FOURTH FIVE-YEAR REVIEW REPORT FOR MAYWOOD CHEMICAL CO. SUPERFUND SITE BERGEN COUNTY, NEW JERSEY

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
cpm	counts per minute
EMP	Environmental Monitoring Program
EPA	United States Environmental Protection Agency
DOE	United States Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
FUSRAP	Formerly Utilized Site Remedial Action Program
FYR	Five-Year Review
ICs	Institutional Controls
LUCIP	Land Use Control Implementation Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCW	Maywood Chemical Works
MFR	Memorandum for Record
MISS	Maywood Interim Storage Site
mrem/yr	millirem per year
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
O&M	Operation and Maintenance
OU	Operable Unit
pCi/g	picoCuries per gram
pCi/l	picoCuries per liter
PRAR	Post Remedial Action Report
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
ROD	Record of Decision
RPM	Remedial Project Manager
UMTRCA	Uranium Mine Tailings Radiation Control Act
USACE	United States Army Corps of Engineer
UU/UE	Unlimited Use and Unrestricted Exposure

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 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 FYR 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 fourth FYR for the Maywood Chemical Company Superfund Site ("Site"). The triggering action for this statutory review is the August 13, 2019 completion date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site is located in Maywood, Lodi and Rochelle Park, Bergen County, New Jersey, and has been divided into four Operable Units (OUs) to systematically address the contamination by responsible entity and media type, as follows: OU1 – Non - Formerly Utilized Sites Remedial Action Program (FUSRAP) Soil and Source Areas; OU2 – FUSRAP Soil and Buildings; OU3 – FUSRAP Groundwater; and OU4 – Non-FUSRAP Groundwater. The OU1 and OU4 response actions are being undertaken by Stepan Company, a Potentially Responsible Party (PRP). OU2 and OU3 response actions are being undertaken by United States Army Corps of Engineers (USACE), as lead federal agency for the portions of the Site being addressed under FUSRAP. The OU1 and OU2 remedies are currently being implemented and are included in this FYR. The OU3 FUSRAP Groundwater Record of Decision (ROD) was signed in 2012 and the selected remedy relies heavily on OU2 being completed and is not included in this FYR. OU3 will be evaluated once all accessible source material is excavated. OU4 Non-FUSRAP Groundwater does not yet have a ROD and is not included in this FYR.

The Maywood Chemical Company Superfund Site FYR was led by Rupika Ketu, EPA Region 2, Remedial Project Manager (RPM). EPA Region 2 participants included: Dan Patel, RPM; Stephanie Vaughn, Mega Projects Section Supervisor; Lora Smith, Ph.D., Human Health Risk Assessor; Paul Zarella, Hydrogeologist; Shereen Kandil, Community Involvement Coordinator; Kathryn DeLuca, Assistant Regional Counsel; Elizabeth LaBlanc, Assistant Regional Counsel. The USACE and Stepan Company were notified of the initiation of the FYR. The review began on June 12, 2023.

Site Background

Site Location and Description

The Site consists of more than 90 industrial, residential, commercial and government properties contaminated by activities of the former Maywood Chemical Works (MCW) which began operations in the 1890s. The properties are in a highly developed, mixed-use area of northeastern New Jersey in the Boroughs of Maywood and Lodi and the Township of Rochelle Park.

The Site is actively used by industrial, commercial, residential, and municipal entities, except for one vacant commercial property, formerly occupied by Sears, where soil remediation work was completed

as a series of interim measures in 2020 and 2021. Redevelopment plans for this property are being evaluated. Current mixed land uses are expected to continue. The Site is located approximately 12 miles north-northwest of New York City and 13 miles northeast of Newark, New Jersey (Figure 1). A Site map is shown on Figure 2.

Waste and residues associated with radioactive thorium and chemical manufacturing processes were generated by the former MCW. The 30-acre MCW property was purchased by Stepan Company in 1959. Wastes from manufacturing processes were generally stored in open piles and retention ponds. Some wastes migrated off the property through two primary mechanisms: natural drainage and flooding events associated with the former Lodi Brook, which originated on the MCW property, and the use of the contaminated soils from the MCW as fill. Stepan Company had a Nuclear Regulatory Commission (NRC) license for the storage of thorium-bearing materials in Burial Pits 1, 2, and 3 on their property.

Site History

In October 1980, the New Jersey Department of Environmental Protection (NJDEP) investigated a citizen complaint about radioactive contamination at an area near Route 17 in Maywood and Rochelle Park, New Jersey. From 1980 through 1983, radiological surveys and sampling were performed in the area by NJDEP, EPA and U.S. Department of Energy (DOE). These studies revealed extensive radionuclide contamination and were the basis for the Site being included on the National Priorities List (NPL) in 1983.

Congress assigned the site to the DOE in 1984. DOE then placed the site in its FUSRAP program. EPA's 1986 study of chemical, non-radioactive pollutants indicated the presence of elevated concentrations of volatile organic compounds, semi-volatile organic compounds, metals, pesticides, and other hazardous substances. In conjunction with DOE's studies and investigations, EPA collected samples of soil and groundwater on the Stepan Company property in late 1987 through the spring of 1988 that indicated the presence of radiological contaminants in the soil and non-radiological contaminants in the soil and groundwater.

A 1990 Federal Facilities Agreement between DOE and EPA defined the steps, responsibilities, and schedule for cleanup activities at Maywood. USACE assumed responsibility from DOE in October 1997 for cleaning up of the Maywood FUSRAP site. Stepan conducts cleanup actions under three EPA enforcement instruments.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Maywood Chemical Company		
EPA ID: NJD980529762		
Region: 2	**State:** NJ	**City/County:** Maywood, Lodi, Rochelle Park/Bergen County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: United States Environmental Protection Agency and Other Federal Agency ***[If "Other Federal Agency", enter Agency name]*:** U.S. Army Corps of Engineers
Author name (Federal or State Project Manager): Rupika Ketu
Author affiliation: EPA
Review period: 6/12/2023- 3/1/2024
Date of Site inspection: 9/28/2023
Type of review: Statutory
Review number: 4
Triggering action date: 8/13/2019
Due date *(five years after triggering action date)*: 8/13/2024

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

OU1

After the Site was listed on the NPL, the Stepan Company conducted a Remedial Investigation/Feasibility Study (RI/FS) under EPA oversight. RI activities were conducted to determine the nature and extent of chemical contamination on the Stepan Property, (formerly) Sears property, and the DeSaussure property. OU1 was found to be contaminated with a variety of chemicals and waste materials, including metals, VOCs and SVOCs from past chemical manufacturing and ore processing activities conducted at the former MCW. Due to the extent, volume, complexity and nature of contamination at the Site, soil and buried waste at the three properties were further divided into five distinct areas of concern, referred to as the Buried Container Area (BCA), Gypsum Material Area (GA), Leather Materials Area (LMA), Former Aromatics Area (FAA) and Central Tank Farm Area (CTFA). A human health risk assessment (HHRA) was conducted, and the results indicated that future ingestion of contaminated soil at the Site posed an unacceptable risk to human health. A baseline ecological risk assessment (BERA) was also conducted and indicated that the contaminated surface water and sediment at the Site may pose unacceptable risk to ecological receptors, primarily due to polycyclic aromatic hydrocarbons (PAHs), barium, lead, and cyanide.

Based on the results of the RI, the HHRA and the BERA, the following contaminants of concern (COCs) were identified for each OU1 area of concern:

- BCA
  - VOCs (1,1,1-trichloroethane, acetone, benzene, chloroform, ethylbenzene, methylene chloride, toluene, TCE and xylene);
  - SVOCs (benzo(a)anthracene and benzo(a)pyrene); and
  - Metals (arsenic, chromium, lead and lithium).
- GA
  - SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene); and
  - Metals (arsenic, barium, chromium, cyanide, lead and mercury).
- LMA
  - SVOCs (benzo(a)anthracene, benzo(a)pyrene and pentachlorophenol); and
  - Metals (arsenic, chromium and lead).
- FAA
  - VOCs (benzene and xylene).
- CTFA
  - VOCs (acetone, benzene, toluene and xylene).

OU2

Numerous investigations have taken place at the Site prior to and after the NPL listing, as described in the Chronology of Site Events Table in Appendix B. In 1992, the DOE issued a Remedial Investigation Report for the Maywood Site, which was the basis for DOE's 1993 Final Baseline Risk Assessment for the Maywood Site. This baseline risk assessment identified radiological COCs and their associated decay products in soils at the Site which posed an unacceptable risk from direct contact to employee and transient populations. COCs for soil and building materials were identified in the risk assessment as follows: Thorium-232 (Th-232); Uranium-238 (U-238); and Radium- 226 (Ra-226). Radon-222 (Rn-

222) was also identified as a COC for indoor air. An ecological risk assessment was conducted to evaluate potential effects from contamination at the Site. The ecological assessment compared contaminant concentrations detected in various media (soil, sediment and water) at the Site with literature on contaminant toxicity to biota. Because the future use of the Site was concluded to likely remain industrial and remedial action will likely remove contaminated soils to depths affecting ecological resources, the ecological assessment concluded that cleanup criteria for the remedy should not be based on potential risks to ecological resources.

Response Actions

Pre-ROD Removal Actions

OU2

1984-1985 Removal Action

DOE conducted removal actions at 26 properties between 1984 and 1985, based on the results of the 1981 radiological surveys. DOE's cleanup criteria were based on EPA's 40CFR192 Uranium Mine Tailings Radiation Control Act (UMTRCA). Excavation cut lines were based on soil sample results and walkover gamma and downhole gamma logging surveys. The surface and subsurface readings of 11,000 and 40,000 counts per minute (cpm) were used as a correlation to 5 picoCuries per gram (pCi/g) and 15 pCi/g, respectively, for Th-232. At that time, commercial disposal facilities were not available for the volume of radioactive waste generated by the cleanup. Therefore, excavated soils were transported to the Maywood Interim Storage Site (MISS) for temporary storage. Post-remedial action sampling was undertaken to confirm the cleanup goals were met and included: surface gamma radiation scans; soil sampling for Ra-226, Th-232 and U-238; and exposure rate measurements. Details of the post-remedial action sampling are described in the first five-year review report.

1994-1996 Removal Action - MISS Disposal

By September 1994, commercial disposal facilities became available and DOE released an Engineering Evaluation/Cost Analysis (EE/CA) evaluating several potential removal alternatives for the MISS. DOE then selected a non-time critical removal action in an Action Memorandum for the removal of the interim waste storage pile to such a facility. Radioactive waste at the MISS was loaded into railcars and shipped to an off-site commercial disposal facility. This removal was initiated in 1994 and completed in 1996.

