPL.

Since the 1985 ROD and subsequent decision documents did not establish any clean-up criteria, there were no specific performance standards that had to be achieved. Instead, EPA determined through the EA that the Site risks fell within EPAs acceptable commercial/industrial risk range and the remedy is protective of tresspassers. In addition, an adequate deed restriction or IC, which restricts certain uses of the Site was recorded to ensure the continued protectiveness of the remedial actions.

IC Summary Table

Table 1 : Summary of Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Soil	Yes	Yes	Book 10915 Page 249; also identified by Town Tax Assessor by Parcel ID 001-000-001C-000	*"The Premises shall not be used for any single-family or multiple-family residences, school facilities, hotel, motel or recreational or community facilities*"*	Declaration of Restrictions, recorded on April 21, 1992

*The Declaration of Restrictions also requires the property owner to "inspect, maintain, and repair the fence constructed on the Premises, until EPA, in consultation with MA DEP, certifies that no further inspection, maintenance, or repair of all or a portion of the fence is required," however, EPA has determined, including in the 1989 EA, and 2018 risk re-evaluation, that no unacceptable risk exists without the fencing and thus this requirement is not necessary to ensure protectiveness.

Systems Operations/Operation & Maintenance

The remedy selected in the ROD did not include any activities which have associated operation and maintenance requirements. No groundwater extraction and treatment systems were required and no source control measures were implemented which would necessitate a long term operation and maintenance program. However as previously stated, Institional Controls were required under the ROD, and the Declaration of Restrictions, which was recorded in 1992 is checked during each Five-Year Review to ensure that it remains in place on the chain of title for the property deed for the Site.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** Five-Year Review, as well as the recommendations from the last Five-Year Review and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2013 FYR

OU #	Protectiveness Determination	Protectiveness Statement
N/A	Protective	The remedy at the Cannon Engineering-Plymouth Harbor Site currently protects human health and the environment because the clean fill and cover remains in-place and the Declaration of Restrictions also remains in place. However, in order for the remedy to be protective in the longterm, the following actions need to be taken: the property owners need to submit a redevelopment plan to EPA and MassDEP prior to any Site redevelopment for commercial, industrial or other non-restricted use, to ensure protectiveness.

Table 3: Status of Recommendations from the 2013 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
N/A	Inadequate access controls. Northern/northeastern perimeter fence in disrepair*	Repair damaged fencing or request EPA approval, in consultation with MassDEP, to discontinue fence maintenance.*	Considered But Not Implemented	EPA determined that access controls are not required for the remedy to remain protective. The EA determined that "regulated access is no longer required for the site." This conclusion is verified by the 2018 risk re-evaluation based on current risk assessment methodology.	7/20/2016
N/A	Inadequate requirements for assessment of protectiveness of Site redevelopment for commercial/industrial use	Prior to Site redevelopment for a non-restricted use, submit redevelopment plan to EPA and MassDEP. EPA, in consultation with MassDEP, will determine if	Considered But Not Implemented	EPA determined that because soil contaminant levels do not present a risk for commercial/industrial uses, this recommendation is not necessary. The 2018 risk re-evaluation verified that no commercial/industrial use risk exists at the Site based on current risk assessment methodology.	6/23/2013

		additional sample collection and risk assessment are required prior to development.			

* Prior to dismantling the tanks and soil removal and disposal, the Site was fenced in June 1987 to restrict uncontrolled accesss and prevent tresspassers from coming into direct contact with containinated soil. However, fencing is not required for the remedy to be protective because soil that posed unacceptable risk was removed and 6-12 inches of clean fill was then placed within the excavated areas. Also, the last paragraph of the 1989 Endangerment Assessment states: "*Regulated access is no longer required for the site.*" In addition, the 2018 re-evaluation of risks determined that there are no unacceptable risks to an older child trespasser, or to a commercial/industrial worker or a construction worker at the Site, including without the fencing and soil cover. EPA has informed property owner that it may petition EPA and MassDEP to certify that the fence no longer needs to be inspected, maintained, repaired and can be removed, under the Declaration of Restriction.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

The public was notified about the start of the Five-Year Review when EPA Region 1 issued a press release on February16, 2018, see Appendix C. The results of this 2018 review and the final report will be made available at the Site information repository located at USEPA - Region 1 New England, 5 Post Office Square, Boston, MA and will also be made available to the public, town officials and the town library via the following EPA link:

www.epa.gov/superfund/cannon

Interviews

On January 22, 2018, Derrick Golden and Kate Melanson of EPA conducted a telephone interview with Joseph Janetty, a principal of the current property owner, New Millenium Ventures, LLC, to learn perceived problems or successes with the remedy. The results of this interview are summarized below:

1. Mr Jannetty stated that conditions at the Site have not changed since the previous FYR in 2013;

2. Mr. Jannetty stated the company has no current plans for redevelopment of the Site;

3. Mr Jannetty stated that he and his partners, who own other companies that own other properties adjacent to the Site, plan to redevelop the other properties first before redeveloping the Site property itself;

4. Mr. Jannety stated that potential future reuse of the Site may include a boat storage facility or parking lot, either of which would require fill to be brought in to raise the grade at the Site and these potential uses are consistant with the ICs;

5. The Site fencing and the wooden snow fence remain in place;

6. The RPM informed Mr. Jannetty that the fencing may be removed at any time, but, per the requirement of the Declaration of Restrictions, the company would first need to send EPA and MassDEP a letter request for EPA and MassDEP certification before beginning that work;

7. EPA informed Mr. Jannetty that prior to any redevelopment at the Site for a restricted use (single-family or multiple-family residences, school facilities, hotel, motel, or recreational or community facilities) that a human health risk assessment must be completed and approved by EPA and MassDEP;

8. EPA recommended that before any type of redevelopment of the Site, including commercial/industrial, that the owner notify EPA and submit a reuse/redevelopment plan;

9. Mr. Jannetty stated that he is not aware of any issues or problems with the company's continued adherence of the IC restrictions;

10. Mr. Jannnety stated that he was not aware of any signs of erosion at the Site.

Data Review

This Five-Year Review included a review of relevant documents including decision documents and monitoring reports. See Appendix to view the list of documents and references that were utilized in preparing this review.

A summary of relevant data regarding the components of the Site remedy is presented below. The data reviewed were collected from 1987 to 1989, as part of the 1987 supplemental sampling required by the 1985 ROD and the 1988 soil excavation response action required by the Consent Decree and the 1989 Endangerment Assessment. The results of these sampling events are summarized below by media.

In 2000, a contractor hired by the property owner of the Site, prepared a risk assessment in an effort to support removing the Declaration of Restrictions. However, the 2000 risk assessment was not considered acceptable to EPA because it did not fulfill all of the requirements of an EPA CERCLA compliant risk assessment and its conclusions are therefore not included in this FYR.

Soil

Soil samples collected during the 1987 supplemental sampling event were analyzed for VOCs, PAHs, pesticides, and inorganics. No VOCs were detected in the soil samples, but low levels of soil excavated from the Tank No. 1 area. Grab samples from each of these four areas were composited PAHs, pesticides, and lead were detected. The distribution of contaminants did not follow a distinct pattern vertically or laterally, as was concluded in the RI. The highest concentrations of contaminants were detected in shallow soil from within the bermed areas (ATSDR, 1988).

Following the excavation and off-site disposal of contaminated soil in 1988, additional soil samples were collected to characterize the excavated areas and general Site soils. Post-excavation soil samples were collected from the base and perimeter walls of the excavations, from around the exterior of the three bermed areas, from inside each of the three berms, and from to form representative samples, which were analyzed for PAHs, inorganics, and pesticides. The results of these 1988 composite samples are discussed below.

PAHs were detected in all of the 1988 composite soil samples. The average total PAH concentration inside the bermed areas was 111 ppm, and outside the bermed areas was 6 ppm (USEPA, 1992a). Inorganic compounds were detected in samples at concentrations that were generally within the range of naturally occurring inorganic compounds. The average lead concentration was 192 ppm inside the bermed areas and 78 ppm outside the bermed areas (USEPA, 1992a). The lowest concentrations of both PAHs and lead were found in the composited samples from outside the berms. The clean soil fill material was also sampled prior to backfilling on the Site. The fill material contained lead at 2.7 ppm, but no PAHs (USEPA, 1992). No pesticides were detected in any of the confirmatory samples, therefore they were not considered a COC.

The carcinogenic Polynuclear Aromatic Hydrocarbons (cPAH) data from the 1988 post-excavation composite soil samples were used in the EA, as well as in the risk computations included in the second, third, fourth, fifth, and this (sixth) Five-Year Review.

