WORK PLAN FOR BASELINE ECOLOGICAL RISK ASSESSMENT

McCAFFREY STREET SITE

(Site No. 442046, USEPA ID# NYD004986741)

Prepared on Behalf of: Saint-Gobain Performance Plastics Corporation and Honeywell International Inc.

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List of Acronyms

1,2-DCE	1,2-dichloroethene
95UCL	one-sided 95 percent upper confidence limit for the arithmetic mean
ADD	average daily dose
AUF	area use factor
BEHP	bis(2-ethylhexyl) phthalate
BERA	baseline ecological risk assessment
bgs	below ground surface
BHHRA	baseline human health risk assessment
BTEX	benzene, toluene, ethylbenzene, and xylenes
BW	body weight
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CN	cyanide
CSM	conceptual site model
DQO	data quality objective
DTSC	California Department of Toxic Substances and Control
EcoSSL	Ecological Soil Screening Level
EPC	exposure point concentration
EqP	equilibrium partitioning
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERM	Environmental Resources Management
ESA	environmental site assessment
ESV	ecological screening value
EU	exposure unit
FOD	frequency of detection
FWIA	Fish and Wildlife Impact Analysis
GAC	granular activated carbon
GSI	GSI Environmental Inc.
HPAH	high molecular weight polycyclic aromatic hydrocarbon
HRWA	Hoosic River Watershed Association
HQ	hazard quotient
IR	ingestion rate
IRM	interim remedial measure
KM	Kaplan Meier
LOAEL	lowest-observed-adverse-effects level
LPAH	low molecular weight polycyclic aromatic hydrocarbon
MCL	maximum contaminant level

MDL .... method detection limit
mg/kg .... milligrams per kilogram
MRL .... method reporting limit
MSL...................................... mean sea level
NAWQC .... National Ambient Water Quality Criteria
ND.. non-detect
ng/L .... nanogram per liter
NLCD………………………… National Land Cover Database
NPL .... National Priority List
NOAEL.................................. no-observed-adverse-effects level
NYCRR .... New York Codes, Rules, and Regulations
NYS...................................... New York State
NYSDEC .... New York State Department of Environmental Conservation
NYSDOH............................... New York State Department of Health
ORNL………………………… Oak Ridge National Laboratory
OSWER .... Office of Solid Waste and Emergency Response
PAH...................................... polycyclic aromatic hydrocarbon
PCB...................................... polychlorinated biphenyl
PEC……………………………probable effects concentrations
PFAS.................................... per-and polyfluoroalkyl substances
PFBS.................................... perfluorobutane sulfonate
PFHpA .... perfluoroheptanoic acid
PFHxS.................................. perfluorohexane sulfonate
PFNA .... perfluorononanoic acid
PFOA .... perfluorooctanoic acid
PFOS .... perfluorooctane sulfonate
PRA……………………………probabilistic risk assessment
PTFE.................................... polytetrafluoroethylene
QA/QC .... quality assurance/quality control
RAGS................................... Risk Assessment Guidance for Superfund
REC .... recognized environmental conditions
RI .... remedial investigation
RI/FS.................................... remedial investigation/feasibility study
RISA..................................... residential irrigated soil area
RPD……………………………relative percent difference
RSV……………………………refined screening values
SAP...................................... sampling and analysis plan
SERDP……………………… Strategic Environmental Research and Development Program
SGPP………………………… Saint-Gobain Performance Plastics Corporation
SGV .... sediment guideline values

SLERA .... screening level ecological risk assessment
SMDP............................. Scientific/Management Decision Point
SQL .... sample quantitation limit
SSL................................ soil screening levels
SUF .... seasonal use factor
SVOC .... semi-volatile organic compound
TAGM .... Technical and Administrative Guidance Memorandum
TAL/TCL .... target analyte list/target compound list
TCE .... trichloroethene
TEC.................................threshold effect concentration
TFE .... tetrafluoroethylene
TPH .... total petroleum hydrocarbons
TRV .... toxicity reference value
μg/kg .... micrograms per kilogram
μg/L .... micrograms per liter
μg/m^3 .... micrograms per cubic meter
USEPA .... United States Environmental Protection Agency
USFWS .... United States Fish and Wildlife Service
USGS .... United States Geological Survey
VOC .... volatile organic compound
WIR .... average daily water ingestion rate

1.0 INTRODUCTION

This Baseline Ecological Risk Assessment (BERA) Work Plan has been prepared by GSI Environmental Inc. (GSI) for the McCaffrey Street Site in Hoosick Falls, New York, (New York State Department of Environmental Conservation Site No. 442046) (the site, Figure 1). This Work Plan was prepared on behalf of Saint-Gobain Performance Plastics Corporation (SGPP) and Honeywell International Inc. (Honeywell) in response to a request from the New York State Department of Environmental Conservation (NYSDEC) dated 27 May 2020 pursuant to the 2016 Order on Consent for the site (NYSDEC, personal communication, May 27, 2020; NYSDEC State Superfund Program, 2016). A baseline risk assessment was requested for the site to fulfill the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or "Superfund") requirements for Remedial Investigation/Feasibility Studies (RI/FS). Although human health risk assessment and environmental ecological assessments are different, when conducted for the same site using the same chemical sampling data, they should share common information and should be coordinated (USEPA, 1989a). Please refer to the companion document for the Baseline Human Health Risk Assessment (BHHRA).

1.1 Scope and Objectives

The goal of Superfund baseline risk assessments is to "provide a framework for developing the risk information necessary to assist decision-making at remedial sites" (USEPA, 1989a). Baseline risk assessments often include evaluations of multiple sources of variability and uncertainty in exposure and response, integrating site-specific data, scientific literature, regulatory guidance, and professional judgment. As such, risk assessments support statements regarding the probability of potential adverse effects, rather than making firm conclusions about disease, causation, or the health status of current or potential future populations. As required under CERCLA section 104(i)(5)(F), the goal of this baseline risk assessment is to characterize the probability of adverse effects from estimated exposures to potential environmental hazards at the site, using quantitative, chemical-specific characterizations and statistical models and estimates of risk (USEPA, 1989a). The assessment will consider assumptions regarding exposure scenarios and potential human and ecological receptors that may contact chemicals in the environment under both current and potential future conditions in order to inform risk management decisions (USEPA, 1989a, 1998).

The BERA will follow the process defined by USEPA for evaluating ecological risks at Superfund Sites (USEPA, 1989a, 1998). Both U.S. Environmental Protection Agency (USEPA) and NYSDEC guidance for conducting a RI/FS require that remedies at contaminated sites be protective of human health and the environment (NYSDEC, 2010a; USEPA, 1988), and the BERA is one of the tools that will be used to select a remedy for the site that meets this requirement.

This Work Plan outlines the procedures by which data collected as part of the remedial investigation (RI) will be evaluated to assess risks to ecological receptors. The RI sampling conducted to date informs the nature and extent of chemicals present in the Primary Project Area, including metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, per- and polyfluoroalkyl substances (PFAS), and volatile and semi-volatile organic compounds (VOC/SVOC) (C.T. Male Associates, 2016, 2019a). This Work Plan presents the problem formulation and initial conceptual site models (CSMs) used to define the scope of the BERA, the results of screening-level risk assessments for identification of contaminants of potential ecological concern (COPECs), and the methods for characterizing exposure, toxicity, and risk in the final baseline risk assessment.

The findings and conclusions of this BERA will be used in conjunction with other RI findings to determine whether remedial action is needed, and if so, to support development of risk management options.

1.2 Risk Assessment Guidance and Regulatory Framework

The methods and approach for the BERA are based on available risk assessment guidance, including but not limited to the key documents listed below. A more extensive list is provided in Table 1.

Federal Guidance:

- OSWER Directive 9355.3-01, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988)
- RAGS, Volume II, Environmental Evaluation Manual, Interim Final. (USEPA, 1989b)
- Framework for Ecological Risk Assessment (USEPA, 1992b)
- Developing a Work Scope for Ecological Assessments (USEPA, 1992a)
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (ERAGS) (USEPA, 1997)
- Guidelines for Ecological Risk Assessment (USEPA, 1998)
- Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites (USEPA, 1999)
- RAGS, Volume III, Part A, Process for Conducting Probabilistic Risk Assessment (USEPA, 2001c)
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002c)
- Guidance for the Data Quality Objectives Process (USEPA, 2006)

New York State Guidance:

- NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010a)
- Fish and Wildlife Impact Analysis (FWIA) for Inactive Hazardous Waste Sites (NYSDEC, 1994)
- New York State Brownfield Cleanup Program - Development of Soil Cleanup Objectives - Technical Support Document (NYSDEC & NYSDOH, 2006)
- Final Commissioner Policy, CP-51, Soil Cleanup Guidance (NYSDEC, 2010b)
- Screening and Assessment of Contaminated Sediment (NYSDEC, 2014)
- Guidelines for Sampling and Analysis of PFAS Under NYSDEC's Part 375 Remedial Programs (NYSDEC, 2020c)

1.3 Work Plan Organization

The BERA Work Plan is organized as follows:

- Section 2 provides a summary of the site setting and background.
- Section 3 provides a summary of previous and current investigations, including a summary of RI/FS work performed to date, as well as anticipated outcomes.