1995-1999 Removal Action

In September 1995, DOE released a separate EE/CA evaluating removal alternatives for the remaining residential, commercial and municipal properties. Soil cleanup criteria identified in the 1993 Dispute Resolution described below were used for the properties remediated from 1995 to 1999. Contaminated materials from 38 properties were excavated, transported to the MISS, loaded into railcars and shipped to an off-site commercial disposal facility in Utah. At properties where contamination was present below structural items such as houses and garages, underpins for wall footings of the structure were installed to support the structure and to facilitate removal of contaminated materials. Details of the post-remedial action sampling are described in the first five-year review report.

The properties addressed by the 1984-1985 DOE removal actions and the 1995-1999 DOE and USAE removal actions are collectively referred to as Phase I properties.

2000 Time Critical Removal Action
A time critical removal action was completed by USACE during the winter of 2000 to remove contaminated sediments from portions of Lodi Brook and a swale located at the terminus of West Howcroft Road. The removal action re-established the hydraulic grade of the brook and swale, prevented additional flooding and prevented the transport or migration of any additional contaminated soil by flood water.

2002 Removal Action in Support of NJDOT Roadway Improvement Projects
This removal action was initiated in January 2002 and was transitioned into the OU2 remedial action cleanup work. This work was associated with: NJ Route (Rt.) 17 and Essex Street interchange and drainage improvements; NJ Rt. 17 drainage improvements; and Interstate (I)-80 sound barrier construction.

Federal Facility Agreement

1990 Federal Facility Agreement
In September 1985, ownership of the property that would become the MISS was transferred to the federal government. A September 17, 1990, Federal Facility Agreement (FFA) between EPA and DOE established terms and requirements of the CERLCA cleanup.

In 1993, EPA and DOE disagreed on the soil cleanup criteria that should be applied to the radioactive materials remaining at the Site. Therefore, EPA and DOE entered a dispute resolution process as provided for in the FFA. This disagreement was resolved in 1994 in a document known as the "Dispute Resolution" with site-specific cleanup criteria established at an average of 5 pCi/g combined Ra-226 and Radium- 228 (Ra-228), above background, for residential properties. For commercial properties, the dispute established cleanup criteria of an average of 15 pCi/g combined Ra-226 and Ra-228, above background, with an "as low as reasonably achievable" (ALARA) goal of 5 pCi/g. USACE determined that attainment of these cleanup criteria would assure compliance with the relevant and substantive requirements of NJDEP's radiation dose standards for the remediation of radioactive contaminated properties. Responsibility for cleanup of the FUSRAP portion of the Site was transferred from DOE to the USACE in October 1997. The FFA requirements for site cleanup were transferred to USACE.

Remedial Action Objectives (RAOs), Remedy Components, and Remediation Goals

OU1 (Non-FUSRAP Soil and Source Areas)

A ROD for OU1 was signed in 2014. A brief description of the OU1 ROD is as follows:

Remedial Action Objectives:
- Prevent direct contact with contaminated soil above levels that are protective of human health;
- Prevent the migration of contaminated soil; and
- Prevent contaminated soil from impacting groundwater quality.

Remedy Components
The major components of the selected remedy for OU1 consist of:
- Excavation and off-site disposal of an estimated 29,100 cubic yards of soil and waste material contaminated with metals, VOCs and SVOCs at an approved off-site disposal facility.
- In situ soil vapor extraction and treatment of an estimated 3,220 cubic yards of VOC

contaminated soil.

- The establishment of ICs, such as deed notices, easements or restrictive covenants to maintain the long-term protectiveness of the remedy; ensure that future use remains commercial/industrial; and prevent future land uses that interfere with the implementation or protectiveness of the Selected Remedy.

On January 22, 2021, based on the results of sampling conducted to support the design of the OU1 remedy, EPA issued an Explanation of Significant Difference (ESD) to add multiple residential properties along Maywood Avenue to the GA area of concern.

Table 1: OU1 ROD Remediation Goals	
Contaminants of Concern	**Soil Remediation Goals (mg/kg)**
Acetone	12
Benzene	0.005 (PQL)
Chloroform	0.2
Ethylbenzene	8
Methylene Chloride	0.007
Toluene	4
1,1,1-Trichloroethane	0.2
Trichloroethene	0.007
Total Xylenes	12
Benzo(a)anthracene	0.5
Benzo(b)fluoranthene	2
Benzo(a)pyrene	0.2 (PQL)
Dibenzo(a,h)anthracene	0.2
Indeno(1,2,3-cd)pyrene	2
Pentachlorophenol	0.3 (PQL)
Arsenic	19[a]
Barium	1,300
Chromium (total)	242[b]
Cyanide	13
Lead	59
Lithium	194[b]
Mercury	0.1 (PQL)

Notes:
Remediation goals were selected for each soil COC based on the lowest of EPA risk-based Industrial use Regional Screening Level value (10^{-6}, or 1 target hazard quotient), the NJDEP Non-Residential Direct Contact Soil Remediation Standards, and NJDEP Default Impact-to-Groundwater Soil Screening Level or a site-specific impact-to-groundwater value calculated according to NJDEP guidance, if a NJDEP impact-to-groundwater level has not been established for the COC.
PQL indicates screening level set at practical quantitation limit.
a. The impact-to-groundwater or health-based level defaults to background.
b. Site-specific impact-to-groundwater values used for chromium and lithium.

OU2 (FUSRAP Soil and Buildings)

A ROD for OU2 was signed in 2003. A brief description of the OU2 ROD is as follows:

Remedial Action Objectives:

Source Media (soil and bulk waste)

- To eliminate or minimize the potential for humans to ingest, come into dermal contact with, or

inhale particulates of radioactive constituents, or to be exposed to external gamma radiation.

- To reduce radium and thorium concentrations in soil including the NRC licensed burial pits to levels in accordance with EPA / DOE dispute resolution cleanup criteria. An average of 15 pCi/g combined Ra-226 and Th-232 above background for the subsurface soils with an ALARA goal of 5 pCi/g; institutional controls to prohibit future residential use will be used. For unrestricted use, the cleanup criterion is an average of 5 pCi/g combined Ra-226 and Th-232 above background for soil.
- To reduce Site concentrations of U-238 to 50 pCi/g (which is essentially 100 pCi/g total uranium) above background. These levels are considered protective for unrestricted use.
- To comply with exposure dose limits of 15 millirem per year (mrem/yr) as specified in NJAC 7:28-12.8(a)1.
- To reduce the potential for environmental impacts and reverse the temporary disturbance of existing wetland habitats through removal of sediments exceeding the cleanup criteria.
- To eliminate or minimize toxicity, mobility, and/or volume of contaminated soils.
- To eliminate or minimize the potential migration of COCs into stream and storm drain sediments by surface water runoff.
- To eliminate or minimize the potential migration of COCs by infiltration or percolation that would result in contamination of the groundwater.
- To comply with ARARs.

Buildings/Structures

- To comply with exposure dose limits of 15 mrem/yr as specified in NJAC 7:28-12(a)1.
- To prevent radon concentrations in buildings from exceeding 3 picoCuries per liter (pCi/L) above background as specified in NJAC 7:28-12.8(a)2.
- To eliminate or minimize toxicity or mobility, and/or volume of COCs.
- To comply with ARARs.

OU2 Remedy Components

The major components of the selected remedy for OU2 consist of:

- Excavation of accessible soils to meet ARARs and soil cleanup criteria for either restricted or unrestricted use as discussed above for each property using federally accepted averaging methods (e.g., Multi-Agency Radiation Survey and Site Investigation Manual [MARSSIM]) to demonstrate compliance with the criteria.
- Physical separation, using backhoes or other heavy construction equipment, of a portion of the excavated material to sort boulders and rocks, waste potentially requiring disposal as mixed waste (radioactive and hazardous waste), and bulk waste such as building rubble.
- Remediation of contaminated buildings/structures (or demolition and disposal as deemed appropriate at the time of work) in consultation with the property owners, as necessary to achieve the criteria of 15 mrem/yr above background as specified in NJAC 7:28-12.8(a) l and the 3 pCi/L Rn-222 limit in NJAC 7:28-12.8(a)2.
- Excavation of inaccessible soils to meet ARARs and cleanup criteria for either restricted or unrestricted use as discussed above if the landowners make them accessible during remediation; otherwise, inaccessible soils currently located under buildings and roadways would be excavated and disposed off-site as they become accessible in the future (e.g., due to renovation or

demolition activities).

- Demolition and disposal of structures on the MISS to access contaminated soils.
- Off-site disposal of all materials above the cleanup criteria at facilities authorized to accept radioactive waste in accordance with applicable regulations.
- Five-year reviews in accordance with CERCLA 121 (c) and 300.430(f)(4)(ii).
- Requesting notification of the USACE and EPA by local municipalities of any land use changes involving those properties where radioactivity remains above an average of 5 pCi/g of Ra-226 and Th-232 combined above background concentrations in soils.
- Periodic Rn-222 monitoring of structures over inaccessible soils to ensure that the structures continue to provide adequate protection from these soils; mitigation of Rn-222 (e.g., sealing foundation cracks, supplementing existing ventilation systems, etc.) would be performed if indoor air levels exceed 3 pCi/L above background.
- Working with local authorities and landowners to implement land use controls (e.g., deed notices, easements, covenants, zoning controls, etc.) on a property by property basis, as necessary, for those properties where radioactivity remains above an average 5 pCi/g of Ra-226 and Th-232 combined above background concentrations in soils and/or due to the presence of inaccessible soil. Objectives of the institutional controls would be to restrict land use to commercial/industrial, prohibit residential or unrestricted use, and prohibit excavation into designated restricted areas. Institutional controls would remain in place as long as Site contaminants remain above levels that allow for unrestricted use.

Table 2: OU2 ROD Remediation Goals

Contaminant of Concern		**Cleanup Criteria**
Radionuclides in Soil	Ra-226 Th-232	Unrestricted use properties: an average of 5 pCi/g[1] Ra-226 and Th-232 combined above background Restricted use properties: an average of 15 pCi/g Ra-226 and Th-232 combined above background for subsurface soils with an ALARA goal of 5 pCi/g
	U-238	100 pCi/g total uranium, 50 pCi/g U-238
Exposure Dose Limit		15 mrem/yr[2] above background dose limit specified in NJAC 7:28-12.8(a)1
Radon and Radon Decay Products in Structure		Indoor radon air concentration: 3 pCi/L[3] radon-222 (Rn-222) limit specified in the NJAC 7:28-12.8(a)2

1 - picoCuries per gram 2 - millirem per year 3 – picoCuries per liter

Anticipated Future Land Use

OU1

The properties included in the original 2014 ROD all have active businesses and are located in a densely populated area, in close proximity to several transportation infrastructure modes. This area is zoned for limited light industrial activities in the Borough of Maywood and for industrial use in the Township of Rochelle Park. Recent demographic information indicates this industrial/commercial area has one of lowest vacancy rates in the nation; therefore, future land use is anticipated to be the same as current land use. The residential portion of the Site, as outlined in the 2021 ESD, is anticipated to remain residential.