The current use scenario outlined in the 1989 EA assumed unlimited access to the entire Site, and therefore assumed that the likelihood of contact with any portion of the Site (inside or outside of the bermed area) was equal. A site-wide average concentration was used to calculate exposure doses. The site-wide average used is an area weighted value calculated assuming the bermed areas comprise approximately 1/3 of the total site area. The contaminant concentrations for the areas inside the berms and outside the berms were obtained from analysis of the fill material covering the berms and the composite samples of the area outside the berms. The area concentrations were weighted to obtain the area weighted site average. Risk calculations performed for the current Five-Year Review use a different approach, consistent with current EPA updated guidance. These updated risk calculations and the results are discussed in Section V and the calcuations and tables are included in Appendix D.

In 2018 a re-evalution of risks was conducted using the the post confirmatory sample results from 1989. See Section V of this FYR for detailed information. This re-evluation of risks determined that there are no unacceptable risks to an older child trespasser or to a commercial/industrial worker or to a construction worker from soil at the Site.

Groundwater

Groundwater sampling was conducted as part of the 1987 supplemental sampling event at both low and high tide to determine if the distribution of contamination was tidally influenced. In both the RI and the supplemental sampling, groundwater samples were free of organic contamination, but contained low levels of lead (below the federal maximum contaminant level (MCL) (at the time) of 50 parts per billion (ppb). The distribution of lead contamination was random and no tidal influence was found (ATSDR, 1988).

The five existing monitoring wells were located during the 2018 Site inspection for this FYR and the wells appeared to be intact and in good condition, however, they were not locked.

Surface Water

Surface water samples were collected from the tidal stream during the 1987 supplemental sampling event. During both the RI and the supplemental sampling investigation, organic compounds were not detected and lead was the only inorganic compound detected. Lead concentrations were significantly higher in the RI samples than they were in the supplemental samples; in fact, only two of the eight samples collected as part of the supplemental investigation contained low-level detectable concentrations. Silver and selenium were detected during the RI investigation, but not during the supplemental sampling round (USEPA, 1989). No COCs associated with surface water were identified.

Sediment

The collection of sediment samples during both the RI and the 1987 supplemental sampling was limited to the tidal stream located to the east and southeast of the Site. See Figure 2. Similar contaminants (PAHs and lead) and levels of contamination were detected in both sets of samples. The only difference noted was that pesticides were not detected in the 1987 supplemental samples as they had been in the 1984 RI (ATSDR, 1988). The contaminants found in sediment were not identified as COCs because there was no evidence of a complete transport pathway from the site and were not Site related.

Site Inspection

The inspection of the Site was conducted on February 28, 2018, by RPM, Derrick Golden. The purpose of the inspection was to assess the protectiveness of the remedy and evaluate current site conditions.

The five existing monitoring wells were located during the inspection. The wells appeared to be intact and in good condition, however they were not locked. There was no evidence of erosion or damage to the soil cover nor was there evidence of contamination (i.e., stained soil, stressed vegetation, odors) observed during the Site inspection. An area of coal slag and clinkers was observed in the north-central portion of the Site, which is consistent with observations made during previous Five-Year Reviews.

The Site is currently vacant and overgrown. Perimeter fencing, which was observed during the Site inspection for the 2013 FYR to be partially damaged, appeared to be intact and/or repaired. Fencing is not required for the remedy to be protective, however, because soil that posed unacceptable risk was removed and replaced with 6-12 inches of clean fill. As noted above, the 1989 EA states that *"regulated access is no longer required for the Site."* In addition, the 2018 re-evaluation of risks determined that there are no unacceptable risks from soil remaining on-site to an older child trespasser, to a commercial/industrial worker or to a construction worker at the Site (irrespective of the fact that the soil is covered and the property is fenced).

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

Yes, the remedy is functioning as intended. In September 1988, approximately 200 tons of stained surface and subsurface soil contaminated with oily and hazardous materials were excavated from the Tank No. 1 area and an additional 50 tons of contaminated soils were excavated from the top 6 to 12 inches inside each of the three bermed areas. After post confirmatory samples were taken, 6 to 12 inches of clean backfill was then placed in each of the bermed areas.

The EA concluded that use of the Site for commercial or industrial purposes, the likely future use, would not present any current or future unaceptable risks to human health or the environment, and that "*regulated access is no longer required for the Site.*" Therefore, Site perimeter fencing, while adding an extra measure to limit exposure, is not needed in order for the remedy to remain protective.

A re-calculation of risk in 2018 based on current risk analysis methodology (discussed below in Question B) further concluded that the remedy remains protective under the current exposure assumptions, i.e., no residential use. This risk analysis conclusion is based on the presumption that soils on site are fully accessible, e.g. without consideration of the fact that the soil is covered with the 6 to 12 inches of clean fill and the property is fenced. The soil cover was observed to be intact during the 2018 site inspection, thus bolstering the conclusion that the remedy remains protective.

Requirements in the Declaration of Restrictions mandate that the property owner perform an EPA-approved (CERCLA-compliant) risk assessment before reuse of the property for certain restricted uses (namely single or multi-unit residential, school facilities, hotel/motel, community-related, and recreational uses) to help ensure that the remedy remains protective with the proposed use.

Remedial Action Performance

The remedial actions continue to operate and function as designed due to the fact that:

- There is no potential exposure because 250 tons of contaminated soil was removed;
- 6 to 12 inches of clean fill was placed over the removal areas;
- The cover of clean fill is effective because there are no signs of damage or erosion;
- The Declaration of Restrictions on the Site property remains in place;
- The 2018 risk re-evaluation determined that there are no unacceptable risks to an older child tresspasser or to commercial/industrial worker or to a construction worker at the Site without the soil cover and without the fencing;
- No other actions are currently necessary, because any immediate threats have been addressed; and
- There is no opportunity to reduce Site costs as the remedial action is complete and there are only minimal costs to complete Five-Year Reviews.

System Operations/O&M

- According to the Site Close-Out Report, prepared by EPA, 1992: "*No groundwater extraction and treatment systems were required and no source control measures, such as capping, were implemented which would necessitate a long term operation and maintenance program*"

Implementation of Institutional Controls and Other Measures

- ICs are in place in the form of a Declaration of Restrictions
  - The IC remains attached to the property deed; verification was completed via a visit to the Plymouth Registry of Deeds, April of 2018.
  - The IC is apparently effective as the Site is not being used for a restricted use as defined in the Declaration of Restrictions, see Appendix B.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Question B Summary:

No. There have been changes in the exposure assumptions and toxicity information since the time of the remedy selection, however the RAOs used at the time of remedy selection are still valid. The changes as described below are not expected to affect the protectiveness of the remedy because 250 tons of contaminated soil were removed and replaced with 6-12 inches of clean fill in the excavated areas. Additionally, ICs are in place to prevent exposure to impacted media. A re-evaluation of risks may be needed if there are any land use changes in the future.

Changes in Standards or TBCs

Since the ROD and subsequent decision documents did not specify any ARARs or TBCs, there were no standards to review, except for the human health risk assessment guidance described below. Site soils were identified as the only potential threat, and PAHs and lead as the only COCs, in the 1989 EA. The soil removal action and subsequent Site deletion were based on risk calculations determined to be within EPA acceptable risk ranges for commercial/industrial uses, coupled with the recording of the deed restriction which restricts certain uses of the property.

Changes in Exposure Pathways

No changes in land use or the physical conditions of the Site property have occurred since the previous Five-Year Review. The 1989 EA identified the older child trespasser, commercial worker, and construction worker as the most likely receptors to be exposed to soil contamination, and dermal contact and incidental ingestion as the only two exposure pathways. These two exposure scenarios remain the most likely current or future exposures. The commercial worker exposure scenario assumes full-time workers are at the Site for commercial/industrial use. In addition, construction workers may be exposed to soil contamination via dermal contact and incidental ingestion, and inhalation of dust, when the Site is redeveloped.

Currently, the Site remains vacant and there is some evidence of trespassing, however, the 2018 re-evaluation of risk determined that there are no unacceptable risks to tresspassers at the Site. Further data may be needed if land use were to change.

Since the development of the scenarios in the EA, EPA has established recommended default exposure frequency and exposure duration assumptions for the commercial worker. These default assumptions reflect greater exposures than those estimated in the EA. Default exposure assumptions for construction worker exposure to soil are available in EPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002).

No default assumptions regarding exposure frequency and exposure duration have been established for trespassers, therefore these values are determined on a site-specific basis. The Risk Assessment Guidance for Superfund: Volume 1 Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA, 2004) was used to establish dermal exposure parameters during a previous Five-Year Review. Although the dermal risk assessment guidance has not been updated, EPA recommendations on the selection of soil adherence factors for trespassers have shifted slightly, reflecting lower dermal exposure than previous Five-Year Reviews.

No new receptors or exposure routes have been discovered for the Site. Additionally, no new contaminants or contaminant sources have been identified since the remedy selection.