- Section 4 provides a summary of data collected to date, Data Quality Objectives (DQO), and Data Usability and Processing Rules.
- Section 5 describes the process and tiered approach to the preparation of the BERA, risk characterization and uncertainty assessment.
- Section 6 provides information on project organization, schedule, and the GSI team.
- Section 7 provides a list of references used in the preparation of this document.

These sections are followed by exhibits and appendices with additional detailed information.

2.0 SITE SETTING AND BACKGROUND

This section describes the operational history and physical setting, as well as the physiographic, geologic, hydrogeologic, and relevant ecological properties of the site. More extensive discussion of the topics summarized here can be found in the RI/FS Work Plan and Supplemental Work Plans (C.T. Male Associates, 2016, 2017a, 2018b, 2019a) .

2.1 Site and Project Area Description

The McCaffrey Street Site ("site") is defined as an unfenced 6.47-acre tax parcel located at 14 McCaffrey Street in the Village of Hoosick Falls, adjacent to the Hoosic River in Rensselaer County, eastern New York State (Figure 1). The industrial facility on this property consists of an approximately 60,000 square foot manufacturing building, parking areas, loading zones, and warehouse areas. Considering variability in exposure scenarios and activities that are assessed in the human health risk assessment, the tax parcel (i.e., "on-site") is divided into two areas: 1) areas near the facility, including the building footprint, adjacent parking areas, and maintained grassy areas to the south and east of the plant buildings; and 2) wooded areas to the south and west, outside the facility but within the tax parcel boundary (Figure 1).

Current site knowledge compiled from a review of historic operations (see Section 3.1), previous investigation activities (see Section 3.3) and ongoing RI investigations have informed the geographic extent of areas potentially impacted by releases of site-related contaminants. Consistent with the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the site (dated August 30, 2016), the Primary Project Area evaluated in the baseline risk assessment includes the McCaffrey Street Site (on-site) and areas located outside the facility tax parcel boundary (i.e., "off-site") (C.T. Male Associates, 2016). Figure 1 illustrates the extent of the Primary Project Area (326 acres) inclusive of the tax parcel area (6.5 acres) facility boundary (4.2 acres), and approximately 0.75 miles of shoreline along the Hoosic River. This shoreline area also includes the Village Greenway Trail system, river access, and recreational nature trails and picnic tables. Suburban residential neighborhoods are present along the northern edge of the tax parcel. The western portion of the Primary Project Area outside the tax parcel is undeveloped and forested and is approximately 200 feet east of the Hoosic River. According to the RI/FS Work Plan, adjacent land use also includes the Village of Hoosick Falls sewer pump station to the north, and the Village of Hoosick Falls water supply well field and water treatment plant to the south (C.T. Male Associates, 2016). There are also Department of Public Works garages, youth sporting fields, and recreational areas in this general vicinity to the south of the site.

The Village of Hoosick Falls within the Town of Hoosick is a rural community located predominantly to the north of the site, that is served by the local municipal water department with drinking water sourced from three nearby groundwater wells. Due to the historic presence of perfluorooctanoic acid (PFOA) in municipal water supply wells, surface soils throughout the water district's distribution system may have been impacted with PFOA via the use of residential tap water for irrigation. Although mitigation measures have been implemented in the municipal water system and irrigation is not a current pathway, residual PFOA may still be present in soil of some yards. Therefore, there is a "Residential Irrigated Soil Area" (RISA) specific only to the evaluation of residential areas with potential PFAS soil impacts throughout the Village municipal water distribution system that has been included as part of the companion BHHRA (Figure 2). The uncertainty associated with ecological receptors with home ranges that may include this expanded area will be addressed in the BERA Uncertainty Section.

The current owner and operator at the site is SGPP. The original developer at the site was Dodge Fibers Corporation (a producer of extruded tapes and circuit board laminates). The site ownership changed several times during a 30-year period beginning in the 1960s. Prior owners include Oak Materials Group (1967), AlliedSignal Fluorglas (1987), Furon (1996), and SGPP, which acquired the property in 1999 (C.T. Male Associates, 2016). Beginning in the late 1980s until 2003, polytetrafluoroethylene (PTFE) coated fiberglass was manufactured at the site. Other historical chemical use on site may have included petroleum fuels, lubricants, degreasing agents, solvents, paints, Triton, and various PFAS (C.T. Male Associates, 2016).

2.2 Physical and Geologic Setting

The Village of Hoosick Falls is located in the New England Upland (Taconic Range) physiographic province, an area defined by ancient (Ordovician) mountain-building continental collisions and more recent (Pleistocene) continental glaciations. The site is located on an elevated glacial terrace underlain by bedrock of the Walloomsac Formation, an Upper Ordovician unit composed of dark-gray siliceous shale, phyllite, limestone, and minor beds of quartzite. Elevation of the terrace ranges from 430 to 460 feet MSL. Topography at the site is moderate to steep and slopes generally to the southeast. Adjacent off-site properties slope to the east, southeast, south, and southwest towards the Hoosic River, a tributary of the Hudson River. The approximately 0.75 mile reach of the Hoosic River within the Primary Project Area is at an elevation of approximately 400 feet MSL (USGS, 2019).

Surficial geology at the site is manmade and glacial in origin. Boring logs from prior investigations indicate as much as 2.7 feet of surficial fill material underlain by glacial till and outwash deposits (C.T. Male Associates, 2016). Elevated areas of the site tend to be underlain by glacial till, and low-lying southern and eastern areas are underlain by outwash and/or alluvial material comprised of sand, silt, clay, gravel, and cobbles (C.T. Male Associates, 2016, 2019a). Depth to bedrock within the tax parcel is typically 10 to 34 feet below ground surface (bgs) (C.T. Male Associates, 2019a). Depth to groundwater ranges 0.8 to 14 feet bgs within the tax parcel and 1.6 to 15 feet bgs within the broader Primary Project Area.

Two hydro-stratigraphic units have been identified in unconsolidated materials at the site. The shallower hydro-stratigraphic unit is possibly perched on top of glacial till, is located within a few feet of the ground surface in northern areas of the site, and is interpreted to leak downwards into the deeper unit, approximately seven to ten feet bgs. The perched unit is not observed in the southeastern portion of the site. Groundwater flows away from the site radially (C.T. Male Associates, 2019a).

2.3 Climate

The climate in most of Central and Upstate New York is humid continental. Winter temperatures are typically below freezing and snow cover is common in late fall, winter, and early spring. Meteorological conditions for Hoosick Falls, NY are available as a weighted average from the three nearest weather stations, corrected for differences in elevation, with weights proportional to the inverse of the distance between Hoosick Falls and a given station (Weatherspark, 2020). The nearest station, William H. Morse State Airport in Bennington, VT, is 5.6 miles to the east and contributes 74% to the estimates. The following statistics are based on hourly weather reports and model reconstruction for the period January 1, 1980 to December 31, 2016 (Weatherspark, 2020):

- The warm season lasts for 3.8 months, from May 24 to September 16, with an average daily high temperature above 70°F. The cold season lasts for 3.3 months, from December 2 to March 10, with an average daily high temperature below 41°F.
- Average precipitation for the area varies seasonally, from a low of 1.3" in January to a high of 3.7" in June and September.
- Snowfall typically occurs within a 5-month period, between October 31 and April 18, with an average monthly accumulation during this period of 0.1 inches (total liquid-equivalent; actual depth of snow on ground surface may be 5 to 10 times greater, assuming the ground is frozen).

A weather station was installed on the rooftop of the McCaffrey Street facility in November 2018 to gather meteorological data that are representative of conditions within the Village. The MetOne, All In One (AIO) Sonic Weather Sensor (model AIO-2) was purchased along with a precipitation gauge (model 360). Following installation, the station began recording meteorological data (including ambient air temperature, relative humidity, wind direction, wind speed, barometric pressure, and precipitation) shortly thereafter. Data are recorded continuously and transmitted every 15 minutes.