OU2

Twenty-four commercial and government properties (some being multiple parcels) are addressed under the 2003 OU2 ROD and are known as Phase II properties. Four additional properties were added by USACE via a November 2014 memorandum. Sixty-four properties were addressed through removal actions by DOE and USACE prior to the OU2 ROD. These properties are known as Phase I properties and cleanup to the unrestricted use criteria at these 64 properties is considered appropriate. In 2021, an ESD was issued to incorporate the Phase I properties into the 2003 OU2 ROD. Based on the historical commercial/industrial use of the Site, the proximity of heavily used transportation corridors (e.g., State Route 17, Interstate-80), and the well-defined commercial/industrial districts, the use of the restricted use cleanup criteria were justified for and applied to select commercial and government properties. For the remaining OU2 properties, cleanup to the unrestricted use criteria is considered more appropriate since they are located within a less defined commercial district with encroaching residential developments on three sides.

Status of Implementation

OU1

In 2015, an Administrative Settlement and Order on Consent for Preliminary Design Investigation and Remedial Design for OU1 (amended in 2021) was entered between EPA and Stepan whereby Stepan has been conducting the design of the OU1 remedy under EPA oversight. A predesign investigation (PDI) was needed to support the development of the design. Field work for the PDI began in February 2017 and was largely completed in 2020. Based on the initial results of the PDI, EPA determined that additional delineation sampling needed to extend onto the residential properties located immediately east of the GA portion of the site, along Maywood Avenue. The majority of this sampling was conducted between 2020 and 2021 and completed in 2023. As mentioned previously, an ESD was signed in January 2021 to add these residential properties to the OU1 remedy and, on July 15, 2021, EPA issued a Unilateral Administrative Order for Remedial Action to expedite the cleanup of the residential properties.

The remedy for the twelve residential properties included excavation with dewatering (as needed), off-site disposal of contaminated soil and waste material at a regulated facility, property restoration, and ICs (as needed). Remedial actions commenced on the residential properties in November 2022. In total, 11,470 cubic yards of contaminated soil were excavated and disposed of at EPA approved off-site disposal facilities. Stepan Company anticipates completing restoration activities by March 31, 2024. Dewatering

was required on five properties (total of approximately 98,500 gallons) to allow removal of contaminated soil. Institutional controls (ICs) are not needed.

Post-ROD Interim Remedial Measures

2019 Interim Remedial Measure
This interim remedial measure was completed between March 26 and 27, 2019. GHD, on behalf of Stepan Company, completed an interim remedial measure for soil located in the southeastern portion of the vacant commercial property, previously owned by Sears and that is identified as 149-151 Maywood Avenue, Maywood, Bergen County, New Jersey. The interim remedial measure was necessary to remediate a hot spot at a location with soil impacted by the SVOC benzo(a)pyrene at a concentration above the EPA ROD Remediation Goal. Expedited cleanup was also necessary to facilitate the restoration of wetlands at the Site by USACE. The measure resulted in the excavation and disposal of 48.89 tons of soil at Wayne Disposal, Inc. in Belleville, Michigan.

2020 Interim Remedial Measure
This interim remedial measure was completed between March 16 and 17, 2020 and June 8 and 23, 2020. GHD, on behalf of Stepan Company, completed an interim remedial measure for soil located in the southwestern portion of the vacant commercial property, previously owned by Sears and that is identified as 149-151 Maywood Avenue, Maywood, Bergen County, New Jersey. The interim remedial measure was necessary to remediate soil impacted by the metal chromium and isotope hexavalent chromium. The measure resulted in the excavation and disposal of 733.85 tons of soil at US Ecology's Wayne Disposal, Inc. Facility in Belleville, Michigan.

Remedial actions for the remainder of OU1 are expected to begin in early 2024. The remedy will consist of soil excavation and off-site disposal of the impacted soils that are contaminated at concentrations greater than OU1 ROD Remediation Goals and restoration. Based on the PDI results, the remedy will be implemented at the GA (non-residential portion), LMA and the FAA areas of concern. The GA (non-residential portion) also contains a wetlands area for which Stepan Company submitted a freshwater wetlands General Permit 4 (GP-4) application to the NJDEP Division of Land Use Regulation for review and approval. NJDEP approved the GP-4 permit on May 20, 2022 and it is valid through May 2027. The work will be conducted pursuant to a Consent Decree between EPA and Stepan which is still being finalized.

Note that, as described in the 2003 OU2 ROD, areas of the (former) Sears and DeSaussure properties where occupied buildings are currently situated are known to contain radiologically contaminated soil that will be addressed under the OU2 remedy, but this soil is currently inaccessible. As this soil becomes accessible in the future (e.g., due to renovation or demolition activities), this OU1 remedy will address any chemically contaminated soil that is not co-mingled with radiologically contaminated soil under the buildings.

OU2

Remedial actions have been undertaken or are underway at properties included in the 2003 OU2 ROD. USACE estimates that the remaining OU2 remedial action work will take another four years to complete and is dependent on Congressional appropriation funding. Monitoring activities and report writing will continue beyond four years.

Radiological data collected during investigations were used to plan remediation activities. Excavation was performed based on the excavation limit depicted on the design drawings showing the extent of contamination at each of these properties. Excavated materials were transported to the MISS for temporary storage, and subsequently transported off-site to a facility authorized to accept radioactive waste in accordance with applicable regulations. Post-remedial action sampling at the remediated properties was conducted utilizing a MARSSIM-based approach. The sampling consisted of gamma walkover surveys and soil sampling. Following verification that cleanup criteria had been met, excavated areas were backfilled with clean fill. Radiological results for the backfill were compared to applicable guidelines. Backfill and clean overburden soil results were below applicable regulatory criteria. Upon completion of the remedial actions, the property was restored to its original condition. Post Remedial Action Reports (PRARs) are prepared for each property to document the attainment of the cleanup criteria.

PRARs are not yet available for all properties; however, based on the available data, all the remediated properties were deemed to have met the respective cleanup criteria for restricted use or unrestricted use, as specified in the 2003 ROD except for twelve properties where inaccessible contamination was present. At these twelve properties, due to safety concerns and structural stability issues, contaminated soils could not be removed from areas underneath and immediately adjacent to, permanent structures such as buildings, a pump station, a sewer force main, a natural gas pipeline and/or utility pole. As such, rather than the unrestricted use originally specified in the 2003 OU2 ROD, these twelve properties have restricted use designations, with proposed implementation of institutional controls (i.e., administrative, legal, and/or physical measures that control potential or actual human health risks), as required by the OU2 remedy. Contaminated soil which is considered inaccessible will be addressed in the future when made accessible by property owners by removal of the permanent structure.

Excavation & Off-Site Disposal - More than 84,000 cubic yards of radiologically contaminated soil were removed from the Site and disposed at off-site facilities that are permitted to accept the waste since the 2019 FYR was completed. The total volume of contaminated soil shipped for the project to date is 836,100 cubic yards.

IC Summary Table

Table 3: Summary of Planned and/or Implemented ICs

OU #	Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Title of IC Instrument Implemented and Date (or planned)
1	Soil	Yes 3 commercial/industrial properties	Deed Notices restricting the use of current industrial/commercial property (i.e., the Stepan Company, formerly Sears, and DeSaussure properties) to commercial/industrial use, requiring notices where future activities could interfere with the implementation or protectiveness of the remedy.	3 Deed Notices planned Planned completion late 2024
2	Soil	Yes 12 commercial or government parcels. Status as follows: 3 final; and 9 processing	Areas restricted by Land Use Controls to prevent exposure and spread of contaminated soil that does not meet the unrestricted use criteria or is inaccessible.	3 Deed Notices implemented 9 Deed Notices planned Planned completion 9/30/2027

Institutional controls in the form of deed notices, pursuant to NJDEP regulations, are actively being pursued by the USACE for properties where unrestricted cleanup criteria have not been met or inaccessible contamination remains on the property. One deed notice was recorded with the Bergen County Clerk in 2020 in addition to two that were previously filed. Several other deed notices have been prepared and are under review. Per the Deed Notice requirements, USACE will determine the protectiveness of the soil remedial action by determining whether any actual or pending zoning or land-use change is consistent with restrictions. USACE is also required to inspect the Site to identify whether any excavation or other disturbance activities have taken place. USACE is responsible for monitoring for radon in buildings where contamination remains under the foundation and NJDEP biennial certification reporting requirements. Two biennial certifications were conducted and recorded by USACE in 2022.

Systems Operations/Operation & Maintenance

OU1

It is not anticipated that long-term monitoring will be required by Stepan Company for the LMA, FAA, and non-wetland, non-residential portion of the GA after OU1 remediation is complete, aside from IC or Deed Notice filings and renewals. Therefore, no Operation, Maintenance and Monitoring (O&M) Plan will be required for any of the final remedies. However, wetlands mitigation is being completed in the GA at the DeSaussure property as per NJDEP regulations. Routine monitoring of the wetlands will be performed through inspections and reporting as required by NJDEP.

OU2

Monitoring - Annual monitoring of air, surface water, sediment and groundwater is carried out, in accordance with the *General Environmental Protection Plan (November 1999),* to ensure the local community is protected. The remedial activities completed for Phase I properties allowed an unrestricted use designation; therefore, operation and maintenance activities were not required at these properties. For OU2 properties, inaccessible soils underneath permanent structures are known to be present at twelve properties, three of which were remediated to the restricted use criteria. Post-remediation radon testing was performed at these four properties and interior gamma survey and inspection for any cracks in basement slabs have also been conducted. Periodic radon monitoring at these properties is included in the USACE's Land Use Control Implementation Plan (LUCIP). Inspections, monitoring and biennial reporting to NJDEP are required at properties with Deed Notices.

Additionally, in accordance with the requirements of the General Environmental Protection Plan, FUSRAP Maywood Superfund Site, Maywood, New Jersey, November 24, 1999 (USACE 1999), an Environmental Monitoring Program (EMP) was established for the Site. One of the main objectives of the EMP is to ensure that the public and the environment are adequately protected from FUSRAP contaminants present at the Site. The results of the EMP are documented in an Annual Environmental Monitoring Report (AEMR) for each calendar year. Prior to the establishment of the USACE EMP, DOE conducted a Site-wide environmental surveillance program to monitor conditions at the Site.

Climate Change

Potential impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the Site (see additional details in Appendix C).

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** FYR as well as the recommendations from the **last** FYR and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2019 FYR

OU #	Protectiveness Determination	Protectiveness Statement
2	Will be Protective	The remedy currently being implemented at OU2 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.

No Issues or recommendations were included in the 2019 FYR.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On August 7, 2023, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands, including the Maywood Chemical Company Superfund Site. The announcement can be found at the following web address: www.epa.gov/superfund/R2-fiveyearreviews.