Although calculated risks from potential exposure pathways at the Site may differ from those previously estimated, slightly higher for some contaminants and slightly lower for others, the revised methodologies themselves are not expected to affect the protectiveness of the remedy. A review of Site information identifies that these updates do not call into question the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

EPA toxicity values, including reference doses (RfDs) and reference concentrations (RfCs), as well as inhalation unit risks (IUR) and cancer slope factors (CSFs), are routinely re-evaluated and updated. These toxicity values are used in the calculations of risk and the development of site-specific, risk-based screening values or cleanup goals. Since the remedy selection, there have been changes in toxicity values, which are described below, however, these changes do not affect the protectiveness of the remedy, as reflected by the 2018 risk re-evaluation. The risk re-evaluation used updated toxicity values and exposure paramaters to run the calculations used for the 2018 re-evalution of risks and determined that there were no unacceptable risks to human health. The soil cover and fencing surrounding the property provides extra protection from unacceptable risks and calculated risks from exposure to soil were found to be within EPA's acceptable range. Additionally, institutional controls are in place to prevent the Site property from being re-developed for residential or other restricted uses without proper approval. If land use were to change in the future, a re-evaluation of risks using the updated toxicity values may be needed.

- ***2011 Methylene Chloride*** - *cancer and non-cancer toxicity values*

On November 18, 2011, EPA finalized the toxicity assessment for methylene chloride. The new values indicate that methylene chloride is more toxic from non-cancer health effects but less toxic from cancer health effects. These toxicity changes would result in an increased non-cancer hazard and a decreased cancer risk from exposure to methylene chloride.

- ***2016 Lead in Soil Cleanups***

EPA's 2016 OLEM memorandum, "Updated Scientific Considerations for Lead in Soil Cleanups" (OLEM Directive 9200.2-167), indicates that adverse health effects are associated with blood lead levels (BLLs) less than 10 µg/dL. The memo mentioned that several studies have observed "clear evidence of cognitive function decrements in young children with mean or group BLLs between 2 and 8 µg/dL." Any soil screening, action or cleanup level developed based on previous BLL of 10 µg/dL may not be protective.

EPA's approach to evaluate potential lead risks is to limit exposure to residential and commercial soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated risk of no more than 5% of the population exceeding a 5 µg/dL blood lead level (BLL). This is based on updated scientific information and is in agreement with the Lead Technical Review Workgroup's current support for using a BLL of 5 µg/dL as the level of concern in the Integrated Exposure Uptake Biokinetic Model (IEUBK) and Adult Lead Methodology (ALM). A target BLL of 5 µg/dL reflects current scientific literature on lead toxicology and epidemiology that provides evidence that the adverse health effects of lead exposure do not have a threshold. Using updated default IEUBK and ALM parameters at a target BLL of 5 µg/dL, site-specific lead soil screening levels (SLs) of 200 ppm and 1,000 ppm are developed for residential and commercial/industrial exposures, respectively.

EPA's 2017 OLEM memorandum, "Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters" (OLEM Directive 9285.6-56), provides updates on the default baseline blood lead concentration and default geometric standard deviation input parameters for the Adult Lead Methodology. These updates are based on the analysis of the NHANES 2009-2014 data, with recommended updated values for baseline blood lead concentration being 0.6 µg/dL and geometric standard deviation being 1.8.

The 1989 EA for the Site identified lead as a COC in the ROD based on a BLL of 10 µg/dL. Following the Region 1 Lead Strategy, existing soil data was screened against 1,000 ppm. Although the EA, which used data collected in the mid-1980s, showed some high detections of lead prior to EPA removal actions, post-removal sampling indicated that lead levels in soil were below the commercial screening level of 1,000 ppm. Based on this available data, there is no unacceptable risk from lead in soil, therefore no further remedial work is currently necessary. However, if land use were to change in the future the lead issue may need to be re-visited.

- ***Polycyclic Aromatic Hydrocarbons (PAHs)*** *- cancer and non-cancer toxicity values*

On January 19, 2017, EPA issued revised (less carcinogenic) cancer toxicity values and new non-cancer toxicity values for benzo(a)pyrene. Benzo(a)pyrene did not have non-cancer toxicity values prior to January 19, 2017. Benzo(a)pyrene is now considered to be carcinogenic by a mutagenic mode of action; therefore, cancer risks must be evaluated for different human developmental stages using age dependent potency adjustment factors (ADAFs) for different age groups. The cancer potency of other carcinogenic PAHs is adjusted by the use of relative potency factors (RPFs), which are expressed relative to the potency of benzo(a)pyrene. The non-cancer effects of benzo(a)pyrene were not evaluated in the past due to the absence of non-cancer values.

The 1989 EA and subsequent Five-Year Reviews calculated risk based on total carcinogenic PAH concentrations in combination with a benzo(a)pyrene CSF. This methodology assumes that the reported

total carcinogenic PAH concentrations represent carcinogenic PAHs of equivalent potency to benzo(a)pyrene, which may overestimate risk. For the 2018 Five-Year Review, risks to trespassers, commercial workers, and construction workers were re-calculated, and the results are presented in tables in Appendix D. The purpose of these calculations was to re-evaluate the risk from exposure to carcinogenic PAHs, as well as a few other chemicals, due to updated toxicity information and exposure assumptions. These calculations indicate that the risks to commercial worker, construction worker, and trespasser fall within EPA's acceptable range, however more data may be needed to confirm protectiveness prior to any land use changes or potential redevelopment.

The calculated potential risks for carcinogenic PAHs are:

Risk for older child trespasser exposure to carcinogenic PAHs = 1.04E-05
Risk for commercial/industrial worker exposure to carcinogenic PAHs = 1.21E-05
Risk for construction worker exposure to carcinogenic PAHs = 5.61E-07

Changes in Risk Assessment methods:

Since the previous 2013, Five-Year Review, EPA has updated some exposure factors and toxicity values, which may result in a different calculated risk than the EA.

- *2014 OSWER Directive on the Update of Standard Default Exposure Factors*

In 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates. http://www.epa.gov/oswer/riskassessment/superfund_hh_exposure.htm (items # 22 and #23 of this web link). Many of these exposure factors differ from those used in the Endangerment Assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals. (Reference: USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6, 2014.) This change is not expected to affect the protectiveness of the remedy at the Site.

- Most current Risk Screening Levels (RSLs) tables

The RSLs are updated twice/year and the most up-to-date tables are available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/. Although some of the toxicity values have been updated since the last Five-Year Review, these changes in the RSL tables do not impact the protectiveness of the remedy.

Although calculated risks at the Site may differ from those previously estimated, the revised methodologies described in this section are not expected to affect the protectiveness of the remedy. A review of Site information finds that these updates do not call into question the protectiveness of the remedy.

Expected Progress Towards Meeting RAOs

The following is a summary of the RAOs for the remedy that were established in the 1985 ROD with a brief assessment of the progress that has been made towards meeting these objectives.

The ROD identified the following RAOs based on the information in the RI:

- Minimize the potential for direct contact with surface soil; and
- Minimize the potential for off-site migration of hazardous chemicals.

Minimize the potential for direct contact with surface soil: The tank removal and disposal, excavation and removal of contaminated soils, and backfilling and covering of tank bermed areas with 6 to 12 inches of clean fill have reduced potential for direct contact with contaminated surface soil.

Minimize the potential for off-site migration of hazardous chemicals: The tank removal and disposal, excavation and removal of contaminated soils, and backfilling and covering of tank bermed areas with 6 to 12 inches of clean fill have reduced off-site migration of hazardous chemicals.

These excavation and soil covering remedial actions are reinforced by a recorded deed restriction, which allows unrestricted redevelopment for commercial/industrial uses, but otherwise requires an updated risk assessment before redevelopment is allowed for certain restricted uses, namely single or multi-unit residential, school facilities, hotel/motel, community-related, and recreational uses.

QUESTION C: Has any **other** information come to light that could call into question the protectiveness of the remedy?