Data monitoring and visual inspections have been conducted in accordance with the station's Operation and Maintenance Plan, which was included in the Work Plan (C.T. Male Associates, 2019a). A data completeness summary and a summary of audit was conducted on May 28, 2020, and based on the results of the audit, no calibration or additional maintenance was recommended at that time.

The following statistics are based on a summary of average monthly measurements during the past two years (2019 and 2020):

- The average daily high temperature was 79°F during the warm months (May through September) and 37°F during the cold months (December through February).
- Average total precipitation varied from a low of 1.5'' in November to greater than 3.5"" in August and October.

2.4 Habitat Characterization

2.4.1 Regional Ecological Setting

Much of eastern New York State is classified as the Northeastern Highlands ecoregion (Bryce et al., 2010); a mountainous forested area of New England and New York. The Northeastern Highlands ecoregion is a transitional zone between the boreal forests of Canada to the north and deciduous ecosystems further south. Forest types in this zone typically include northern hardwoods (maple-beech-birch), northern hardwoods/spruce, and northeastern spruce-fir (Bryce et al., 2010).

The site is located within the Taconic Foothills sub-region of the Northeastern Highlands, an area defined by eroded metamorphic foothills that are capped with glacial till. Many of these foothills were cleared for historical agricultural use (Bryce et al., 2010), but have now been restored to forests. The area contains many alluvial valleys, glacial lake basins, and high-quality farmland and productive soils (Bryce et al., 2010; Winter et al., 2018). The Village of Hoosick Falls is a suburban/industrial corridor within an otherwise forested and agricultural valley. Land cover in the watershed is estimated to be 73% forested and 12% agricultural land (Martinez et al., 2005).

2.4.2 Hoosic River Watershed

The site is located adjacent to the Hoosic River, an approximately 76-mile-long tributary of the Hudson River (Figure 3). The Primary Project Area includes approximately 0.75 miles of shoreline of the river. The Hoosic River originates in the western Berkshire Hills of Massachusetts, flowing through the Green Mountains in southwest Vermont, into eastern New York. After flowing northward through Hoosick Falls, the river bends westward through the hamlets of Eagle Bridge and Johnsonville, and the town of Schaghticoke, at which point it drains into the Hudson River at Stillwater, approximately 15 miles north of Troy, New York.

Hoosic River water quality in the vicinity of the site is characterized by NYSDEC as generally ‘slightly impacted’ (NYSDEC, 2016b). Elevated levels of PCBs are thought to originate from historical industrial activity in the region and have resulted in contaminated river sediments (NYSDEC, 2016b), and measurable quantities of perfluorooctane sulfonate (PFOS) and other PFAS have been detected in fish collected from the river and adjacent ponds (NYSDEC, 2016a). Regionally, the Hoosic River is also impacted by non-point source contamination such as run-off from lawns, roads, and agricultural fields (Fontana, 2012).

Table 2 summarizes water use classifications for the Hoosic River for reaches near the site according to 6 New York Codes, Rules, and Regulations (NYCRR) § 701 and § 940.4 (NYSDEC, 2020a, 2020b). The reach adjacent to the site is classified as a Class C waterbody, meaning that it is suitable for general recreation and supports aquatic life, but not as a water supply or bathing without treatment (NYSDEC, 2016b). Immediately downriver from the site, the designation changes to Class D, which downgrades aquatic life habitat suitability from “Propagation and Survival” to “Survival” due to changes in “such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions”.

Fish advisories on the Hoosic River include a “Don’t Eat” determination for women under 50 and children under 15 years throughout Rensselaer and Washington Counties due to elevated levels of polychlorinated biphenyls (PCBs) (NYSDEC, 2016a, 2016b). Effective July 24, 2017, NYSDOH also recommended people to not consume fish from water bodies around Newburgh and Hoosick Falls areas until testing for PFOA, PFOS, and other PFAS is complete (NYSDOH, 2017).

2.4.3 Ecological Resources

Based on aerial imagery, land use classification inventories, and a site visit in August 2020, areas adjacent to the site support riparian, wetland, and forest ecological communities. Habitat areas within and immediately adjacent to the facility and tax parcel boundary, are dominated by mixed forest, shrub/scrub, open space, and small areas of wooded wetland to the south (Figure 4 and Exhibits 1 and 2). Figure 5 shows land cover classifications across the Primary Project Area based on National Land Cover Classifications (NLCD) downloaded from the Multi-Resolution Land Characteristics website. This inventory indicates that the 326-acre Primary Project Area consists of approximately 40 acres (13%) of deciduous, evergreen, and mixed forest; 27 acres (8%) of woody wetlands and open water; 23 acres (7%) of agricultural land; and 88 acres (27%) of open space.

The topographic low located approximately 400 feet south of the site is classified as a PF04/1A wetland by the National Wetlands Inventory (USFWS, 2020). This means that the area is considered a forested palustrine (non-tidal) area "dominated by trees, shrubs, [and] persistent emergents". Trees in the area are classified as a combination of needle-leaved evergreen ("typically young or stunted trees such as black spruce or pond pine") and broad-leaved deciduous, woody angiosperms "with leaves that are shed during the cold season" (USFWS, 2020). The water regime classification for this area is "temporary flooded", meaning that surface water is occasionally present, but that the potentiometric surface is below the ground surface for the majority of the year (USFWS, 2020).

The Hoosic River (as well as Rensselaer County in which the site is located and the Hudson River downstream) is classified as a confined riverine community (rank G4 S3S4) by the New York Natural Heritage Program (Edinger et al., 2014). Traits typical of confined river aquatic communities (as described in Edinger et al. 2014) include:

- Relatively large, fast-flowing moderate to gentle-gradient streams.
- Alternating pools, riffles, runs, and channel islands and bars (low sinuosity).
- Autochthonous river systems, meaning that energy supply is created *in-situ* in the form of photosynthesis from large plants and algae.
- Moderate fish diversity.
- Species assemblages characteristic of riffles and rock bottoms.
- Clear, well-oxygenated water surrounded by upland riverside communities such as riverside sand/gravel bar or cobble shore outcrop communities.

Observed fish populations in Hoosick Falls are mostly non-native/introduced species such as brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), white sucker (*Catostomus commersonii*), carp (*Cyprinus carpio*), and smallmouth bass (*Micropterus dolomieu*) (Fontana, 2012). Aquatic macroinvertebrate populations are present and are monitored by the Hoosic River Watershed Association (HRWA). Macroinvertebrate species found in the vicinity of Hoosick Falls include (but are not limited to):

- Arthropods: Ephemeroptera (mayflies), Coleoptera (beetles), Megaloptera (the order containing alderflies, dobsonflies & fishflies), Trichoptera (caddisfly), Diptera ('true flies')
- Decapoda (crustaceans)
- Nemertea ('ribbon worms')
- Oligochaeta (annelid worms)

Macroinvertebrate communities in the area of Hoosick Falls are classified by the HRWA as 'slightly impacted' (Nolan, 2008).

In addition to aquatic vertebrate and macroinvertebrate species, the Hoosic River corridor is known to host white-tailed deer (*Odocoileus virginianus*), muskrat (*Ondatra zibethicus*) and bird species including the great blue heron (*Ardea herodias*) and smaller heron species, kingfishers (*Alcedinidae*), bank swallows (*Riparia riparia*), common yellowthroats (*Geothlypis trichas*), catbirds (*Dumetella carolinensis*), killdeer (*Charadrius vociferous*), sandpipers (family *Scolopacidae*), red-tailed hawk (*Buteo jamaicensis*), and bald eagle (*Haliaeetus leucocephalus*) (Fontana, 2012). The bald eagle is listed as a threatened species by NYSDEC (NYSDEC, 2015).

3.0 SUMMARY OF PREVIOUS AND CURRENT INVESTIGATIONS

3.1 Chemical Use Based on Operational History and Early Investigations

This section summarizes chemicals that were used over the operational history of the site, as well as classes of chemicals analyzed from previous investigations. The facility was originally built on vacant land in 1961. Site ownership changed several times during a 30-year period beginning in the 1960s. Prior owners include Dodge Fibers Corp. (1961), Oak Materials Group (Oak Electronetics) (1967), AlliedSignal Laminate Systems Inc. and its predecessors (1986), Furon (1996), and SGPP, which acquired the property in 1999 (C.T. Male Associates, 2016). Operations at the site largely focused on thin film application of polytetrafluoroethylene (PTFE) to fiberglass. Depending on product specifications, PTFE was mixed with certain additives at times, pressed though an extruder and thinly applied to fiberglass.