In addition to this notification, the EPA Community Involvement Coordinator for the Site, Shereen Kandil, posted a public notice on the EPA Site webpage www.epa.gov/superfund/maywood-chemical and provided the notice to Lodi and Maywood boroughs by email on January 16, 2024 with a request that the notice be posted in municipal offices and on the borough webpages. This notice indicated that a Five-Year Review (FYR) would be conducted at the Maywood Chemical Company Superfund Site to ensure that the cleanup at the Site continues to be protective of people's health and the environment. Once the FYR is completed, the results will be made available at the following repository/ies: U.S. Environmental Protection Agency, Superfund Records Center, 290 Broadway, 18th floor, New York, NY 10007, Maywood Public Library, 459 Maywood Avenue, Maywood, New Jersey 07607, Maywood FUSRAP Public Information Center, 75A West Pleasant Avenue, Maywood, New Jersey 07607. In addition, the final report will be posted on the following website: www.epa.gov/superfund/maywood-chemical. Efforts will be made to reach out to local public officials to inform them of the results.

OU1

EPA regularly provides the community surrounding the Maywood Chemical Company Superfund Site with updates on the cleanup work being performed at the Site via online updates and flyers. EPA also held multiple individual and group meetings with homeowners directly impacted by the OU1 residential remediation work and maintains a website for the Site where key Site-related documents can be accessed for viewing: https://www.epa.gov/superfund/maywood-chemical.

OU2

As the lead federal agency, DOE, and its successor, USACE, established and maintain an extensive community involvement program. EPA has coordinated with the lead federal agencies throughout the project to ensure that the local community is kept well informed of cleanup activities. Communications with the property owners, surrounding community and local government officials is an ongoing and critical component of the remedial work. A Public Information Center with project records was established in the business district of Maywood, New Jersey and was open through late 2022. The community was notified of its upcoming closure and directed to both the project website (www.FUSRAPMaywood.com) as well as the New York District project website for information. Project updates are prepared and sent out to the local community on a routine basis. USACE's project website includes project documents, maps, notices and updates. The nature of the work requires constant communication with property owners where cleanup is required from initial investigations until final property status reporting.

Data Review

OU1

The documents listed below were reviewed for OU1 in preparation for this report. However, the summary of the data collected supporting the residential remediation will be included in the final Remedial Action Report, when this effort is completed.

- OU1 Record of Decision (2014)
- OU1 Explanation of Significant Differences (2021)
- 100% Design Report, Operable Unit 1 (Soil) (2021)
- Institutional Control Implementation Assurance Plan (2021)
- 100% Design Report, Gypsum Area Residential Properties (Soil) (2022)
- Gypsum Area (GA) Residential Remediation Summary (2023)

OU2

The Annual Environmental Monitoring Reports (EMR) used in preparing this Five-Year Review Report covered the calendar years 2018 through 2021, as these are the reports that were completed and available for review at the time of the preparation of this FYR. The EMR for calendar year 2022 and some subsequent years will be used in preparing the next FYR. The annual EMR is implemented for the Site to ensure that the public and the environment are adequately protected from FUSRAP contaminants, through annual monitoring of the air, surface water, sediment, and groundwater at the Site. Based on the most recent (2021) EMR, the monitoring results were within the historical ranges and comparable to those reported in previous years. Surface water and sediment results continue to be below annual EMR Screening Levels.

Data collected as part of the PRAR for individual property remedial actions were reviewed. In addition, data from the radiological characterization reports, 2013 Property Assessment Tech Memo and other Site investigation reports and Annual Monitoring Reports from 2014 to 2017 were reviewed to prepare this report to ensure that where remediation has been completed, remediation goals have been achieved.

Groundwater- Although groundwater remediation is covered by OU3 (not included in this FYR), groundwater quality is tied to the effectiveness of the OU2 soil remedy. Groundwater samples that were collected during the review period are briefly discussed below. Samples were collected in 2018, 2019, 2020, and 2021 from 27 wells (overburden and bedrock) located onsite and offsite of the MISS. Samples were analyzed for chemical and radiological parameters. These parameters and associated EMR Screening Levels are as follows. For radiological parameters: gross alpha at 15pCi/L, gross beta at 50 pCi/L, sum of Ra-226 and Ra-228 at 5 pCi/L, and total uranium at 30 µg/L. For chemical parameters: arsenic at 3 µg/L, benzene at 1 µg/L, and lithium at 730 µg/L. The results for radiological parameters are summarized as follows:

- During the 2021 sampling event, detected gross alpha results for the overburden wells ranged from 0.36 pCi/L to a maximum of 30.3 pCi/L at Well B38W15S. The detected gross alpha results for the bedrock wells ranged from 0.72 pCi/L to a maximum of 88.5 pCi/L at Well B38W15D. The gross alpha SL of 15 pCi/L was exceeded at Wells B38W15S, MISS01AR, MISS07AR, MW3SR, B38W02D, B38W03B, B38W15D, B38W17B, B38W18DR, MISS01BR, and MISS05BR. However, there were no corresponding exceedances of isotopic uranium or radium activity at these wells. Overall, for well gross alpha concentrations that showed significant change, approximately two-thirds of these were lower than the 2020 sampling data. During the review period, gross alpha in overburden ranged up to 40.9 pCi/L at MISS01AR in 2020, and in bedrock ranged up to 88.5 pCi/L at B38W15D in 2021.
- During the 2021 sampling event, detected gross beta results for the overburden wells ranged from -4.0 pCi/L to a maximum of 71.0 pCi/L at Well B38W25SR. The gross beta detected

results for the bedrock wells ranged from -1.2 pCi/L to a maximum of 88.4 pCi/L at Well B38W02D. Note that the lowest reported result (-4.0 pCi/L) reflects a positive detection with a net negative concentration after adjustment for naturally occurring potassium-40 contribution to gross beta. These were the highest gross beta detections during the review period. In 2021 the gross beta AEMR Screening Level was exceeded at Wells B38W25SR, B38W02D, B38W03B, B38W15D, and B38W25DR.

- During the 2021 sampling event, the combined Ra-226 and Ra-228 detected results for the overburden wells ranged from 0.29 pCi/L to a maximum of 1.28 pCi/L at Well B38W25SR. The combined Ra-226 and Ra-228 detected results for the bedrock wells ranged from 0.44 pCi/L to a maximum of 1.48 pCi/L in Well B38W17B. The highest combined Ra-226 and Ra-228 were detected in 2018 at 1.82 pCi/L in overburden well B38W25SR and 2.46 pCi/L in bedrock well B38W03B. In general, the combined Ra-226 and Ra-228 results for the review period were within the historical range.
- In 2021, the detected total uranium results for the overburden wells ranged from non-detect to a maximum of 1.93 µg/L at Well B38W14S. The detected results for the bedrock wells ranged from 0.20 µg/L to a maximum level of 12 µg/L in Well MW24D. All values continue to be well below the AEMR Screening Level for total uranium. During the review period, total uranium ranged up to 2.26 pCi/L in overburden well MISS07AR and up to 12.7 pCi/L in bedrock well MW24D, both in 2018. All values during the review period continue to be well below the AEMR Screening Level for total uranium.

The OU3 ROD states, "The remedial action will be considered complete and will be discontinued when non-radiological source soils that cause groundwater contamination above cleanup levels are removed on the MISS, and groundwater monitoring indicates that COCs are at, or below, cleanup levels on the MISS and off-site groundwater monitoring well sampling locations, using standard methods of demonstrating achievement of groundwater remediation cleanup levels." Radiological contamination in groundwater appears to be stable to declining and monitoring will continue to ensure that the selected remedy continues to function properly. Groundwater samples were also analyzed for non-radiological COCs, the results are summarized as follows:

- During the review period, detectable arsenic concentrations ranged from 0.98 µg/L to a maximum concentration of 351 µg/L in overburden well MW3SR in 2020. During the most recent sampling event in 2021, arsenic concentrations exceeded the cleanup standard of 3 µg/L in 9 of the 27 wells sampled. The AEMR Screening Level for arsenic is 3 µg/L.
- During the review period, benzene ranged up to 16,500 µg/L in bedrock well MISS05BR in 2018 with the next highest 2018 benzene concentration being Well MW24D at 1 µg/L. During the most recent sampling event in 2021, benzene as was detected in bedrock wells MW24D (0.84 µg/L) and MISS05BR (55.1 µg/L). Benzene was not detected in any of the 13 overburden wells during the review period. The Screening Level for benzene is 1 µg/L.
- Lithium ranged up to 9,760 in bedrock well MISS05BR in 2018. During the 2021 sampling event, lithium was detected in 26 of 27 wells at concentrations ranging from 14.5 µg/L to 3,090 µg/L in Bedrock Well MISS07B. The Screening Level for lithium is 40 µg/L.

The selected remedy for non-radiological groundwater constituents of concern is MNA for lithium and benzene in overburden and shallow bedrock groundwater, and MNA for arsenic in shallow bedrock groundwater. If required, in situ treatment of arsenic in the overburden aquifer using oxidation

reduction alteration will be implemented. These COCs will continue to be monitored and will be addressed in future FYRs.

Site Inspection

The inspection of the Site was conducted on September 28th, 2023. In attendance were Rupika Ketu, EPA RPM; Stephanie Vaughn, EPA Mega Projects Section Chief; Paul Zarella, EPA Hydrogeologist; Shereen Kandil, EPA Community Involvement Coordinator; John Canby, USACE; Angela Sabet, USACE Project Manager; and Ann Ewy, USACE Technical Manager. The purpose of the inspection was to assess the protectiveness of the OU1 and OU2 remedies.

The USACE Maywood FUSRAP project team members discussed remedial action progress since the last FYR was completed and provided several drawings that noted excavation areas completed. A tour of the MISS soil stockpile, railroad load-out system used for transportation of waste for off-site disposal, active construction areas on MISS and other properties was performed. No issues affecting protectiveness were identified. The team did not conduct interviews during the Site inspection because Site communication activities for the ongoing and future cleanup work were deemed sufficient. USACE maintains a robust communications program for the ongoing soil cleanup work which includes a website and newsletter outreach to the local community and elected officials.

V. TECHNICAL ASSESSMENT

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

Yes, the remedies for OU1 and OU2 are functioning as intended by the 2014 (OU1) and 2003 (OU2) RODs. The remedial actions for each OU, consisting of excavation and off-site disposal of soils exceeding the remediation goals established in the RODs, are progressing and continue to be implemented as designed. The remedial actions are performing as expected, and the RAOs are expected to be achieved in a reasonable timeframe. At OU2, based on results of chemical and radiological analyses, NJDEP determined in 2018 that certain soil meeting the definition of clean fill and concrete meeting the definition of "Uncontaminated Surface Soil" could be used without restriction. To date, USACE has re-used about 12,000 cubic yards of soil and 9,000 cubic yards of crushed concrete as backfill primarily at the former Sears property. This has significantly reduced costs and impacts from trucking backfill to the Site from distant locations.