Question C Summary:

No, no additional information was found that would effect the current protectiveness of the remedies at the Site. The Site has not been impacted by climate change or any natural disasters, i.e., sea level rise, changes in precipitation, floods, hurricanes, etc.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None. No issues were identified for OU1 or for OU2 in this 2018 FYR

OTHER FINDINGS

Although there were no issues identified in this 2018 FYR, the following findings were made while conducting the FYR and will help to facilitate the reuse of the property; but they do not affect current and/or future protectiveness:

- It was recommended, to the property owner, that it notify EPA and MassDEP and submit a reuse/redevelopment plan for the Site prior to beginning any redevelopment of the property.
- The five monitoring wells were located during the 2018 Site inspection and the wells appeared to be intact and in good condition, however, they were not locked. Although the wells are not

needed for the Site remediation any longer, EPA notes their unlocked condition as an issue to watch in case site circumstances change and the wells need to be secured at a future time.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: 1 & 2	*Protectiveness Determination:* Protective	6/26/2018
Protectiveness Statement: *The remedy at the Plymouth Harbor, Cannon Engineering Corporation (CEC) Superfund Site is protective of human health and the environment. This is supported by the fact that the 2018 re-evaluation of the risks determined that there are no unacceptable risks to an older child trespasser, or to a commercial/industrial worker, or to a construction worker at the Site.*		

VIII. NEXT REVIEW

The next Five-Year Review report for the the Plymouth Harbor/Cannon Engineering Corp. Superfund Site is required five years from the completion date of this review; which will be on or before **July 3, 2023.**

APPENDICES

Figure 1 – Site Locus
Figure 2 – Site Map

Appendix A – Town of Plymouth Zoning Map, 2012
Appendix B – 1992 - Deed Restriction/Institutional Contorls
Appendix C - 2018 - EPA Press Release
Appendix D – 2018 - EPA Re-evaluation of Risk
Appendix E – List of Documents & References Utilized for this FYR

Figure 1

Quadrangle Location

USGS TOPOGRAPHIC MAP

PLYMOUTH, MASSACHUSETTS
1968; (Photo-revised 1984)

APPROXIMATE SCALE
1" = 2,000 FEET

FIGURE 1	PLYMOUTH HARBOR, CANNONS ENGINEERING CORPORATION SUPERFUND SITE PLYMOUTH, MASSACHUSETTS SITE LOCUS PLAN	Nobis Nobis Engineering, Inc. 430 South Union Street Building 2, Suite 207 Lawrence, MA 01843 (978) 683-0801 www.nobisengineering.com	DATE: 07/15/08 REV. 00 PROJECT NO. 80034 FILE NAME: Locus Plan.MXD PREPARED BY: D. McGRATH CHECKED BY: S. HARDING	N	Graphic Obtained From MASSGIS

Figure 2

FIGURE 2	PLYMOUTH HARBOR, CANNONS ENGINEERING CORPORATION SUPERFUND SITE PLYMOUTH, MASSACHUSETTS SITE LAYOUT PLAN	Nobis Engineering, Inc. 439 South Union Street Building 2, Suite 207 Lawrence, MA 01843 (978) 683-0091 www.nobisengineering.com	DATE: 08/20/08 REV. 01 PROJECT NO. 80034 FILE NAME: Layout_Plan.MXD PREPARED BY: D. McGRATH CHECKED BY: S. HARDING Feet 0 50 100	LEGEND Overburden Monitoring Well Intact Fence Snow Fence Tank Berms Property Boundary Tidal Stream Graphic Obtained From MASSGIS

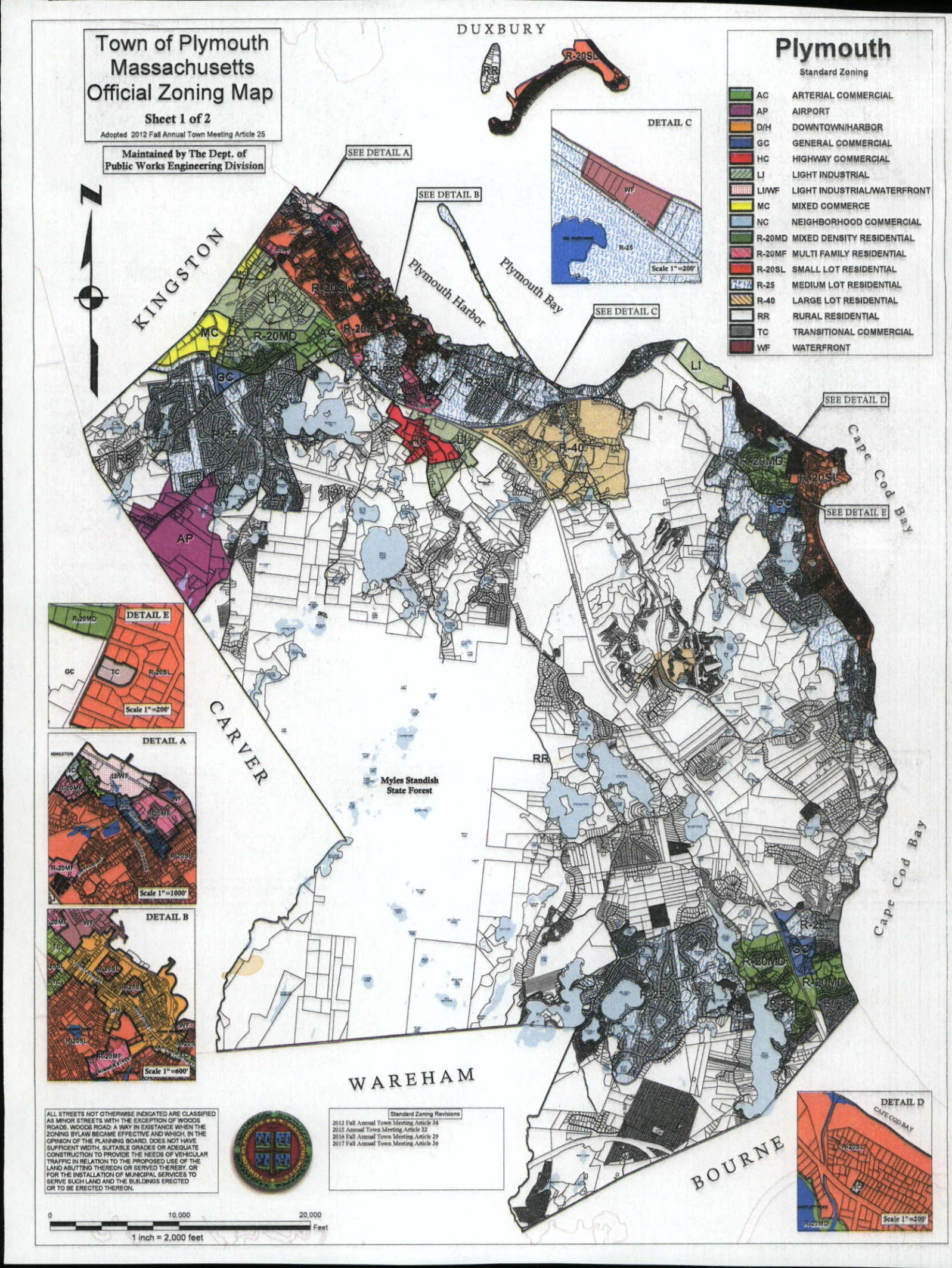
Appendix A

Town of Plymouth Massachusetts Official Zoning Map

Sheet 1 of 2

Adopted 2012 Fall Annual Town Meeting Article 25

Maintained by The Dept. of Public Works Engineering Division



ALL STREETS NOT OTHERWISE INDICATED ARE CLASSIFIED AS MINOR STREETS WITH THE EXCEPTION OF WOODS ROADS. WOODS ROAD: A WAY IN EXISTANCE WHEN THE ZONING BYLAW BECAME EFFECTIVE AND WHICH, IN THE OPINION OF THE PLANNING BOARD, DOES NOT HAVE SUFFICENT WIDTH, SUITABLE GRADES OR ADEQUATE CONSTRUCTION TO PROVIDE THE NEEDS OF VEHICULAR TRAFFIC IN RELATION TO THE PROPOSED USE OF THE LAND ABUTTING THEREON OR SERVED THEREBY, OR FOR THE INSTALLATION OF MUNICIPAL SERVICES TO SERVE SUCH LAND AND THE BUILDINGS ERECTED OR TO BE ERECTED THEREON.

Standard Zoning Revisions

2012 Fall Annual Town Meeting Article 34
2015 Annual Town Meeting Article 32
2016 Fall Annual Town Meeting Article 29
2017 Fall Annual Town Meeting Article 36

0 10,000 20,000 Feet

1 inch = 2,000 feet

Appendix B

592-194

Received & Rec'd
PLYMOUTH COUN
REGISTRY OF DE
21 APR 1992 03
JOHN D. RIORD
REGISTER

DECLARATION OF RESTRICTIONS

Reference is made to the following facts:

A. Arthur B. Blackett, Konrad Gesner and Francis C. Rogerson, Jr., not individually but as trustees of Salt Water Trust ("SWT") under declaration of trust dated June 2, 1966, recorded with the Plymouth County Registry of Deeds ("Deeds") at Book 3568, Page 228, as amended, own certain land situated in the Town of Plymouth, Massachusetts, as more particularly shown as "Restricted Area" on a plan entitled "Plan of Restricted Area in Plymouth, Massachusetts" prepared for Arthur B. Blackett, Konrad Gesner and Francis C. Rogerson, Jr., Trustees of Salt Water Trust by Hayward-Boynton and Williams, Inc., dated October 1, 1991, to be recorded herewith (the "Plan"), containing approximately 2.73 acres (the "Premises").