Historical chemical use at the site included petroleum fuels, lubricants, degreasing agents, solvents, paints, Triton, and per-and polyfluoroalkyl substances, sometimes referred to as compounds (historically abbreviated as PFCs, but hereafter abbreviated as PFAS) (C.T. Male Associates, 2016). Several previous documents, including the 1996 Parsons Phase I and Phase II Environmental Site Assessments (ESA) (Parsons Engineering Science, 1996a, 1996b) and work conducted by C.T. Male Associates (C.T. Male Associates, 2016), summarize the historical use of the following specific substances: The reported historical use of the following specific substances:

- **Chromium**: chromium-bearing wastes (elemental chromium) from coating operations and a research and development laboratory on-site (disclosed by AlliedSignal) as well as dyes and pigments containing chromium. The 1996 Parson Phase I ESA refers to “green dispersion” in reference to the list of hazardous materials used at the facility. Compounds comprised of trivalent chromium present as a green solution when dissolved in water, in contrast to compounds comprised of hexavalent chromium, which produce yellow, orange, and red solutions (Lennartson, 2014);
- **Polychlorinated biphenyls (PCBs)**: one exterior pad-mounted transformer (owned and operated by Niagara Mohawk) containing transformer fluid with PCBs;
- **Triton X**: a surfactant included in air emission permits;
- **Polyaromatic hydrocarbons (PAHs):** fuel oil (presence of one fuel oil underground storage tank used to fire the boiler at the facility), Mobiltherm™ 603 (paraffin distillate), propane tank, creosote, naphthalene;
- **PTFE products:** including Teflon™ and premixed Teflon™ dispersions;
- **Chlorinated solvents:** Saran™ (1,2-dichloroethene [1,2-DCE]) and vinyl chloride;
- **Other solvents**: benzene, toluene, xylenes, acetone, diglyme, and 1,4-dioxane; and
- **Other substances:** ammonia hydroxide, various lab packs, PTFE resins and dispersants, acids, primary alcohol ethoxylates, amines (Rustlick G-25J), and various aerosols.

Recognized environmental conditions (RECs) in the Phase I investigation included the presence of an underground storage tank (which was removed in 1995) and the presence of a floor drain and a sump in the vicinity of mixing and coating operations (Parsons Engineering Science, 1996b). The report recommended Phase II activities be conducted at the site.

The C.T. Male Associates 2016 RI/FS Work Plan (C.T. Male Associates, 2016) summarizes prior environmental investigations at the facility, including the 1996 Parsons ESAs. According to the work plan, the Phase II ESA included the following: 1) collection of six soil boring samples; 2) collection of five groundwater samples for analysis of volatile organic compounds (VOCs) and total petroleum hydrocarbons (TPHs); 3) analysis of semi-volatile organic compounds (SVOCs) and metals in two of the five groundwater samples; 4) collection of five surface soil samples - three surface from the vicinity of an old pad mounted transformer and two from beneath the asphalt of a paved (formerly gravel) driveway from “oily stained zones” (per Parsons) for analysis of PCBs and TPHs (target analytes selected based on information that prior to 1981, hydraulic oil was applied for dust suppression (AlliedSignal Fluorglas, 1995)); 5) collection of six subsurface soil samples from soil borings for analysis of VOCs and TPHs; and 6) analysis of SVOCs and metals from two of the six subsurface soil samples (C.T. Male Associates, 2016). Results were as follows:

- **VOCs:**
  - **Soil:** acetone, methylene chloride, 2-butanone, and trichloroethene (TCE) were detected but did not exceed NYSDEC Technical and Administrative Guidance Memorandum (TAGM; version January 1994) comparison values. Acetone was also detected in soil field blanks.
  - **Groundwater:** TCE was detected at levels exceeding the Federal Safe Drinking Water Act maximum contaminant level (MCL), New York State (NYS) Groundwater Class GA standard, and New York State Primary Drinking Water Quality standard in two samples from downgradient monitoring wells. 1,2-DCE (Saran™), used as a stand-alone chemical and formed as a degradation product of TCE) and chloroform were detected at estimated concentrations below federal MCLs and New York State groundwater quality standards.

- **SVOCs:**
  - **Soil:** four compounds – di-n-butylphthalate, bis(2-ethylhexyl)phthalate (BEHP), benzo(a)pyrene, and benzo(g,h,i)perylene – were detected at estimated values in soil, but did not exceed NYSDEC comparison values. BEHP was also detected in soil field blanks.
  - **Groundwater**: three compounds – diethyl phthalate, di-n-butylphthalate, and BEHP – were detected at concentrations ranging from 0.3 to 6.0 µg/L, below NYSDEC comparison values. All three compounds were also detected in groundwater field blanks.

- **TPHs:**
  - **Soil**: TPH was detected in both of the samples collected from the gravel driveway and one surface soil sample collected in the vicinity of an old transformer. There was no TAGM comparison value for TPH in soil at the time.
  - **Groundwater**: TPH and benzene, toluene, ethylbenzene, and xylenes were not detected.

- **PCBs:**
  - **Soil**: Two PCB compounds – Aroclor 1254 and Aroclor 1260 - were detected at estimated concentrations in three samples. Concentrations were well below TAGM values.

- **Metals:**
  - **Soil:** nineteen metals were detected in two samples; 11 exceeded recommended soil cleanup objective concentrations including: aluminum, beryllium, calcium, chromium, iron, magnesium, manganese, nickel, potassium, selenium, and zinc. Of those metals, five were not naturally occurring and, therefore, classified as *more of a concern*: beryllium, chromium, nickel, selenium, and zinc.
  - **Groundwater:** antimony (maximum 16 µg/L), iron (maximum 3,060 µg/L), and manganese (maximum 343 µg/L) were detected at concentrations above New York State standards. Five metals were not detected in any of the five samples: arsenic, beryllium, copper, mercury, and thallium.

As of 1996, TCE was not stored or generated at the facility. The Phase II report concluded that the source of TCE was likely related to the facility sump pit and recommended that additional record searches be performed to evaluate potential uses during operations (Parsons Engineering Science, 1996b).

Additional sampling was conducted for PFOA and PFOS in soil, groundwater and wastewater by C.T. Male and Ramboll in 2015 (Ramboll Environ, 2016), at which point PFAS became chemicals of concern at the site. PFAS sampling and investigations are discussed in more detail in Sections 3.2 and 3.3 below.

Additional investigations planned in the C.T. Male 2016 RI/FS Work Plan included the Target Compound List (TCL) of VOCs, SVOCs, pesticides and PCBs; the Target Analyte List (TAL) of metals (including mercury); cyanide; major cations (Ca, Mg, Na, and K) and anions (Cl, SO_4, CO_3 and HCO_3); and TO-15 list of VOCs in indoor air and soil gas (C.T. Male Associates, 2016).

The Saint-Gobain Performance Plastics site was added to the National Priorities List (NPL) in 2016. Known chemicals listed in USEPA documentation for the site included:

- **VOCs**: extruded tapes and circuit board laminates in the 1960's; halogenated (i.e., chlorinated) solvents such as TCE are known to be associated with the manufacture of circuit boards and other electronic equipment (USEPA, 2016b);
- **PFAS**: past manufacturing activities included the use of no-stick coatings and fluoropolymers known to include PFOA; and
- **PCBs**: the NPL listing documents state the soil samples collected in August 2015 indicated the presence of PCBs in site soils, and sampling by EPA in 2016 documented PCB Aroclors above background in soil borings from the northeastern part of the facility. Surface soil collected at SGPP-SS07B had 110 µg/kg Aroclor-1254 and 120 µg/kg Aroclor-1260 (USEPA, 2016b).

The key contaminants identified in the Hazard Ranking System documentation for the site included vinyl chloride, 1,2-DCE, TCE, PCBs, and PFOA (USEPA, 2016b). The document does not mention other contaminant classes such as metals, PAHs, or pesticides.

3.2 Historical Sampling Events

In 1996, Parsons Engineering performed a Phase I Environmental Site Assessment at the site (C.T. Male Associates, 2016; Parsons Engineering Science, 1996a). In response to the conditions found at the site, a Phase II Environmental site Assessment was completed to investigate baseline soil and groundwater quality (Parsons Engineering Science, 1996b). Chlorinated VOCs including TCE and 1,2-DCE were detected in the on-site soil and groundwater (Parsons Engineering Science, 1996b; USEPA Region 2, 2016).