For the remedies at OU1 and OU2 to be protective, the completion of remedial action is required. In addition, in the long-term, institutional controls need to be in effect for properties where soil contamination remains above OU1 ROD remediation goals as well as properties where radioactivity remains above 5 pCi/g of Ra-226 and Th-232 combined above background concentrations for soils in OU2. Nevertheless, exposures at the OU2 properties with ongoing remedial action, which could potentially result in unacceptable risks, are being controlled through access controls, fencing, security guard, warning signs, workplace management practices, property owner notifications, monitoring, existing zoning ordinances and communication with local officials and affected property owners. In addition, properties with inaccessible contamination are routinely monitored for gamma exposure rates and radon in buildings. In all cases, the measurements have not required further actions and meet applicable gamma dose and radon levels.

Implementation of Institutional Controls and Other Measures

For OU1**,** Stepan Company has established an Institutional Control Implementation and Assurance Plan (ICIAP), which was approved by EPA, to describe how ICs will be implemented, maintained, and monitored at the Site once all OU1 remedial activities are complete. Stepan Company is responsible for obtaining EPA approval for the ICs described in the ICIAP and Section II of this FYR prior to finalizing and recording them and for providing copies to the NJDEP at the same time they are provided to EPA. Stepan Company will be responsible for monitoring those proprietary controls and the access restrictions. EPA will ensure the ICs are enforced in accordance with the ICIAP and 2014 OU1 ROD.

Per the 2003 OU2 ROD, institutional controls are required for properties with inaccessible soils or properties exhibiting residual radioactivity in soil above an unrestricted use cleanup criterion (i.e., an average of 5 pCi/g of Ra-226 and Th-232 combined above background). One deed notice was recorded with the Bergen County Clerk in 2020 in addition to two that were previously filed (previously described in the 2019 FYR). Several other deed notices have been prepared and are under review. USACE has a LUCIP, and USACE is negotiating land use controls with property owners. Addresses and figures where "Call Army Corps Before Digging" areas are identified have been posted on the USACE Maywood project website.

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?

The 2014 OU1 ROD followed the Risk Assessment Guidance for Superfund used currently by EPA. The HHRA results indicated that the future ingestion of contaminated soil at the Site poses an unacceptable risk to human health. All other evaluated pathways were acceptable. There have not been changes in toxicity values which would alter the protectiveness of the remedy. All ROD-selected remediation goals are more conservative than the current NJDEP Migration to Groundwater Soil Remediation Standards. Remediation goals defined in the OU1 ROD are necessary to achieve the Remedial Action Objectives listed in Section II, which remain appropriate. The OU1 remedial action began but is not yet complete. It is anticipated that the remedy will be protective once additional excavation and off-site disposal of impacted soils at concentrations above remediation goals on the non-residential properties identified in the OU1 ROD is completed. No institutional controls are needed. Remediation of residential properties identified in the OU1 ROD ESD are expected to be completed by March 31, 2024.

DOE conducted the OU2 Baseline Risk Assessment in 1993 in accordance with EPA Risk Assessment Guidance for Superfund (RAGS) as well as Residual Radiation (RESRAD) computer modeling. The process used remains valid, although currently the EPA radiological preliminary remediation goal calculator would be utilized to determine PRGs and whether or not an unacceptable risk is present. Using the most recent maximum soil concentrations of COCs (Ra-226, Th-232 and U-238, with associated decay products such as Radon-222) from the 2021 AEMR and assuming maximum exposure to a resident (unrestricted use), including contribution from consuming vegetables from a home garden, resulted in cancer risks within the CERCLA risk range (10-5 risk level for all pathways). As a result, exposures to site-related soils are currently protective of human health.

The exposed populations and exposure pathways evaluated as part of the OU2 Baseline Risk Assessment included the following adult receptors: residents, employees, and transients (e.g., visitors, customers, trespassers, and commuters) and pathways: ingestion, dermal contact with, or inhale

particulates of radioactivity. While children were not evaluated as residents or transients, many of the properties were remediated to unrestricted use and those that were not are not appropriate for children to spend considerable time (e.g., the MISS, Stepan Company and NYS&W Railway). Exposure pathways remain appropriate currently and for the next five years. Toxicity factors and contaminant characteristics have not changed in a way that could affect the protectiveness of the remedy.

To reduce radium and thorium concentrations in soil, including the NRC licensed burial pits, to levels in accordance with EPA/DOE dispute resolution cleanup criteria, an average of 15 pCi/g combined Ra-226 and Th-232 above background for the subsurface soils with an ALARA goal of 5 pCi/g with institutional controls to prohibit future residential use will be used. For unrestricted use, the cleanup criterion is an average of 5 pCi/g combined Ra-226 and Th-232 above background for soil. The U-238 cleanup goal in Site soils was 50 pCi/g (which is essentially 100 pCi/g total uranium) above background. These levels are considered protective for unrestricted use.

For indoor air, the cleanup goal for radon (Rn-222) in buildings was 3 picoCuries per liter (pCi/L) above background as specified in NJAC 7:28-12.8(a)2, which is below the EPA Action Level of 4 pCi/L and considered protective. The OU2 ROD called for periodic Rn-222 monitoring of structures over inaccessible soils to ensure that the structures continue to provide adequate protection from these soils. If indoor air levels exceed 3 pCi/L above background, mitigation of Rn-222 (e.g., sealing foundation cracks, supplementing existing ventilation systems, etc.) would be performed. EMP radon monitoring is not intended to monitor soils over inaccessible properties. The periodic Rn-222 monitoring of structures is addressed through deed notices. The RAOs identified in the OU2 ROD remain valid.

Excavation of contaminated soil has prevented further release to environment, thus mitigating/minimizing human health impacts. While groundwater is the subject of OUs 3 and 4, some data was collected in the last five years. There remain exceedances of radiological and non-radiological contaminants but in fewer wells and with steady or decreasing concentration trends. Soil excavation work to date appears to have resulted in some of the groundwater improvements observed. Potable water in the vicinity of the Site is provided by a public water supply; however, some private domestic wells exist within a mile of the Site. Groundwater monitoring will continue. It is anticipated that concentrations will decrease over time. Remediation of FUSRAP and non-FUSRAP groundwater will be assessed when remedial actions for OU1 and OU2 are complete. It is expected that the site will be protective of human health. Environmental monitoring, including indoor air radon monitoring, will continue until such time.

Based on the available PRARs, all the remediated properties were deemed to have met the respective cleanup criteria as specified in the 2003 ROD except for twelve properties where inaccessible contamination was present and for various safety and/or structural reasons could not be removed. As such, rather than the unrestricted use originally specified in the ROD, these twelve properties have restricted use designations, with proposed implementation of institutional controls (ICs), as required by the OU2 remedy. Contaminated soil which is considered inaccessible will be addressed in the future when it becomes accessible by removal of the permanent structure. The remedy will be fully protective when ICs are in place at all properties where unrestricted cleanup criteria have not been met or inaccessible contamination remains to prevent it from human contact or becoming mobilized.

Vapor Intrusion

Soil vapor intrusion (SVI) is evaluated when soils and/or groundwater are known or suspected to contain VOCs. Since the OU1 remediation is ongoing and will include additional excavation and off-site disposal, it is anticipated that less vapor-forming contaminants will be available for the vapor intrusion pathway. Further, for those properties with inaccessible contamination, ICs are required to prevent unacceptable exposures. However, any future construction in OU1 should be done with a consideration of the vapor intrusion pathway.

OU2 has not identified VOCs as COCs; however, radon (Rn-22) and thoron (Rn-220) are indoor air concerns. As discussed above, the potential for radon and thoron to migrate indoors is being evaluated in buildings that have not been released for unrestricted use.

Ecological Risk

The 1993 Risk Assessment concluded that remedial action would likely remove contaminated soils to depths affecting ecological resources. The habitat at the Site and surrounding and downstream properties is typical of urban areas, and generally consists of early to late old-field stages, usually along transportation rights-of-way or unused corners of commercial/industrial properties. Overall, there is very little wildlife habitat near the Site, other than ornamental plantings, mowed lawns and scattered patches of wooded and herbaceous vegetation along stream corridors and dividing lines of commercial/industrial properties. Some wetland vegetation is present along the brooks and some drainage swales within the boundaries of the FUSRAP portion of the Site. Westerly and Lodi Brooks are underground for most of their length; near the Saddle River, riparian vegetation is found along the banks of both brooks.

Although the ecological risk assessment screening and toxicity values used to support the 2003 OU2 ROD may not necessarily reflect the current values, the RAOs for source media (soil and bulk waste) remain protective of the environment and the selected remedy consisting of the excavation of contaminated soils and burial pits along with the excavation of contaminated sediments from wetland habitats and off-site disposal of contaminated material eliminates any potential risk from surface soil contaminants to terrestrial receptors.

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

There is no new information that calls into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1 and OU2

No issues or recommendations are being made for OU1 or OU2, which are the subject of this FYR, since remedial action is ongoing.

OTHER FINDINGS

With regards to OU3, since the issuance of the 2012 ROD, the latest toxicological information suggests that the remediation goal for lithium may need to be revised. EPA and the USACE are currently re-evaluating the need to adjust the cleanup level. Additionally, the potential for vapor intrusion should be considered in the IC plan developed for OU1.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: OU1	*Protectiveness Determination:* Will be Protective
Protectiveness Statement: The remedy currently being implemented at OU1 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.	
Protectiveness Statement(s)	
Operable Unit: OU2	*Protectiveness Determination:* Will be Protective
Protectiveness Statement: The remedy currently being implemented at OU2 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.	

VIII. NEXT REVIEW

The next FYR report for the Maywood Chemical Company Superfund Site is required five years from the completion date of this review.