B. The Premises constitutes the Cannons Engineering Corporation - Plymouth Harbor Superfund Site which was listed on the National Priorities List of hazardous substances sites pursuant to Section 105 of Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. § 9605, on September 8, 1983.

C. The Premises is the subject of a partial consent decree entered by the United States District Court for the District of Massachusetts in the case of United States v. Cannons Engineering Corporation, et al., 720 F. Supp. 1027 (D. Mass. 1989), aff'd,

mail!

John G. Casagrande, Jr.
Palmer & Dodge
One Beacon St.
Boston, MA 02108

899 F.2d 79 (1st Cir. 1990).

D. The United States Environmental Protection Agency ("USEPA"), in consultation with the Massachusetts Department of Environmental Protection ("MADEP"), has selected and overseen the implementation of response actions for the Site pursuant to CERCLA.

E. The response actions consisted in part of the removal of three storage tanks from the Premises and the sampling of soils from under those tanks, and the sampling of soils and groundwater on the Premises and of surface water and sediments off-Premises. Thereafter, the USEPA, in consultation with the MADEP, determined that removal and disposal of contaminated soil contaminated with oily materials and CERCLA hazardous substances was necessary. The contaminated soil was located inside the berm where storage tank #1 previously was situated and consisted of shallow soils, contaminated with oily materials and CERCLA hazardous substances to a depth of three to five feet.

NOW, THEREFORE, in order to protect the health, safety and welfare of the inhabitants of the Town of Plymouth, SWT hereby grants the following restrictions to the USEPA, its successors and assigns, and the MADEP, its successors and assigns, which inure to their benefit;

(1) The Premises shall not be used for any single-family or multiple-family residences, school facilities, hotel, motel, or recreational or community facilities (collectively, the "Restricted Uses") unless the terms of this paragraph (1)(a)

through (1)(d) have been complied with.

(a) Prior to using all or any portion of the Premises for any Restricted Uses, an evaluation (hereafter, "risk assessment") of the potential health risks of exposure to contaminated Premises soil due to the proposed Restricted Use shall be conducted by SWT or its successors or assigns, at the expense of SWT or its successors or assigns. The risk assessment shall be performed by persons(s) experienced in the performance of risk assessments and, unless otherwise directed by USEPA in consultation with MADEP, shall be conducted in accordance with CERCLA, the National Contingency Plan ("NCP"), 40 C.F.R. Part 300, and USEPA and Massachusetts guidance in effect at the time the risk assessment is performed. A full description of the proposed Restricted Use, including all proposed development plans, must be submitted to USEPA and MADEP along with the risk assessment.

(b) Within 120 days of receipt by USEPA and MADEP of the risk assessment and the description of the proposed Restricted Use, USEPA, in consultation with MADEP, shall determine in writing if the proposed Restricted Use would pose an unacceptable risk of exposure to contaminated Premises soils, or shall inform SWT or its successors or assigns of a reasonable additional period of time which USEPA and MADEP require to review the

risk assessment and description of the proposed Restricted Use. Failure by USEPA to respond within 120 days shall not constitute a determination authorizing SWT, or its successors or assigns, to proceed with its plans to use the Premises for such proposed Restricted Use.

(c) If USEPA, in consultation with MADEP, determines that SWT, or its successors or assigns, may proceed with its plans to use the Premises for a proposed Restricted Use, it shall so certify, in a form recordable by SWT or its successors or assigns, and such portion of the Premises proposed to be used for a Restricted Use may be used for such purpose without limitation or restriction, effective upon the recording of such certification in Deeds.

(d) After reviewing the risk assessment and the description of the proposed Restricted Use, if USEPA, in consultation with MADEP, determines that the proposed Restricted Use would pose an unacceptable risk of exposure to contaminated Premises soils, such portion of the Premises proposed to be used for a Restricted Use thereafter may be used for such purpose only after a response action to reduce such potential unacceptable health risk has been authorized by USEPA, in consultation with MADEP, and performed and completed by SWT or its successors or assigns, at the expense of

SWT or its successors or assigns. Such action shall be performed in accordance with CERCLA, the NCP, and all other applicable federal and state laws and regulations. Following completion of such response action, SWT or its successors or assigns shall submit to USEPA and MADEP a written report signed by a professional engineer certifying that such action has been fully performed and completed. Within 120 days after receipt of such written report and certification, USEPA, in consultation with MADEP, shall certify, in a form recordable by SWT or its successors or assigns, one of the following: (i) that the portion of the Premises proposed to be used for such Restricted Use may be used without limitation or restriction, effective upon the recording of such certification in Deeds; (ii) that additional work must be performed in order to complete the response action; or (iii) that USEPA and MADEP require a reasonable additional period of time or additional information in order to review the performance of the response action. Failure by USEPA to provide such certification within 120 days shall not constitute a determination that the portion of the Premises proposed to be used for such Restricted Use may be used without limitation or restriction.

(2) Nothing contained in this Declaration of Restrictions is intended to limit or restrict or otherwise effect use of the

Premises for any commercial, industrial or other use now or hereafter permitted under Section 401.16 (Light Industrial/ Waterfront) or other applicable sections of the Town of Plymouth, Massachusetts Zoning Bylaw, as amended, except for the Restricted Uses as provided above and as provided in paragraph (3) below.

(3) SWT or its successors or assigns shall inspect, maintain, and repair the fence constructed on the Premises as part of the response actions, which is shown on the Plan, until USEPA, in consultation with MADEP, certifies that no further inspection, maintenance, or repair of all or a portion of the fence is required; provided, however, that USEPA, in consultation with MADEP, shall agree to so certify upon request in connection with any use of the Premises for any purposes allowed hereunder other than Restricted Uses wherever such use, in the opinion of USEPA in consultation with MADEP, would not significantly increase the potential health risks of exposure to contaminated Premises soil due to the proposed use. Within 30 days after receipt of a request for such certification, USEPA, in consultation with MADEP, shall grant or deny the requested certification or shall inform SWT or its successors or assigns of a reasonable additional period of time which USEPA and MADEP require to review the request for such certification. Failure by USEPA to respond to such request within 30 days shall not constitute a certification that no further inspection, maintenance, or repair of the fence is required.

(4) These restrictions shall run with the land.

(5) These restrictions hereby imposed are in gross and are not for the benefit of or appurtenant to any particular land but are for the benefit of and enforceable by the USEPA, its successors and assigns, and MADEP, its successors and assigns.

(6) These restrictions shall be enforceable by the United States and the Commonwealth of Massachusetts, pursuant to the provisions of G.L. c. 184, § 26 et seq., or otherwise, or by either one acting singly. A notice of restrictions, in compliance with law, shall be recorded before the expiration of thirty (30) years from the date of this Declaration of Restrictions and shall name the person or persons appearing of record who own the Premises at the time of recording; and in the case of any such recording, a subsequent notice of rest iction shall be recorded within twenty (20) years after the recording of any prior notice of restriction until the period of these restrictions has elapsed. Any grantee hereby covenants for itself, its successors and assigns, to timely execute, and record such documents and take such action, including the surrender of certificate of title, if any, for notation thereon, as shall be necessary to cause such notice of restriction to be effective and enforceable under the then applicable G.L. c. 184, § 26, et seq. The grantor further covenants for itself, its successors and assigns, to include the restrictions and protective covenants herein set out, in each lease and sublease of the Premises or any portion thereof.

No documentary stamps are affixed hereto as none are

required by law as this conveyance is made without monetary consideration.

Executed as a sealed instrument this 16th day of April, 1992.

SALT WATER TRUST

By _____
Arthur B. Blackett, Trustee

By _____
Konrad Gesner, Trustee

By _____
Francis C. Rogerson, Jr., Trustee

COMMONWEALTH OF MASSACHUSETTS

Plymouth, ss. April, 1992

On this 16th day of April, 1992, before me appeared Arthur B. Blackett, Konrad Gesner and Francis C. Rogerson, Jr., to me personally known, who, being by me duly sworn, did say that they are Trustees of Salt Water Trust, and that said instrument was signed on behalf of Salt Water Trust as their free act and deed.

_____
Notary Public
My commission expires: June 5, 1998

Rec'd April 21 19 92 at 3:24 PM and recorded.
The foregoing is a true copy from the
Plymouth County Registry of Deeds,
Instrument # 40583
Attest:
_____ Register

Appendix C

U.S. ENVIRONMENTAL PROTECTION AGENCY
NEWS RELEASE
WWW.EPA.GOV/NEWSROOM

CONTACT: Emily Bender: bender.emily@epa.gov, 617-918-1037

EPA Begins Reviews of 24 New England Site Cleanups during Current Fiscal Year

Boston - EPA plans to conduct comprehensive reviews of site cleanups at 24 National Priorities List Sites (Superfund Sites), including two Federal Facilities, across New England by performing required Five-Year Reviews of sites. The Superfund program, a federal program established by Congress in 1980, investigates and cleans up the most complex, uncontrolled or abandoned hazardous waste sites in the country and endeavors to facilitate activities to return them to productive use.