In 2015, C.T. Male Associates and Ramboll Environ conducted preliminary investigations and sampling to assess soil, groundwater, and wastewater at the site. The preliminary investigations included the advancement of several soil borings and installation of monitoring wells, as well as the collection of wastewater samples from a manhole and sewage ejector pit at the site. Groundwater, soil, and wastewater samples were analyzed for PFAS (C.T. Male Associates, 2016; Ramboll Environ, 2016).

Additional sampling events took place from 2016 through 2019 to investigate soil, groundwater, wastewater, and surface water, and to evaluate soil gas conditions and potential vapor intrusion into the site building (C.T. Male Associates, 2016, 2017a, 2018b, 2019b, 2020; Ramboll Environ, 2016).

3.3 Timeline of Investigation of PFAS

Site investigation activities conducted during the period 2015 through 2019 have informed the nature and extent of PFAS and other chemicals present on- and off-site. These data, together with the interim remedial measures (see Section 3.4), support the Primary Project Area identified for evaluation in the baseline risk assessments. The following timeline briefly describes key sampling events and regulatory developments during this period:

2015

- February: PFOA levels of 490 ng/L were measured in public water supply Village Well 7 (USEPA Region 2, 2016).
- June and July: PFOA concentrations of 620 ng/L and 662 ng/L were measured in Village Well 7 and the Water Plant Clearwell, respectively (USEPA Region 2, 2016, p. 2).
- August: seven monitoring wells were installed at the site. PFOA was detected in soil samples from 0 – 2 feet bgs and 2 – 4 feet bgs, particularly in the southeastern portion of the site (USEPA Region 2, 2016). Other PFAS identified during this event included: perfluoroheptanoic acid (PFHpA), perfluorohexane sulfonate (PFHxS), perfluorononanoic acid (PFNA), and PFOS (C.T. Male Associates, 2016). PFHxS was only detected in the surface soil (0-2 feet bgs). PFOA concentrations ranged from 1.0 – 4.1 µg/kg in surface soil and 0.41 – 2.4 µg/kg in soils sampled 2-4 feet bgs.
- September: C.T. Male Associates conducted two rounds of groundwater sampling. PFOA and PFHpA were identified at concentrations ranging from ~550 – 18,000 ng/L for PFOA and 10-400 ng/L PFHpA; concentrations remained similar between events (C.T. Male Associates, 2016).
- October: The site wastewater system is tested for PFAS; results show detectable PFOA (~1000 ng/L) and PFHpA (~20 ng/L) (Ramboll Environ, 2016).

2016

- April and May: USEPA Region 2 conducted a sampling event for soil, groundwater and wastewater on-site as well as off-site groundwater, residential drinking water, and raw water(USEPA Region 2, 2016, p. 2).
- June: The site is added to the state registry of inactive hazardous waste disposal sites under the NYSDEC State Superfund Project (NYSDEC State Superfund Program, 2016).

- August: C.T. Male Associates prepared a Final RI/FS Work Plan to assess surface and subsurface soil, surface water, groundwater, soil gas, and indoor air quality at the site and in the surrounding community. The Work Plan states that the RI/FS will include a Fish and Wildlife Resources Impact Analysis and a Qualitative Human Health Exposure Assessment to assess risk associated with human and ecological exposure (C.T. Male Associates, 2016).
- September: USEPA Region 2 proposed adding the site to the National Priority List (NPL) (USEPA Region 2, 2016).

2017

- May: C.T. Male Associates submitted a Supplemental Scope of Work to further investigate the extent of the PFOA impacts at and near the site, including sewer and storm water line inspections, additional soil borings, installation of several permanent and temporary monitoring wells, an electromagnetic survey, and surface water sampling (C.T. Male Associates, 2017a).
- July: The site was added to the NPL.

2018

- August: C.T. Male Associates submitted a second Supplemental Scope of Work proposing further investigations of soil vapor intrusion, roof drain/drip line soil sampling and installation of several permanent and temporary monitoring wells both on-site and in the nearby village (NYSDEC, 2018).

2019

- August: C.T. Male Associates reported on RI progress, including soil, groundwater, and surface water sample collection. Interim Remedial Measure (IRM) design work, various surveys and tests, and repair of the sewer overflow pipe were also performed (C.T. Male Associates, 2019c).
- December: NYSDEC Division of Air Resources summarized the results of a PTFE sintering oven emissions characterization study; in which the USEPA Office of Research and Development concluded that “any PFAS and PTFE decomposition emissions from the sintering ovens are minimal and are primarily the TFE monomer that is a known degradation product of the sintering process” (C.T. Male Associates, 2019a; NYSDEC, 2019).

2020

- April: C.T. Male Associates submitted an update to NYSDEC on 2019 RI activities. RI activities in 2019 included the installation of several off-site groundwater monitoring wells, soil borings, groundwater monitoring (on-site and off-site), and sampling of off-site surface water (C.T. Male Associates, 2020, p. 20).

3.4 Interim Remedial Measures In-Place

Pursuant to the 2016 administrative order, Interim Remedial Measures were initiated at the site as part of the RI/FS (NYSDEC State Superfund Program, 2016). Early measures were implemented even prior to entry of the order and described in the order consisted of the installation of a temporary granular activated carbon (GAC) water treatment system (March 2016) for the Village Municipal Water Supply and the distribution of bottled water to the community (ERM & CHA, 2020). NYSDEC coordinated the installation of point of entry treatment systems on private water supplies (ERM & CHA, 2020). The order also required the design, installation, operation, sampling, and monitoring of a full capacity GAC treatment system suitable for the permitted maximum daily flow for the municipal system (NYSDEC State Superfund Program, 2016).

The design for the full capacity GAC system was approved by New York State Department of Health on April 5, 2016, and the system became operational in February 2017 (NYSDEC State Superfund Program, 2016). Removal of PFAS from the municipal water supply continues to be demonstrated as of August 2020 (ERM & CHA, 2020). In addition to the GAC system, an IRM concept plan for groundwater interception design was submitted to the NYSDEC on August 28, 2017 (C.T. Male Associates, 2017b). A Draft Interim Remedial Measure Work Plan detailing the installation plans for the Groundwater Capture and Treatment System was submitted in August 2018 (C.T. Male Associates, 2018a), and the Interim Remedial Measure Work Plan was submitted on April 3, 2019 (C.T. Male Associates, 2019a).

Operation of the groundwater capture and treatment system within the southeastern corner of the site began August 22, 2019. Analytical results from the treated water are typically non-detect for PFAS (C.T. Male Associates & BEC Engineering and Geology, 2020; NYSDEC & NYSDOH, 2019).

3.5 Summary of Ongoing Work

A Municipal Water Supply Study report was presented by ERM and CHA in August 2020 to assess alternative potable water sources for the Village of Hoosick Falls Municipal Water Supply as required by the 2016 consent order (ERM & CHA, 2020). An air deposition study is also ongoing to assess regional air deposition of PFAS (NYSDEC & NYSDOH, 2019). Remedial Investigation work continues as of 2021 (C.T. Male Associates, 2020).

On May 27, 2020, NYSDEC notified SGPP and Honeywell that a risk assessment for both human health and ecological receptors would be required (NYSDEC, personal communication, May 27, 2020). A baseline risk assessment is required as part of the CERCLA Superfund process for RI/FS. This BERA Work Plan outlines the process for the ecological risk assessment at the site to fulfill that requirement. A companion Work Plan is also being submitted for the BHHRA.

4.0 DATABASE AND DATA EVALUATIONS

4.1 Risk Assessment Database

The RI database was provided to GSI for use in the BERA and BHHRA. The RI database includes all analytical chemistry results for environmental samples collected by C.T. Male Associates for the RI during the period 2016 through 2019. The target analytes for these investigations are listed in the RI/FS Work Plan and include chemical classes on New York's target analyte list/target compound list (TAL/TCL) (e.g., metals, PAHs, PCBs, pesticides, VOCs/SVOCs), water quality parameters, as well as either a list of 12 or 21 PFAS sampled in groundwater, soil, sediment, and/or surface water, depending on the medium. Analytical chemistry results for VOCs/SVOCs also includes samples of sub-slab soil gas and indoor air from the site building, site outdoor ambient air, and soil gas from on and near the site collected in 2017 and 2019.