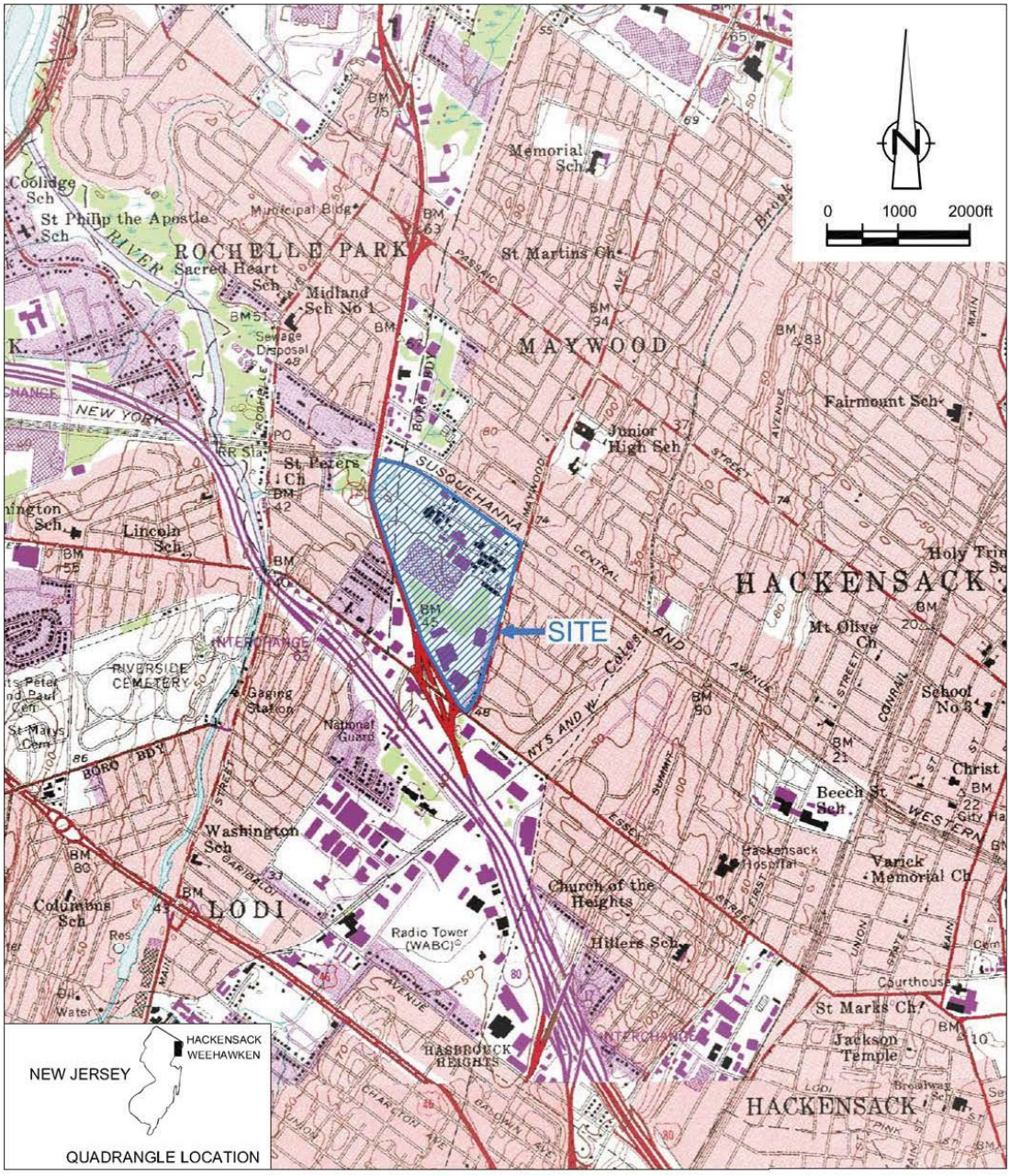
APPENDIX A – REFERENCE LIST

- Annual Environmental Monitoring Report, 2018 (USACE)
- Annual Environmental Monitoring Report, 2019 (USACE)
- Annual Environmental Monitoring Report, 2020 (USACE)
- Annual Environmental Monitoring Report, 2021 (USACE)
- Record of Decision, Maywood Chemical Company Superfund Site, Operable Unit 1, Non-FUSRAP Soil and Source Areas, 2014 (EPA)
- Explanation of Significant Differences, Maywood Chemical Company Superfund Site, Operable Unit 1: Non-FUSRAP Soil and Source Areas, 2021 (EPA)
- 100% Design Report, Operable Unit 1 (Soil), 2021 (Stepan Company)
- Institutional Control Implementation Assurance Plan, 2021 (Stepan Company)
- 100% Design Report, Gypsum Area (AOC 2) Residential Properties (Soil), 2022 (Stepan Company)
- Memorandum: Gypsum Area (GA) Residential Remediation Summary, 2023 (GHD)

APPENDIX B – Figures and Chronology Table

- Figure: Site Location
- Figure: Site Map
- Table: Chronology of Site Events

Figure 1: Site Location Map



HDR

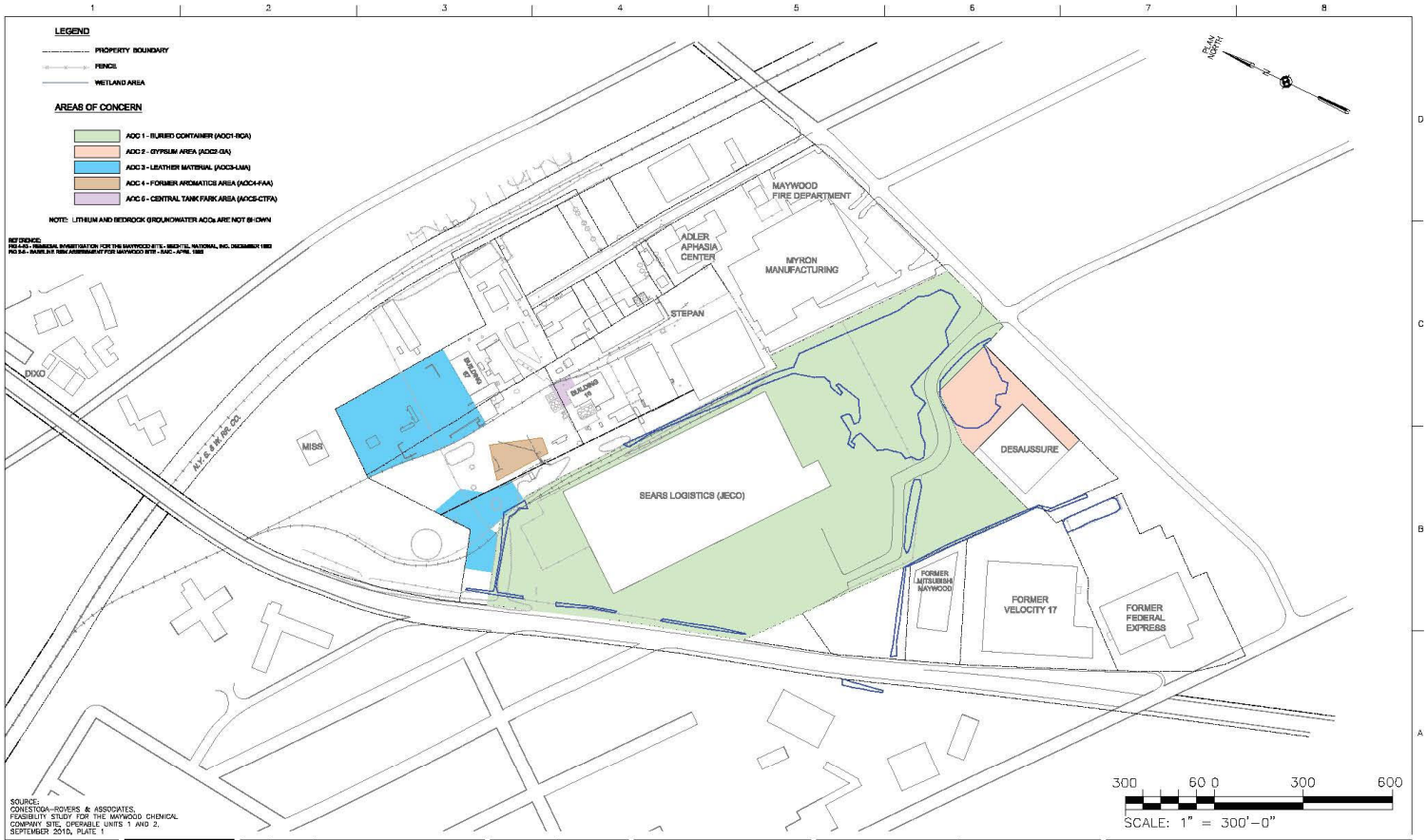
SITE LOCATION MAP

MAYWOOD CHEMICAL COMPANY SUPERFUND SITE
MAYWOOD AND ROCHELLE PARK
BERGEN COUNTY, NEW JERSEY

DATE
MAY 2013

FIGURE
FIGURE 1

Figure 2: Site Map



Chronology of Site Events

Event	Date(s)
Maywood Chemical Works (MCW) receives Atomic Energy Commission (AEC) License R-103 for thorium possession, processing and re-sale.	1954
Processing of monazite sands for rare earths and thorium ceases.	1956
AEC License R-103 expires.	1957
Stepan Company buys MCW and applies for AEC license "to cover our operations as processors and exporters of source material." Application states "active manufacturing in the Thorium Plant is at a standstill."	1959
Stepan Company receives an AEC radioactive materials license.	1961
Based on AEC inspections and information related to a property west of NJ State Route 17, known as the Ballod property, Stepan Company agrees to take certain corrective actions and began to clean up residual thorium waste, by partially stabilizing residues and tailings.	1963
Stepan Company removes approximately 19,100 cubic yards (cy) of contaminated soil from the Ballod property and places it into three burial pits (1, 2 & 3) on the Stepan Company property.	1966-1968
EPA adds the Maywood Chemical Company Site to the Superfund National Priorities List. In late 1983, Congress assigns DOE a research and development project to clean up the radioactive wastes at the site (via the FY84 Energy and Water Appropriations Act).	1983
DOE assigns the Site to the Formerly Utilized Sites Remedial Action Program (FUSRAP) to address radiological contamination with USACE as the lead agency.	1983
DOE begins investigating the Sute and surrounding area. Vicinity properties on Grove Avenue and Parkway in Rochelle Park are surveyed in late 1983, and nine of the surveyed properties are designated for remedial action as a result. In addition, a "drive-by" gamma survey followed by ground surveys that included limited sampling are completed for properties in Lodi.	1983-1984

Approximately 35,000 cy of contaminated materials are removed from the Ballod property and from 17 vicinity properties on Davison Avenue, Latham Street, Grove Avenue, and Parkway in Maywood and Rochelle Park. An additional 500 cy of contaminated materials are removed from eight vicinity properties located on Avenue C, Avenue F, Hancock Street, and Trudy Drive in Lodi, and another portion of the Ballod property in Rochelle Park. The excavated materials are stored in a protective enclosure cell on a portion of 100 West Hunter Avenue (now known as the Maywood Interim Storage Site (MISS)) which DOE acquired in 1985 to expedite cleanup of the vicinity properties.	1984-1985
EPA begins characterizing chemical, non-radiological contamination on the Stepan Company property and surrounding areas.	1986
EPA and Stepan Company enter into an Administrative Order on Consent to investigate the (formerly) Sears and adjacent properties.	1987
EPA and DOE enter into Federal Facility Agreement (FFA).	1990
EPA issues a Unilateral Administrative Order for Stepan Company to investigate the Stepan Company property.	1991
Stepan Company initiates the Remedial Investigation at the Site for chemical, non-radiological contamination in overburden soils and groundwater, bedrock groundwater, and surface water and sediment.	1991
A time-critical removal action is undertaken by DOE to decontaminate one additional residential property in Lodi due to the significantly elevated gamma exposure rates measured inside the residence.	1991
DOE issues the report titled, *Remedial Investigation Report for the Maywood Site*.	1992
DOE issues the document titled, *Final Baseline Risk Assessment for the Maywood Site.*	1993
EPA completes a Site baseline risk assessment based on Stepan Company's Remedial Investigation findings.	1993
Stepan Company completes, and EPA approves the *Remedial Investigation Report* for chemical contamination in overburden soils and groundwater, bedrock groundwater, and surface water and sediment.	1994
Additional cleanup criteria for the radionuclide contamination in soil at the site are established in 1994. DOE implements interim property cleanups as removal actions as described in the September 1995 *Engineering Evaluation/Cost Analysis (EE/CA) for the Cleanup of Residential and Municipal Vicinity Properties at the Maywood Site, Bergen County, New Jersey* under CERCLA.	1994-1995