"Under Administrator Pruitt, EPA has a renewed focus to make progress on Superfund sites across the country," said EPA regional administrator Alexandra Dunn. "We are dedicated to addressing risk at sites, which is why it's important for us to conduct these regular reviews of previously completed cleanups to make sure these remedies remain protective of human health and the environment."

EPA is actively involved in Superfund studies and cleanups at 123 sites across New England. There are many phases of the Superfund cleanup process including considering future use and redevelopment at sites and conducting post cleanup monitoring of sites. EPA must ensure the remedy is protective of public health and the environment and any redevelopment will uphold the protectiveness of the remedy into the future.

The Superfund Sites and Federal Facilities where EPA will begin work on Five- Year Reviews in 2018 are below. Please note, the web links listed below provide detailed information on site status and past assessment and cleanup activity. Once the Five-Year Review is complete, a report of its findings will be posted to this website. The web link also provides contact information for the EPA Project Manager and Community Involvement Coordinator at each site. Community members and local officials are invited to contact EPA with any comments or concerns about a Superfund site.

Five-Year Reviews being initiated in FY18

Superfund Sites:

Barkhamsted- New Hartford Landfill: Barkhamsted, CT

Beacon Heights Landfill: Beacon Falls, CT

Laurel Park, Inc: Naugatuck Borough, CT

Yaworski Waste Lagoon: Canterbury, CT

Industri-Plex: Woburn, MA (to be completed in Fiscal Year 2019)

Iron Horse Park: Billerica, MA

Nyanza Chemical Waste Dump: Ashland, MA (to be completed in Fiscal Year 2019)

Plymouth Harbor/Cannon Engineering Corporation: Plymouth, MA

Re-Solve, Inc: Dartmouth, MA

Sullivan's Ledge: New Bedford, MA

McKin Co: Gray, ME

West Site/Hows Corners: Plymouth, ME

Kearsarge Metallurgical Corp: Conway, NH

Keefe Environmental Services: Epping, NH

Mottolo Pig Farm: Raymond, NH

Ottati & Goss/ Kingston Steel Drum: Kingston, NH (to be completed in Fiscal Year 2019)

South Municipal Water Supply Well: Peterborough, NH

Tibbetts Road: Barrington, NH

Central Landfill: Johnston, RI

Picillo Farm: Coventry, RI

Western Sand & Gravel: Burrillville, RI

Old Springfield Landfill: Springfield, VT

Federal Facilities:

Otis Air National Guard Base: Falmouth, MA

Davisville Naval Construction Battalion Center: North Kingstown, RI

Appendix D

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 Post Office Square, Suite 100
BOSTON, MA 02109-3912

Date: April 6, 2018

From: Courtney Carroll, Human Health Risk Assessor, Technical & Enforcement Support Section

To: Derrick Golden, RPM, Office of Site Remediation and Restoration

Subject: Re-calculations of risks to trespassers, commercial workers and construction workers for the Cannons Engineering Plymouth Harbor 2018 Five-Year Review

The purpose of this memorandum is to provide a re-calculation of risks for the Cannons Engineering Corporation, Plymouth Harbor Superfund Site, Plymouth, Massachusetts as part of the 2018 Five-Year Review. Risk computations were done using total polycyclic aromatic hydrocarbon (PAHs) concentrations from the mid-1980's sampling. No newer data has been collected. Following the completion of EPA removal actions and data collection in the 1980's, the remaining subsurface contamination was covered by clean fill, therefore calculations from the original PAH data are likely to overestimate exposures to commercial workers, construction workers or trespassers who do not disturb the soil.

The original PAH data collected during the mid-1980's reflects post-removal composite sampling and included individual PAH concentrations (as opposed to total PAHs). This risk re-evaluation used updated toxicity values and exposure parameters to run the calculations used for the previous risk evaluation, which evaluated cancer risks and non-cancer risks for trespassers, commercial workers and construction workers. The 1989 Endangerment Assessment (EA) identified these as the most likely receptors to be exposed to soil contamination, and dermal contact and incidental ingestion as the only two exposure pathways.

As part of the 1998 Second Five-Year Review, risk computations were performed using the highest composite total carcinogenic PAH concentrations from the mid-1980's sampling and the scenarios as defined in the 1989 EA. Similarly, the Third, Fourth, and Fifth Five-Year Reviews included updated risk calculations based on total carcinogenic PAH concentrations. These calculations assumed that the total carcinogenic PAH concentration reflected the most toxic PAH, benzo(a)pyrene. The Third, Fourth, and Fifth Five-Year Reviews also incorporated changes to dermal risk assessment guidance (*The Risk Assessment Guidance for Superfund: Volume 1 Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA, 2004) and the EPA's Guidelines for Carcinogen Risk Assessment (EPA, 2005a) and *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (*EPA, 2005b*)*. The latter provided new direction on evaluating cancer risks to children from exposure to carcinogens such as carcinogenic PAHs, that act via a mutagenic mode of action.

In addition to carcinogenic PAHs, the primary contaminants of concern at this site have included lead. Since the previous Five-Year Review, EPA Region 1 has developed a lead strategy which is described in

detail under the Technical Assessment Question B section of this 2018 Five-Year Review. According to the Region 1 Lead Strategy, the existing post-removal soil data for lead was compared against the commercial screening level of 1,000 ppm. Lead levels following removal actions were found to be below the commercial screening level and therefore do not pose a public health hazard.

The site is currently vacant and undeveloped. The presumed receptors for this site are a commercial worker, construction worker, and an older child trespasser. To update risk calculations for commercial workers and construction workers, reviews utilized recommended default exposure frequencies and exposure durations that have been updated by EPA since the 1989 EA, as well as updated toxicity information. The child trespasser does not have any default exposure parameters and requires site-specific parameters. For this review, the site-specific parameters used are consistent with those used in prior calculations.

The dermal risk assessment guidance (*The Risk Assessment Guidance for Superfund: Volume 1 Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA, 2004) has not been updated since the last Five-Year Review, however EPA recommendations on the selection of soil adherence factors have shifted slightly. These changes were incorporated in the revised risk calculations. Though some of the exposure assumptions and toxicity values have changed since the previous Five-Year Review, these changes do not result in an unacceptable risk or alter the protectiveness of the remedy.

The trespasser scenario exposure assumptions and rates are presented below.

To address the older child trespasser scenario, which used site-specific parameters, cancer risk computations are provided in Table 1 for older child trespassers potentially exposed via dermal contact and ingestion pathways. Table 2 presents non-cancer hazard index calculations. These risk computations use the highest composite concentrations for each contaminant from the mid-1980's sampling as shown on the tables.

<u>Incidental Soil Ingestion Exposure Assumptions:</u>
Older child soil ingestion rate: 100 mg/day
Older child exposure frequency: 78 days/year
Older child exposure duration: 10 years
Older child body weight: 39 kg

<u>Dermal Contact Exposure Assumptions:</u>
Dermal absorption PAHs: 0.13
Older child exposed surface area: 4,184 cm^2
Older child soil adherence factor: 0.2 mg/cm^2-day
Older child exposure frequency: 78 days/year
Older child exposure duration: 10 years
Older child body weight: 39 kg

Equations used to calculate intake and risks, and the chemical-specific absorption factors, age-dependent adjustment factor (ADAF), and cancer slope factors for the trespasser scenario are presented in Table 1. Equations used to calculate intake and non-cancer hazard indices, and the chemical-specific absorption factors, and reference doses are presented in Table 2.

The commercial worker scenario exposure assumptions and rates are presented below.

To address the commercial worker scenario, cancer risk computations are provided in Table 3 for commercial workers potentially exposed via dermal contact and ingestion pathways. Table 4 presents non-cancer hazard index calculations. These risk computations use the highest composite concentrations for each contaminant from the mid-1980's sampling as shown on the tables.

Incidental Soil Ingestion Exposure Assumptions:
Commercial worker ingestion rate: 100 mg/day
Commercial worker exposure frequency: 250 days/year
Commercial worker exposure duration: 25 years
Commercial worker body weight: 80 kg

Dermal Contact Exposure Assumptions:
Dermal absorption PAHs: 0.13
Commercial worker surface area: 3,300 cm^2
Commercial worker soil adherence factor: 0.2 mg/cm^2-day
Commercial worker exposure frequency: 250 days/year
Commercial worker exposure duration: 25 years
Commercial worker body weight: 80 kg

Equations used to calculate intake and risks, and the chemical-specific absorption factors, and cancer slope factors are presented in Table 3. Equations used to calculate intake and non-cancer hazard indices, and the chemical-specific absorption factors, and reference doses are presented in Table 4.

The construction worker scenario exposure assumptions and rates are presented below.