The BERA database also includes analytical chemistry results for samples of fish tissue (fillets and whole-body tissue) collected by (and obtained from) NYSDEC from the Hoosic River watershed that were analyzed for PFAS only (see Figure 3). These data may include important information on PFAS levels in fish, relevant to both the human and ecological risk assessments.

A supplemental biota sampling and analysis (Biota SAP) Work Plan is being prepared as discussed in Section 5.3. The site-specific samples will be collected in spring and summer of 2021, and validated data from this investigation will be used in both the BHHRA and BERA.

4.2 Database Evaluation and Processing

The project database was evaluated for data usability in the risk assessment. Several processing steps were applied to generate this project database from the data provided by C.T. Male Associates. These processing steps are described below.

- **McCaffrey Street Site Project Area.** The first processing step involved an evaluation of the sample locations. Samples collected outside the Primary Project Area (see Section 2.1 and Figure 1) are excluded from the risk assessment, but may be considered qualitatively as part of the uncertainty analysis, or as part of the evaluation specific to the RISA in the BHHRA. The only exception is that analytical chemistry results for fish samples collected in the Hoosic River (described above) were retained. Additional information regarding local reference conditions will be provided from a field sampling program in 2021, which will include samples of sediment, surface water, and biota (described further in the Biota SAP).

- **Data Usability Assessment**. The second processing step involved screening the project database for data usability based on an evaluation of data qualifiers and sample representativeness. Consistent with standard DQO practice (USEPA, 2002a), the following samples were excluded from the project database:

  - All results qualified as *rejected* during data validation. These sample results did not pass data quality objectives specified in the analytical chemistry protocols (see RI/FS Work Plan).
  - All data for solid and aqueous treatability test samples, which lack spatial coordinates. These samples inform the RI/FS investigation, but do not directly inform the exposure assessment component of the risk assessments.

  - All data for samples collected from roof drains, which also inform the RI/FS, but not the risk assessment. In lieu of roof drain samples, results from samples of soil collected near or downgradient of roof drainage areas are incorporated in the exposure assessment.

- **Duplicate Sample Results.** The third processing step involved handling of field split samples ("duplicates"). All quality assurance/quality control (QA/QC) samples and data qualifier flags present in the main database were carried forward to the project database. This includes measurements of splits of field samples (i.e., duplicates or triplicates). Other QA/QC samples (e.g., laboratory replicates, equipment blanks) were not included in the RI database provided to GSI, but are further addressed in the RI/FS work plan documents (C.T. Male Associates, 2016, 2017a, 2018a, 2019a). Field duplicate results will be used in the baseline risk assessment to inform estimates of measurement error associated with sample collection and handling in the field, as well as sample handling, processing, and analysis at the analytical laboratory. Specifically, consistent with USEPA guidance on statistical analysis of environmental samples (USEPA, 2009), while field duplicate results were retained for evaluation of the relative percent difference (RPD) of duplicate pairs, they were not mathematically combined as an arithmetic mean. USEPA (2009) notes that because only a fraction of the samples collected from a project area have a corresponding duplicate pair, averaging results for a portion of the samples can introduce a downward bias in estimates of the variance in concentrations within the project area. Accordingly, for samples with one or more duplicate results, a single result was selected at random for use in calculations in the risk assessment.

Concentration units were standardized in the Primary Project Area database so that the same units are used for each combination of analyte, unit dimension (e.g., mass per mass or mass per volume), and measurement basis (e.g., dry weight basis, wet weight basis). In general, chemical concentrations are reported in the following units by medium:

- Soil (milligrams per kilogram, mg/kg)
- Sediment (micrograms per kilogram, µg/kg)
- Surface water and groundwater (micrograms per liter, µg/L)
- Air (micrograms per cubic meter, $\mu g/m^3$)
- Fish tissue (milligrams per kilogram, mg/kg)

Sample results include results reported as non-detects (ND), defined as concentrations that are less than the method detection limit (MDL). Non-detect (ND) results for individual analytes are reported as equal to the full MDL and qualified with a "U" or "UJ" flag in the database. While the project database also includes the sample quantitation limit and method reporting limit (MRL) for each result, only the MDL value is used in the risk assessment calculations involving censored datasets (i.e., dataset with one or more NDs).

Data processing steps and statistical analysis methods applied in the exposure assessment will take into account data qualified as detected and ND concentrations. Estimated values qualified with a "J flag" (i.e., quantified but estimated to be between the MDL and MRL) will be included as detects. The approach that will be used in the exposure calculations for samples reported as ND will be determined after review of the properties of a dataset, including the frequency of detection across media, the range of MDLs, and the ranking of MDLs relative to detects. For calculations of summary statistics (e.g., sum, arithmetic mean, standard deviation) for individual chemical datasets, generally Kaplan Meier (KM) estimation methods will be applied, consistent with USEPA

(2015) guidance on the use of ProUCL software for statistical analysis of environmental data. For calculations involving multiple chemicals, consistency in proportions of co-occurring chemical mixtures across samples with a higher frequency of detection (FOD) will be explored as a means of improving estimates for NDs among sample results with a lower FOD. Uncertainty introduced by simple substitution (imputation) of proxy values for NDs (e.g., zero, ½ MDL, or MDL) is especially important when evaluating the maximum concentration (e.g., for screening to identify COPECs) as well as sample-specific calculations involving the total (sum) of concentrations for all constituents within the chemical group (e.g., low or high molecular weight PAHs, total PCB Aroclors, total DDT). This is because inclusion of non-zero proxy values in the calculated totals can sometimes artificially inflate calculated exposure concentrations, especially if individual chemicals within the group are detected infrequently. The sensitivity of inferences based on alternative ND handling methods is discussed in this Work Plan for COPEC screening (see summary tables of Appendix B) and will also be assessed and included in the uncertainty analysis of the BERA with respect to outcomes of refined COPEC screening and exposure assessment.

The RI database is maintained in a secure PostgreSQL and PostGIS database. Selected fields were also exported to develop GIS shapefiles and a Microsoft Excel® workbook, referred to as a “flat file” to facilitate data exploration and generation of data summary tables for this Work Plan. The database fields exported to the flat file are further described below and in Appendix A.

As noted in Appendix B (Section 1.2.1), at the request of NYSDEC, for the Screening Level Ecological Risk Assessment (SLERA), the sample quantitation limit (SQL) is used instead of the method detection limit (MDL) for NDs. The sensitivity of the COPEC determination to the use of ND proxy values is examined by applying ½ SQL and SQL proxy values for NDs for individual chemical results, and ½ SQL and zero values for NDs for chemicals represented by summations (i.e., LPAH, HPAH, Total PAHs, Total PCB Aroclors, sum of DDT). The results were insensitive to the substitution, in that PAHs, PCBs, and DDT all screened in for further evaluation in the BERA, regardless of ND handling.

4.3 Flat File Data Columns and Relationships

All field headers for the columns in the flat file data export are listed and described in Appendix A, Table A1. There are three sets of field headers that are used to represent the sampling structure and relationships between samples:

- **Collection Identifiers.** The term *collection* is used to identify material that is collected together and that may be subsequently subdivided into distinct interpretive samples. An example is a soil boring or sediment core, where the entire boring or core is considered to be the collection, and horizons from within that boring or core are individual interpretive samples. For single grab samples (e.g., of sediment or water), the collection and the interpretive sample are one and the same, and the same identifier is used as both a collection identifier and a sample identifier. Collections are identified by unique combinations of the *study_id* and *collection_id* columns.
- **Interpretive Samples.** The term *interpretive sample* is used to identify material that is presumed to be uniform in composition and that represents the environmental conditions at a particular point in space and time, and that will be used for data analysis and interpretation. There may be multiple interpretive samples per collection. An interpretive sample may be split to produce separate quality control (QC) duplicates. Interpretive samples are identified by unique combinations of the *study_id* and *sample_id* columns.

- **Analytical Samples.** The term *analytical sample* is used to identify material that is submitted to a laboratory for analysis. When an interpretive sample is split, each split is assigned a unique analytical sample ID. When an interpretive sample is not split, the interpretive sample ID and the analytical sample ID are one and the same. Analytical samples are identified by unique combinations of the *study_id* and *sample_no* columns.

In the flat file table, related splits (QC duplicates) can be identified because they have the same *sample_id* identifier but different *sample_no* identifiers. Ordinarily one of the splits has a *sample_no* that is the same as the *sample_id*, and one has a different identifier. The *duplicate_yn* column identifies those rows where the identifiers are different.