Cleanup at fourteen residential properties, four municipal properties (three parks and a fire station) and one commercially zoned property is initiated. Previously stored excavated materials are removed from the MISS and sent to a permanent, off-site commercial disposal facility.	1995-1997
USACE performs remediation of the remaining 23 vicinity properties. During these cleanup actions, an additional five properties in Lodi and Maywood are remediated as the contamination extended onto adjacent undesignated properties.	1997-1999
A time critical removal action is completed by USACE during the winter of 2000 to remove contaminated sediments from portions of Lodi Brook and a swale located at the terminus of West Howcroft Road. The removal action re-establishes the hydraulic grade of the brook and swale, prevents additional flooding, and prevents the transport or migration of contaminated soil by flooding water.	2000
USACE issues the *Engineering Evaluation/Cost Analysis for a Removal Action in Support of NJDOT Roadway Improvement Projects at the FUSRAP Maywood Superfund Site (FMSS)*.	2001
The *Feasibility Study for Soils and Buildings at the FUSRAP Maywood Superfund Site* is completed and submitted for public comment along with the *Proposed Plan for Soils and Buildings at the FUSRAP Maywood Superfund Site*.	2002
EPA and USACE sign the *Record of Decision (ROD) for Soils and Buildings at the FUSRAP Maywood Superfund Site.*	2003
USACE completes the Remedial Design for FUSRAP Soils and Buildings.	2004
On-site FUSRAP Soils and Buildings remedial action construction starts.	2004
Post Remedial Action Reports for individual properties are developed.	2005 to present
EPA issues the First Five-Year Review Report.	2009
USACE submits a Technical Memo assessing all property investigations and cleanups to date.	2013
EPA completes the non-FUSRAP final soil and source areas *Feasibility Study*.	2013
EPA announces the *Proposed Plan* for Operable Unit 1 (OU1).	2013
EPA issues the Second Five-Year Review Report.	2014
EPA issues a *Record of Decision for the Maywood Chemical Company Superfund Site Operable Unit 1 Non-FUSRAP Soil and Source Areas*.	2014
EPA issues the Third Five-Year Review Report.	2019

USACE issues an *Explanation of Significant Differences* for the *Record of Decision for Soils and Buildings at the FUSRAP Maywood Superfund Site*.	2021
EPA issues an *Explanation of Significant Differences* to modify the *Record of Decision for the Maywood Chemical Company Superfund Site Operable Unit 1 Non-FUSRAP Soil and Source Areas* to include residential properties, with the assumption that current and future land use will remain residential.	2021
EPA approves the *100% Design Report* for OU1.	2021
EPA approves the *100% Design Report for the Gypsum Area (AOC 2) Residential Properties* for OU1.	2022
EPA approves the *Remedial Action Work Plan for the Gypsum Area (AOC 2) Residential Properties* for OU1.	2022
Stepan Company initiates the remedial work for the Gypsum Area (AOC 2) Residential Properties for OU1.	2022
Fourth Five-Year Review Report	2024

APPENDIX C – CLIMATE CHANGE ASSESSMENT

Appendix C – Climate Change Assessment

In accordance with the Region 2 Guidance for Incorporating Climate Change Considerations in Five Year Reviews, four climate change tools were utilized to assess the Maywood Chemical Company Superfund Site ("Site"). The tools were only used for Maywood, NJ since Lodi and Rochelle Park are neighboring towns. Screenshots from each of the tools assessed are included below.

The first tool utilized in the assessment was The Climate Explorer. According to this tool, the average daily maximum temperature is expected to increase to around 71°F if global emissions of heat-trapping gases continue increasing through 2100 (Figure C-1). No significant changes in total precipitation are expected if global emissions of heat-trapping gases continue increasing through 2100, which is similar to the projection for the number of days per year with > 3 inches of precipitation (Figures C-2 and C-3). Annual counts of intense rainstorms — those that drop two or more inches in one day – are projected to have between a 1% decrease and a 7% increase. Historically, Maywood averaged 1 (0 - 6) intense rainstorms per year.

The second tool utilized in the assessment was Risk Factor (formerly Flood Factor). According to this assessment tool, there are 298 properties in Maywood that have greater than a 26% chance of being severely affected by flooding over the next 30 years. This represents 15% of all properties in Maywood. Overall, the Site has a moderate risk of flooding. Although Risk Factor gives a moderate flood risk rating to the area, the Site itself has not been impacted by flooding in the past.

The third tool utilized in the assessment was the National Oceanic and Atmospheric Administration's (NOAA) tool called Sea Level Rise. As shown in Figure C-4, there is little to no impact to Maywood from sea level rise (10 ft water level) and overall Maywood has low vulnerability to sea level rise (Figure C-5).

The final tool utilized in the assessment was the U.S. Geographical Service National Landslide Inventory. There are currently no indications of landslides impacting Maywood (Figure C-6).

Potential impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the Site.

Figure C-1

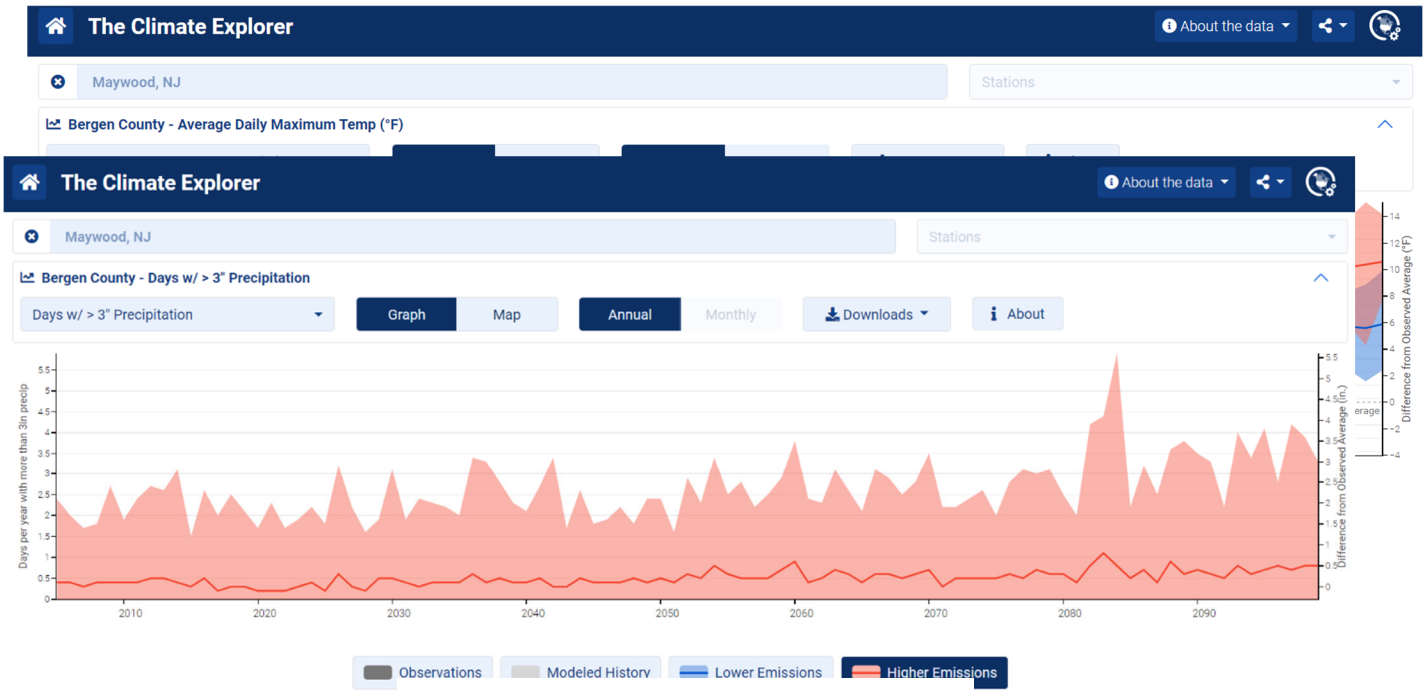

The Climate Explorer
About the data
Maywood, NJ
Stations
Bergen County - Average Daily Maximum Temp (°F)
The Climate Explorer
About the data
Maywood, NJ
Stations
Bergen County - Days w/ > 3" Precipitation
Days w/ > 3" Precipitation
Graph
Map
Annual
Monthly
Downloads
About
Days per year with more than 3in precip
Difference from Observed Average (in.)
Difference from Observed Average (°F)
2010
2020
2030
2040
2050
2060
2070
2080
2090
Observations
Modeled History
Lower Emissions
Higher Emissions

Figure C-2

Figure C-3

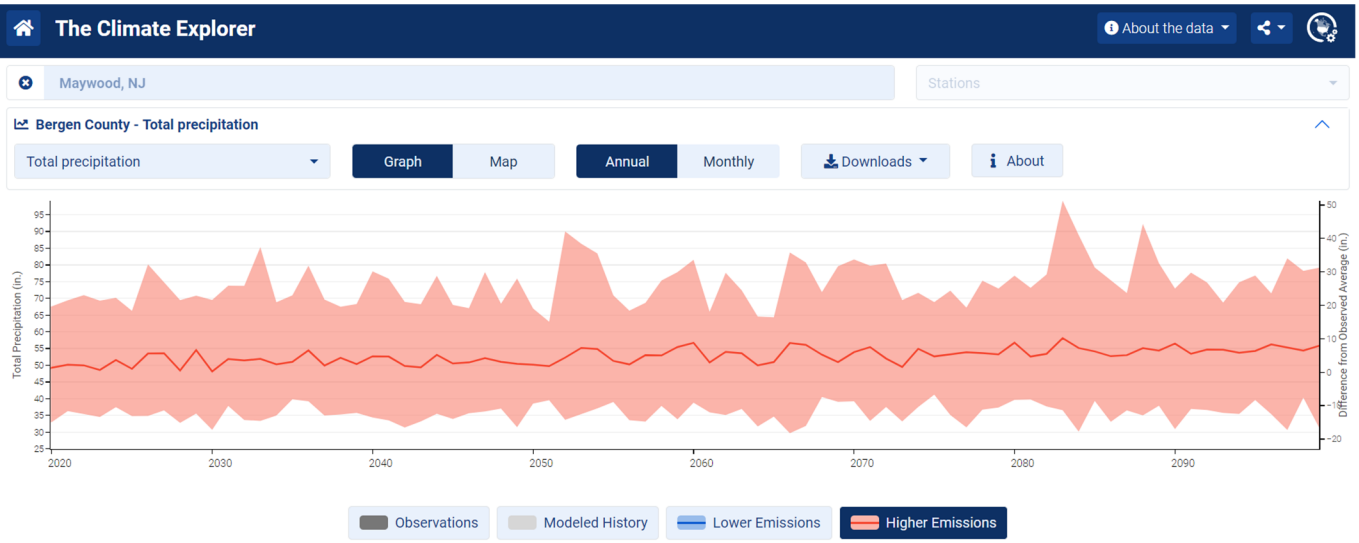

The Climate Explorer
About the data
Maywood, NJ
Stations
Bergen County - Total precipitation
Total precipitation
Graph
Map
Annual
Monthly
Downloads
About
Total Precipitation (in.)
Difference from Observed Average (in.)
2020
2030
2040
2050
2060
2070
2080
2090
Observations
Modeled History
Lower Emissions
Higher Emissions