To address the construction worker scenario, cancer risk computations are provided in Table 5 for constructions workers potentially exposed via dermal contact and ingestion pathways and Table 7 for construction workers potentially exposed via inhalation of dust. Table 6 presents non-cancer hazard index calculations. These risk computations use the highest composite concentrations for each contaminant from the mid-1980's sampling as shown on the tables.

Incidental Soil Ingestion Exposure Assumptions:
Construction worker ingestion rate: 330 mg/day
Construction worker exposure frequency: 130 days/year
Construction worker exposure duration: 1 year
Construction worker body weight: 80 kg

Dermal Contact Exposure Assumptions:
Dermal absorption PAHs: 0.13
Construction worker exposed surface area: 3,300 cm^2
Construction worker soil adherence factor: 0.2 mg/cm^2-day
Construction worker exposure frequency: 130 days/year
Construction worker exposure duration: 1 year
Construction worker body weight: 80 kg

Inhalation of Dust Exposure Assumptions:
Particulate Emission Factor: 1.4E+06 m^3/kg
Construction worker exposure time: 8 hours/day
Construction worker exposure frequency: 130 days/year
Construction worker exposure duration: 1 year

Equations used to calculate intake and risks for the ingestion and dermal contact pathways and the chemical-specific absorption factors, and cancer slope factors are presented in Table 5. Equations used to calculate average daily exposure concentrations and risks for the inhalation of the dust pathway and chemical-specific inhalation unit risk factors are presented in Table 7. Equations used to calculate intake and non-cancer hazard indices for the ingestion and dermal contact pathways and the chemical-specific absorption factors and reference doses are presented in Table 6. Non-cancer hazard indices for the inhalation pathway were not calculated because of the absence of inhalation reference concentrations for the PAHs.

Based on the risk estimates presented below, the older child trespasser, commercial worker, and construction worker exposures are within EPA's target risk range.

References:
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EPA, 2005b. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, U.S. Environmental Protection Agency, Washington, DC, EPA/630/R-03/003F, March 2005.

Table 1. Older Child Trespasser Soil Cancer Risk - Plymouth Harbor

COPCs	Intake (mg/kg-d)	Total Cancer Risk	Max Concentration (mg/kg)	EF (d/yr)	ED (yrs)	IR (mg/day)	Oral ABS (unitless)	SA (cm^2)	AF (mg/cm^2-day)	Dermal ABS (unitless)	BW (kg)	AT (yrs)	CSF $(mg/kg\text{-}d)^{-1}$	CF mg/kg	ADAF (unitless)
Benz(a)anthracene	2.61E-06	**7.84E-07**	16	78	10	100	1	4184	0.2	0.13	39	70	1.0E-01	1.00E+06	3
Benzo(a)pyrene	2.29E-06	**6.86E-06**	14	78	10	100	1	4184	0.2	0.13	39	70	1.0E+00	1.00E+06	3
Benzo(b)fluoranthene	4.58E-06	**1.37E-06**	28	78	10	100	1	4184	0.2	0.13	39	70	1.0E-01	1.00E+06	3
Benzo(k)fluoranthene	1.34E-06	**4.02E-08**	8.2	78	10	100	1	4184	0.2	0.13	39	70	1.0E-02	1.00E+06	3
Chrysene	2.61E-06	**7.84E-09**	16	78	10	100	1	4184	0.2	0.13	39	70	1.0E-03	1.00E+06	3
Dibenz(a,h)anthracene	3.43E-07	**1.03E-06**	2.1	78	10	100	1	4184	0.2	0.13	39	70	1.0E+00	1.00E+06	3
Indeno(1,2,3-cd)pyrene	1.01E-06	**3.04E-07**	6.2	78	10	100	1	4184	0.2	0.13	39	70	1.0E-01	1.00E+06	3
Bis(2-ethylhexyl)phthalate	5.03E-06	**7.05E-08**	35	78	10	100	1	4184	0.2	0.1	39	70	1.4E-02	1.00E+06	1
Total cPAHs		**1.04E-05**													

Intake = (EPC*EF*ED*((IR*ABSoral)+(SA*AF*ABSdermal)))/(BW*AT*365*CF)

Cancer Risk = Intake*CSF*ADAF

Table 2. Older Child Trespasser Soil Non-cancer Risk - Plymouth Harbor

COPCs	Intake (mg/kg-d)	Total Hazard Quotient	Max Concentration (mg/kg)	EF (d/yr)	ED (yrs)	IR (mg/day)	Oral ABS (unitless)	SA (cm^2)	AF (mg/cm^2-day)	Dermal ABS (unitless)	BW (kg)	AT (yrs)	RfD (mg/kg-d)	CF mg/kg
2-Methylnapthalene	3.89E-05	**9.72E-03**	34	78	10	100	1	4184	0.2	0.13	39	10	4.0E-03	1.00E+06
Acenapthene	6.06E-06	**1.01E-04**	5.3	78	10	100	1	4184	0.2	0.13	39	10	6.0E-02	1.00E+06
Anthracene	1.26E-05	**4.19E-05**	11	78	10	100	1	4184	0.2	0.13	39	10	3.0E-01	1.00E+06
Benzo(a)pyrene	1.60E-05	**5.34E-02**	14	78	10	100	1	4184	0.2	0.13	39	10	3.0E-04	1.00E+06
Fluoranthene	4.69E-05	**1.17E-03**	41	78	10	100	1	4184	0.2	0.13	39	10	4.0E-02	1.00E+06
Fluorene	6.18E-06	**1.54E-04**	5.4	78	10	100	1	4184	0.2	0.13	39	10	4.0E-02	1.00E+06
Napthalene	4.00E-06	**2.00E-04**	3.5	78	10	100	1	4184	0.2	0.13	39	10	2.0E-02	1.00E+06
Pyrene	6.18E-05	**2.06E-03**	54	78	10	100	1	4184	0.2	0.13	39	10	3.0E-02	1.00E+06
Bis(2-ethylhexyl)phthalate	3.52E-05	**1.76E-03**	35	78	10	100	1	4184	0.2	0.1	39	10	2.0E-02	1.00E+06
Butylbenzylphthalate	3.02E-06	**1.51E-05**	3	78	10	100	1	4184	0.2	0.1	39	10	2.0E-01	1.00E+06
Diethyl Phthalate	3.52E-07	**4.40E-07**	0.35	78	10	100	1	4184	0.2	0.1	39	10	8.0E-01	1.00E+06
Dibutyl phthalate	5.13E-06	**5.13E-05**	5.1	78	10	100	1	4184	0.2	0.1	39	10	1.0E-01	1.00E+06

Intake = (EPC*EF*ED*((IR*ABSoral)+(SA*AF*ABSdermal)))/(BW*AT*365*CF)

Hazard Quotient = Intake/RfD

Commercial Worker Soil Cancer Risk - Plymouth Harbor

COPCs	Intake (mg/kg-d)	Total Cancer Risk	Max Concentration (mg/kg)	EF (d/yr)	ED (yrs)	IR (mg/day)	Oral ABS (unitless)	SA (cm^2)	AF (mg/cm^2-day)	Dermal ABS (unitless)	BW (kg)	AT (yrs)	CSF $(mg/kg\text{-}d)^{-1}$	CF mg/kg
Benz(a)anthracene	9.09E-06	9.09E-07	16	250	25	100	1	3300	0.2	0.13	80	70	1.0E-01	1.00E+06
Benzo(a)pyrene	7.95E-06	7.95E-06	14	250	25	100	1	3300	0.2	0.13	80	70	1.0E+00	1.00E+06
Benzo(b)fluoranthene	1.59E-05	1.59E-06	28	250	25	100	1	3300	0.2	0.13	80	70	1.0E-01	1.00E+06
Benzo(k)fluoranthene	4.66E-06	4.66E-08	8.2	250	25	100	1	3300	0.2	0.13	80	70	1.0E-02	1.00E+06
Chrysene	9.09E-06	9.09E-09	16	250	25	100	1	3300	0.2	0.13	80	70	1.0E-03	1.00E+06
Dibenz(a,h)anthracene	1.19E-06	1.19E-06	2.1	250	25	100	1	3300	0.2	0.13	80	70	1.0E+00	1.00E+06
Indeno(1,2,3-cd)pyrene	3.52E-06	3.52E-07	6.2	250	25	100	1	3300	0.2	0.13	80	70	1.0E-01	1.00E+06
Bis(2-ethylhexyl)phthalate	1.78E-05	2.49E-07	35	250	25	100	1	3300	0.2	0.1	80	70	1.4E-02	1.00E+06

Intake = (EPC*EF*ED*((IR*ABSoral)+(SA*AF*ABSdermal)))/(BW*AT*365*CF)
Cancer Risk = Intake*CSF