Whereas there are potentially three levels to the sampling hierarchy—collection, interpretive sample, and analytical sample—these data were proved by ERM in an EQuIS export, and EQuIS only accommodates two levels: a “sys_sample_code” and a “parent_sample_code”. Not every “sys_sample_code” has a corresponding “parent_sample_code”. Although EQuIS does not enforce any rules regarding the usage of these identifiers, commonly when these are both present, the “parent_sample_code” represents an interpretive sample and the “sys_sample_code” represents a split of that interpretive sample. When a “parent_sample_code” appears on another row as the “sys_sample_code”, that represents the other split.

5.0 BASELINE ECOLOGICAL RISK ASSESSMENT APPROACH

5.1 Overview of the Process

The risk assessment approach for the BERA will closely follow USEPA guidance, both specific to ecological risk assessment (USEPA, 1997, 1998) and more generally applicable to a tiered approach to baseline risk assessments (e.g., USEPA 2001c).

USEPA's 1998 guidelines for ecological risk assessment emphasizes a structured approach that guides specific risk management decisions based on a well-defined set of assessment and measurement endpoints. The guidance recommends that BERAs include the following elements:

- Problem Formulation – This is the first phase of the BERA during which the goals, breadth, and focus of the assessment are articulated;
- Analysis – The analysis phase consists of the technical evaluation of data. This phase is divided into the "characterization of exposure and the characterization of ecological effects"; and
- Risk Characterization – During this phase, "the likelihood of adverse effects associated with exposure to a stressor" is evaluated.

During this same period, the USEPA Office of Emergency & Remedial Response developed guidance for conducting BERAs at sites regulated under the Comprehensive Environmental Responsibility, Cleanup, and Liability Act (CERCLA). This Superfund guidance, entitled Process for Designing and Conducting Ecological Risk Assessments or "ERAGS" (USEPA, 1997) placed the three phases of the BERA into a more structured eight-step process to allow a proactive mechanism to measure the progress and organization of the BERA. The eight steps outlined in that document will be applied to this BERA and consist of:

- Step 1 – Preliminary Screening Level, which includes preliminary problem formulation and preliminary toxicity evaluation.
- Step 2 – Screening Level, which includes development of exposure estimates and preliminary risk calculations. The step includes the first Scientific/Management Decision Point (SMDPa).
- Step 3 – Baseline Risk Assessment Problem Formulation, which includes a toxicity evaluation, development of a preliminary CSM and exposure pathways, and development of assessment endpoints. This step also includes a second SMDP (SMDPb).
- Step 4 – Study Design and Data Quality Objectives (DQO) Development. This step includes development of the Work Plan and Sampling and Analysis Plan based upon results of the previous three steps. This step also includes a third SMDP (SMDPc).
- Step 5 – Verification of Field Sampling Design. This step includes a determination of the feasibility of the field program as outlined in Step 4. This step includes a fourth SMDP (SMDPd).
- Step 6 - Site Investigation and Data Analysis. This step includes another SMDPe.

- Step 7 – Risk Characterization. This step includes more refined and detailed quantification of potential site risks and is generally a more realistic evaluation of risks than was performed in Step 2.

- Step 8 – Risk Management, which includes selection of alternatives in the Record of Decisions as a final SMDP (SMDPf).

Steps 1 and 2 have been completed as part of the screening level ecological risk assessment (SLERA). Methods and results are presented in Appendix B. The results of the SLERA show that site-specific chemicals could pose a risk to ecological receptors in the Primary Project Area, and that further investigation is warranted to understand the nature, extent, and magnitude of risks (i.e., Steps 3 through 8).

Additional guidance on the goals of a BERA and the types of questions addressed at each SMDP are outlined in an OSWER directive (USEPA, 1999).

Table 3 provides a summary of the assessment and measurement endpoints proposed for each of the receptor categories included in the ecological CSMs discussed in the next section. An assessment endpoint is defined in Guidelines for Ecological Risk Assessment (USEPA, 1998) as, "an explicit expression of the environmental value to be protected, operationally defined as an ecological entity and its attributes". The guidelines provide three selection criteria: ecological relevance, susceptibility (exposure plus sensitivity), and relevance to management goals. Measurement endpoints (also known as measures of effects) are the results of tests or observational studies that are used to estimate the effects on an assessment endpoint of exposure to a stressor. Assessment and measurement endpoints may be expressed at the same level of organization (e.g., organism level); however, the same measure of effect may be used, with considerably greater uncertainty, to estimate risks to a population-level assessment endpoint (e.g., abundance of fish species) or a community-level endpoint (e.g., number of species) (USEPA, 2003).

In practice, assessment endpoints for a BERA are selected based on ecosystems, communities, and/or species potentially present at the site (HRWA, 2014; Nolan, 2007). The selection of assessment endpoints depends on:

- COPECs and their concentrations;
- Mechanisms of toxicity of the contaminants to different groups of organisms;
- Ecologically relevant receptor groups that are potentially sensitive or highly exposed to COPECs and attributes of their natural history; and
- Potentially complete exposure pathways.

The selection of assessment endpoints requires careful consideration, given that their relevance to the ecological entity and ability to support management decisions rests upon the decisions made in the selection process. Suter (1990) developed a list of considerations for the selection of assessment endpoints, which were further developed in the 1996 USEPA Guidance (Ecological Significance and Selection of Candidate Assessment Endpoints) (USEPA, 1996), the 1997 Ecological Risk Assessment Guidance for Superfund (ERAGS) (USEPA, 1997), and the 1998 USEPA guidelines for ecological risk assessment (USEPA, 1998). These considerations include societal relevance, biological relevance, an unambiguous operational definition, accessibility to prediction and management, and susceptibility to the hazardous agent.

The SLERA (Appendix B) for the McCaffrey Street Site identified numerous preliminary COPECs in all environmental media. Methods and findings are discussed in Appendix B, and Table 4 provides a final list of COPECs grouped as primary (P) or secondary (S). A primary COPEC is a chemical for which the maximum concentration is a detect (rather than a nondetect), the applicable screening level is exceeded, and the frequency of detection in the medium is at least 5%. A secondary COPEC is a chemical that screens in, but is less likely to be identified as a candidate for risk management upon closer evaluation in the BERA for one or more of the following reasons:

- Low frequency of detection (e.g., < 5%);
- Maximum concentration is a ND;
- Maximum concentration in soil is lower than the NYS background threshold value; or
- The chemical was retained because no media-specific screening level was available to screen out the chemical at this step.

Both “P” and “S” categories of COPECs will be further evaluated in the BERA, beginning with a refined screening step, as described in Appendix B (SLERA). Criteria will not be applied in a “pass/ fail” approach, but rather, the lines of evidence will be considered in the context of additional site-specific information obtained during the RI investigation. For example, if a chemical is detected in less than 5% of the samples, it may be retained as a “P” category COPEC if there are gaps in spatial coverage, or subareas of elevated concentrations.

The current group of “P” COPECs include mostly metals, PAHs, and selected pesticides. PFOA is retained as a “P” COPEC because the soil screening level is exceeded in both on-site and off-site soils and the frequency of detection is greater than 5%. Other PFAS are also retained, but are categorized as “S”, most often because they are infrequently detected.

Analytes that have a potential to bioaccumulate in the food chain require additional consideration, particularly for upper trophic level ecological receptors. Table 5 summarizes analytes identified by USEPA (2000b) and New York State (NYSDEC & NYSDOH, 2006) to be potentially bioaccumulative. Analytes that are potentially bioaccumulative, detected in soil, sediment, and/or surface water, and that have screening levels that may not be protective of upper trophic level organisms, are also retained for further evaluation in the BERA. Bioaccumulation potential is often estimated based on findings from studies under laboratory or field conditions, as well as predictions from statistical models that account for differences in physical/chemical properties (e.g., log K_{ow} as surrogate for lipophilicity). Differences in physical/chemical properties of PFAS compared with many other organic compounds introduces greater uncertainty in model-based estimates. SERDP (2019) provides a summary of bioconcentration and bioaccumulation factors for selected PFAS based on a review of studies published as of 2019, focusing on findings under controlled (laboratory) conditions. Table 6.1 summarizes recommended values for fish and Table 6.2 summarizes recommended values for invertebrates and plants. USEPA’s AQUATOX model (USEPA, 2018c) implements the same equations developed by Martin et al. (2003a, 2003b) to predict BCFs for PFAS as a function of the number of perfluorinated carbons (see further details in the footnotes of Table 6.1). These studies support observations regarding general trends in bioaccumulation potential as a function of carbon chain length, functional group, environmental conditions, and taxonomic grouping of receptors. These factors and additional literature will be further explored and discussed in the BERA.