Figure C-4

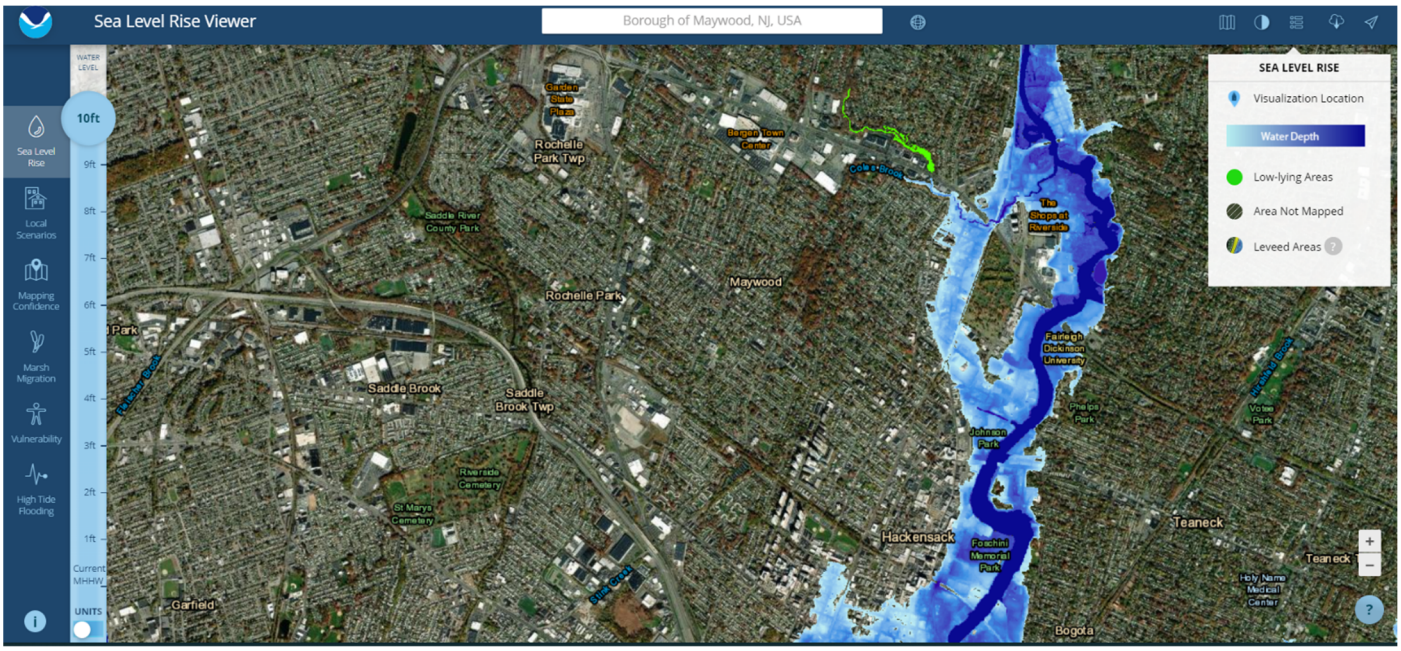


Figure C-5

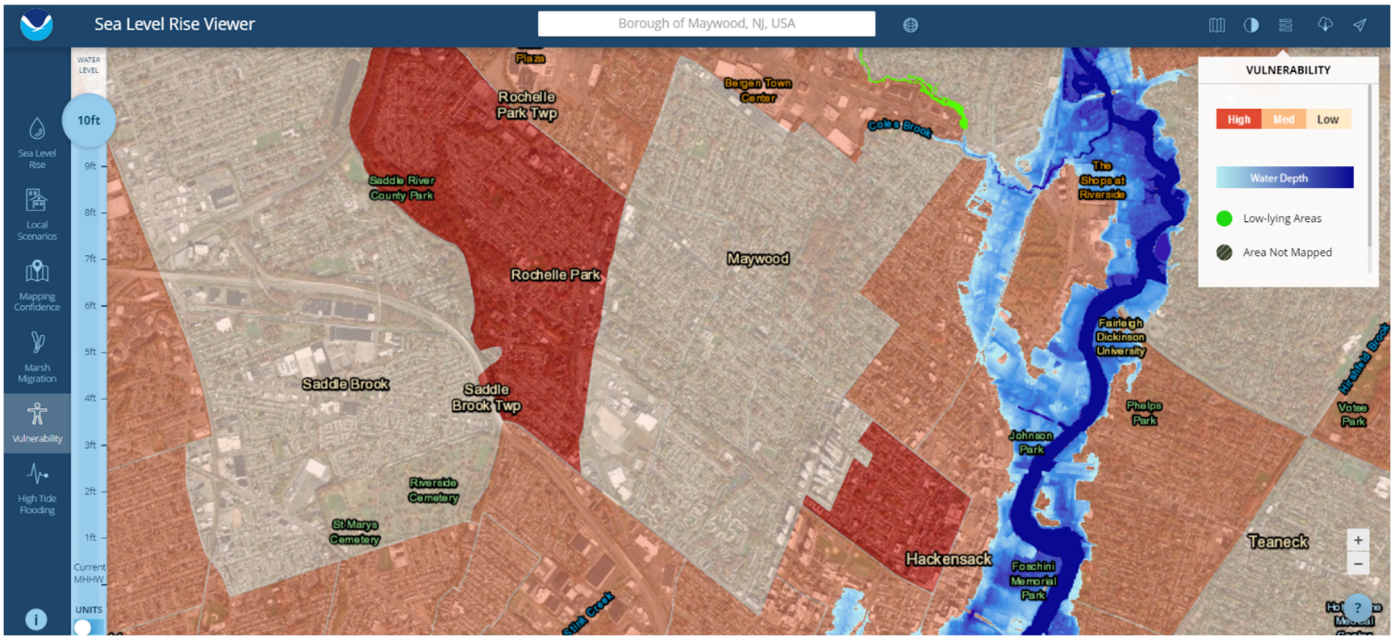
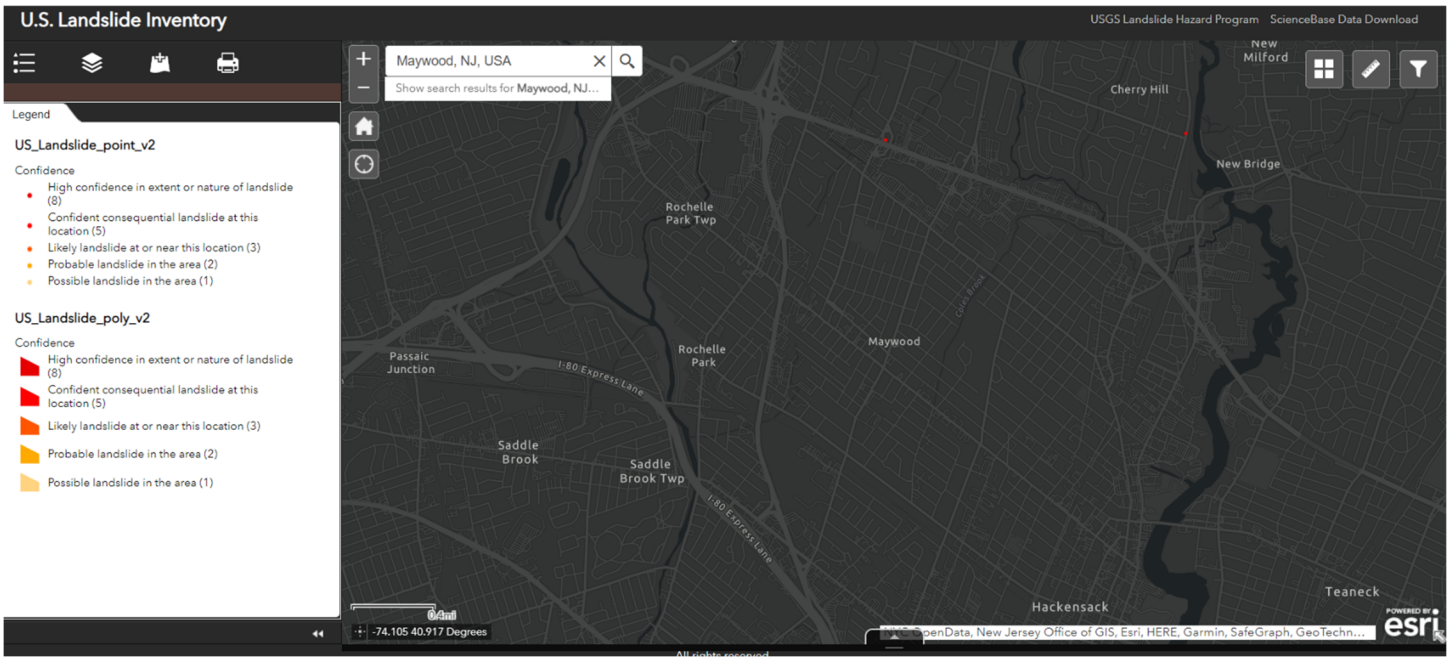


Figure C-6


U.S. Landslide Inventory
USGS Landslide Hazard Program
ScienceBase Data Download
Maywood, NJ, USA
Show search results for Maywood, NJ...
Legend
US_Landslide_point_v2
Confidence
High confidence in extent or nature of landslide (8)
Confident consequential landslide at this location (5)
Likely landslide at or near this location (3)
Probable landslide in the area (2)
Possible landslide in the area (1)
US_Landslide_poly_v2
Confidence
High confidence in extent or nature of landslide (8)
Confident consequential landslide at this location (5)
Likely landslide at or near this location (3)
Probable landslide in the area (2)
Possible landslide in the area (1)
New Milford
Cherry Hill
New Bridge
Rochelle Park Twp
Maywood
Rochelle Park
Passaic Junction
I-80 Express Lane
Saddle Brook
Saddle Brook Twp
Hackensack
Teaneck
-74.105 40.917 Degrees
esri