Commercial Worker Soil Non-cancer Risk - Plymouth Harbor

COPCs	Intake (mg/kg-d)	Total Hazard Quotient	Max Concentration (mg/kg)	EF (d/yr)	ED (yrs)	IR, (mg/day)	Oral ABS (unitless)	SA (cm^2)	AF (mg/cm^2-day)	Dermal ABS (unitless)	BW (kg)	AT (yrs)	RfD (mg/kg-d)	CF mg/kg
2-Methylnapthalene	5.41E-05	1.35E-02	34	250	25	100	1	3300	0.2	0.13	80	25	4.0E-03	1.00E+06
Acenapthene	8.43E-06	1.41E-04	5.3	250	25	100	1	3300	0.2	0.13	80	25	6.0E-02	1.00E+06
Anthracene	1.75E-05	5.83E-05	11	250	25	100	1	3300	0.2	0.13	80	25	3.0E-01	1.00E+06
Benzo(a)pyrene	2.23E-05	7.42E-02	14	250	25	100	1	3300	0.2	0.13	80	25	3.0E-04	1.00E+06
Fluoranthene	6.52E-05	1.63E-03	41	250	25	100	1	3300	0.2	0.13	80	25	4.0E-02	1.00E+06
Fluorene	8.59E-06	2.15E-04	5.4	250	25	100	1	3300	0.2	0.13	80	25	4.0E-02	1.00E+06
Napthalene	5.57E-06	2.78E-04	3.5	250	25	100	1	3300	0.2	0.13	80	25	2.0E-02	1.00E+06
Pyrene	8.59E-05	2.86E-03	54	250	25	100	1	3300	0.2	0.13	80	25	3.0E-02	1.00E+06
Bis(2-ethylhexyl)phthalate	4.97E-05	2.49E-03	35	250	25	100	1	3300	0.2	0.1	80	25	2.0E-02	1.00E+06
Butylbenzylphthalate	4.26E-06	2.13E-05	3	250	25	100	1	3300	0.2	0.1	80	25	2.0E-01	1.00E+06
Diethyl Phthalate	4.97E-07	6.22E-07	0.35	250	25	100	1	3300	0.2	0.1	80	25	8.0E-01	1.00E+06
Dibutyl phthalate	7.25E-06	7.25E-05	5.1	250	25	100	1	3300	0.2	0.1	80	25	1.0E-01	1.00E+06

Intake = (EPC*EF*ED*((IR*ABSoral)+(SA*AF*ABSdermal)))/(BW*AT*365*CF)
Hazard Quotient = Intake/RfD

Construction Worker Soil Cancer Risk - Plymouth Harbor

COPCs	Intake (mg/kg-d)	Total Cancer Risk	Max Concentration (mg/kg)	EF (d/yr)	ED (yrs)	IR (mg/day)	Oral ABS (unitless)	SA (cm^2)	AF (mg/cm^2-day)	Dermal ABS (unitless)	BW (kg)	AT (yrs)	CSF $(mg/kg\text{-}d)^{-1}$	CF mg/kg
Benz(a)anthracene	4.23E-07	4.23E-08	16	130	1	330	1	3300	0.2	0.13	80	70	1.0E-01	1.00E+06
Benzo(a)pyrene	3.70E-07	3.70E-07	14	130	1	330	1	3300	0.2	0.13	80	70	1.0E+00	1.00E+06
Benzo(b)fluoranthene	7.40E-07	7.40E-08	28	130	1	330	1	3300	0.2	0.13	80	70	1.0E-01	1.00E+06
Benzo(k)fluoranthene	2.17E-07	2.17E-09	8.2	130	1	330	1	3300	0.2	0.13	80	70	1.0E-02	1.00E+06
Chrysene	4.23E-07	4.23E-10	16	130	1	330	1	3300	0.2	0.13	80	70	1.0E-03	1.00E+06
Dibenz(a,h)anthracene	5.55E-08	5.55E-08	2.1	130	1	330	1	3300	0.2	0.13	80	70	1.0E+00	1.00E+06
Indeno(1,2,3-cd)pyrene	1.64E-07	1.64E-08	6.2	130	1	330	1	3300	0.2	0.13	80	70	1.0E-01	1.00E+06
Bis(2-ethylhexyl)phthalate	8.82E-07	1.23E-08	35	130	1	330	1	3300	0.2	0.1	80	70	1.4E-02	1.00E+06

Intake = {EPC*EF*ED*((IR*ABSoral)+(SA*AF*ABSdermal))}/(BW*AT*365*CF)
Cancer Risk = Intake*CSF

Construction Worker Soil Non-cancer Risk - Plymouth Harbor

COPCs	Intake (mg/kg-d)	Total Hazard Quotient	Max Concentration (mg/kg)	EF (d/yr)	ED (yrs)	IR (mg/day)	Oral ABS (unitless)	SA (cm^2)	AF (mg/cm^2-day)	Dermal ABS (unitless)	BW (kg)	AT (yrs)	RfD (mg/kg-d)	CF (mg/kg)
2-Methylnapthalene	7.19E-05	1.80E-02	34	130	1	330	1	3300	0.2	0.13	70	1	4.0E-03	1.00E+06
Acenapthene	9.81E-06	1.64E-04	5.3	130	1	330	1	3300	0.2	0.13	80	1	6.0E-02	1.00E+06
Anthracene	2.04E-05	6.79E-05	11	130	1	330	1	3300	0.2	0.13	80	1	3.0E-01	1.00E+06
Benzo(a)pyrene	2.59E-05	8.64E-02	14	130	1	330	1	3300	0.2	0.13	80	1	3.0E-04	1.00E+06
Fluoranthene	7.59E-05	1.90E-03	41	130	1	330	1	3300	0.2	0.13	80	1	4.0E-02	1.00E+06
Fluorene	1.00E-05	2.50E-04	5.4	130	1	330	1	3300	0.2	0.13	80	1	4.0E-02	1.00E+06
Napthalene	6.48E-06	3.24E-04	3.5	130	1	330	1	3300	0.2	0.13	80	1	2.0E-02	1.00E+06
Pyrene	1.00E-04	3.33E-03	54	130	1	330	1	3300	0.2	0.13	80	1	3.0E-02	1.00E+06
Bis(2-ethylhexyl)phthalate	6.17E-05	3.09E-03	35	130	1	330	1	3300	0.2	0.1	80	1	2.0E-02	1.00E+06
Butylbenzylphthalate	5.29E-06	2.64E-05	3	130	1	330	1	3300	0.2	0.1	80	1	2.0E-01	1.00E+06
Diethyl Phthalate	6.17E-07	7.71E-07	0.35	130	1	330	1	3300	0.2	0.1	80	1	8.0E-01	1.00E+06
Dibutyl phthalate	8.99E-06	8.99E-05	5.1	130	1	330	1	3300	0.2	0.1	80	1	1.0E-01	1.00E+06

Intake = {EPC*EF*ED*((IR*ABSoral)+(SA*AF*ABSdermal))}/(BW*AT*365*CF)
Hazard Quotient = Intake/RfD

Construction Worker Soil Non-cancer Risk - Plymouth Harbor

COPCs	Average Daily Concentration ($\mu g/m^3$)	Inhalation Cancer Risk	Max Soil Concentration (mg/kg)	EF (d/yr)	ED (yrs)	AT (yrs)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	ET (hr/d)	CF days/hr	Particulate Emission Factor days/hr	Concentration in Air ($\mu g/m^3$)
Benzo(a)anthracene	7.13E-03	4.28E-07	16	130	1	70	6.00E-05	8	0.042	1.40E+06	1.14E-02
Benzo(a)pyrene	6.24E-03	3.74E-06	14	130	1	70	6.00E-04	8	0.042	1.40E+06	1.00E-02
Benzo(b)fluoranthene	1.25E-02	7.49E-07	28	130	1	70	6.00E-05	8	0.042	1.40E+06	2.00E-02
Benzo(k)fluoranthene	3.65E-03	2.19E-08	8.2	130	1	70	6.00E-06	8	0.042	1.40E+06	5.86E-03
Chrysene	7.13E-03	4.28E-09	16	130	1	70	6.00E-07	8	0.042	1.40E+06	1.14E-02
Dibenz(a,h)anthracene	9.36E-04	5.62E-07	2.1	130	1	70	6.00E-04	8	0.042	1.40E+06	1.50E-03
Ideno(1,2,3-cd)pyrene	2.76E-03	1.66E-07	6.2	130	1	70	6.00E-05	8	0.042	1.40E+06	4.43E-03
Napthalene	1.56E-03	5.30E-08	3.5	130	1	70	3.40E-05	8	0.042	1.40E+06	2.50E-03

Average Daily Concentration = (Concentration in Air*ET*EF*ED*CF(0.042 days/hr))/AT
Concentration in Air = Concentration in soil*PEF*CF(1,000 µg/mg)
Cancer Risk = Average Daily Concentration*IUR

Appendix E

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