Site-specific estimates of bioaccumulation will also be generated using paired (co-located) samples of biota and abiotic media (i.e., soil, sediment, surface water). Details regarding the tissues, sampling units and number of samples, and sample collection methodology will be included in the Biota SAP Work Plan. Tissues will include aquatic macroinvertebrates, fish, aquatic and emergent plants, soil invertebrates, small mammals, and herbaceous plants. Data will be explored for potential regression relationships by examining the statistical significance of the slope as well as exploratory data analysis (e.g., graphical analysis, outlier analysis).

The BERA will be conducted using reasonable but conservative exposure assumptions and toxicity reference values to characterize the range of potential site risks. The incorporation of site-specific exposure information will be used, when available, to reduce the uncertainty in the risk characterization for the site. Uncertainties in both exposure and toxicity information will be identified. Based on these initial findings, the BERA will characterize the probability of potential ecological effects as a result of potential exposure to one or more of the site-related chemical stressors, in the absence of any actions taken to reduce or mitigate exposures. The results may help focus future remedial action and risk management decisions.

5.2 Ecological Conceptual Site Model

The CSM for the BERA is informed by the COPECs identified in the SLERA and provides the foundation for the problem formulation for the BERA. The CSM may be further refined during the course of the BERA, as relative exposure pathways are assessed for each exposure scenario. The CSM may also be refined based on findings from the RI investigation of potential sources and mechanisms of fate and transport.

A CSM identifies the potential sources, and release mechanisms and identifies the primary exposure points, receptors, and exposure routes within the Primary Project Area. A specific exposure pathway for a potential receptor is qualified as complete or incomplete, as well as significant or insignificant, depending on the likelihood and relative magnitude of contact (resulting in uptake via roots, skin, or gills, ingestion of biotic and abiotic media, and/or inhalation) with COPECs present in an exposure medium (i.e., biota, groundwater, surface water, sediment, air, or soil). The following steps are necessary for a complete exposure pathway:

1. Source and mechanism of chemical release into the environment.
2. An environmental transport medium for the released chemical or mechanism of transport between media.
3. A point of potential receptor contact with the contaminated medium.
4. An exposure route at the point of contact (i.e., dermal absorption, inhalation, or ingestion).

In the event one of these elements is missing, considering the set of primary COPECs, the pathway is incomplete. Exposure pathways considered complete and significant will be evaluated quantitatively, while exposure pathways considered complete yet insignificant will be evaluated qualitatively in the baseline risk assessments. In order to focus the risk characterization on the essential chemicals of concern, incomplete pathways will not be further evaluated in the baseline risk assessments.

Separate CSMs for the ecological receptors within the Primary Project Area were developed for the aquatic ecosystem (Figure 6a) and terrestrial ecosystem (Figure 6b). Each CSM illustrates the progression from sources of site-related COPECs, routes of exposure, and exposure pathways, to representative ecological receptors that may be exposed to site-related COPECs. Ecological receptors are categorized as ecological communities and wildlife. Ecological communities are general categories (i.e., not species-specific) of indicator species and include plants, soil invertebrates, sediment-dwelling invertebrates, and aquatic life. Wildlife receptors are species-specific indicator species and include aquatic and terrestrial birds and mammals.

Twelve aquatic receptors and nine terrestrial receptors were selected as representative receptors for the BERA (see Table 7). It is not practical to conduct an exposure assessment for each species of an ecological community found in the vicinity of the site, and even this list may be subject to refinement if a smaller set is determined to be sufficient to characterize site-specific risks. These receptors were selected to represent species from different trophic levels, habitats, and dietary preferences for communities in the vicinity of the site. The basis for these determinations is briefly discussed below for each receptor scenario. Complete summaries of life histories (e.g., dietary preferences, home and foraging ranges, habitat preferences, notable behaviors) will be included in the BERA.

Federal and state-listed species of special concern potentially occurring within the vicinity of the Primary Project Area were identified by searching online databases and resources available through the U.S. Fish and Wildlife Service, NYSDEC, and New York Natural Heritage Program. The results of these searches are provided in Appendix B.

The USEPA has identified general routes by which ecological receptors may be exposed to COPECs in environmental media:

- Direct contact with abiotic environmental media (e.g., sediment or water) and uptake (e.g., through the roots, skin, or gills)
- Ingestion of abiotic environmental media (e.g., soil, sediment, or water)
- Inhalation (e.g., lungs)
- Dietary ingestion of contaminated biota

The following complete and potentially significant exposure pathways for aquatic receptors will be evaluated quantitatively in the BERA. See aquatic CSM for additional details (Figure 6a):

- Dietary ingestion of prey by mink, mallard, and great blue heron.
- Ingestion of off-site surface water by aquatic mammals and birds.
- Dermal/direct contact with off-site surface water by macrophytes/algae, aquatic invertebrates, and fishes.
- Dietary ingestion of macrophytes/algae by aquatic invertebrates, pumpkinseed, brown bullhead, and mallard.
- Dietary ingestion of aquatic prey by aquatic invertebrates, fishes, aquatic mammals, and aquatic birds.
- Incidental ingestion of off-site sediment by aquatic invertebrates, aquatic mammals, and aquatic birds (except for bald eagle for which incidental ingestion of sediment is negligible).
- Dermal/direct contact with off-site sediment by macrophytes/algae and aquatic invertebrates.

The following complete and potentially significant exposure pathways for terrestrial receptors will be evaluated quantitatively in the BERA. See terrestrial CSM for additional details (Figure 6b):

- Incidental ingestion of surface soil by terrestrial invertebrates, American robin, and terrestrial mammals (except for the little brown bat for which incidental ingestion of surface soil is negligible)
- Dermal/direct contact with surface soil by terrestrial plants and terrestrial invertebrates

- Dietary ingestion of surface soil plants by terrestrial invertebrates, American robin, and terrestrial mammals (except for the little brown bat for which dietary ingestion of surface soil plants is negligible)
- Dietary ingestion of surface prey by terrestrial invertebrates, terrestrial mammals, and terrestrial birds
- Dietary ingestion of off-site surface water by terrestrial mammals and terrestrial birds

The following complete but likely insignificant exposure pathways for aquatic receptors will be evaluated qualitatively in the BERA. See aquatic CSM for additional details (Figure 6a):

- Incidental ingestion of surface soil by mallard
- Dermal/direct contact with surface soil by mallard
- Dietary ingestion of surface prey by fishes, spotted sandpiper, and bald eagle
- Dermal/direct contact with off-site surface water by aquatic mammals and aquatic birds
- Incidental ingestion of off-site sediment by fishes
- Dermal/direct contact with off-site sediment by fishes, aquatic mammals, and aquatic birds (except for bald eagle for which direct contact and dermal exposure to sediment is negligible)

The following complete but likely insignificant exposure pathways for terrestrial receptors will be evaluated qualitatively in the BERA. See terrestrial CSM for additional details (Figure 6b):

- Dermal/direct contact with surface soil by American robin and terrestrial mammals (except for little brown bat for which direct contact and dermal exposure to surface soil is negligible)
- Dermal/direct contact with subsurface soil by meadow vole
- Dermal/direct contact with off-site surface water by red fox
- Dietary ingestion of aquatic prey by northern short-tailed shrew, red fox, little brown bat, and terrestrial birds
- Incidental ingestion of off-site sediment by red fox
- Dermal/direct contact with off-site sediment by red fox

An inhalation exposure pathway is excluded from the aquatic and terrestrial CSMs because exposures for terrestrial receptors are considered negligible relative to ingestion and dermal contact. There are no federal or state ecological screening levels for concentrations in air for evaluating risks to wildlife. There are three VOCs categorized as “P” COPECs (see Table 4): acetone, benzene, and carbon disulfide. If the list of “P” COPECs changes to include additional VOCs, the CSMs will be modified to include an inhalation exposure pathway.

5.2.1 Aquatic Ecosystem Receptors

The following aquatic receptors were selected after considering local habitat (Figure 4) (Nolan, 2007; NYSDEC, 1989), land uses (Figure 5), site-specific conditions observed during site visits, and consistency with BERAs for sites with similar environmental settings (e.g., Hudson River in NY, Housatonic River in MA, Stony Creek in Noblesville, Indiana) (ARCADIS, 2010; CDM, 2003; ENVIRON International Corp, 2010; Nobis Engineering, Inc & Avatar Environmental, LLC, 2008; TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000; Weston Solutions, Inc., 2004). Table 7 summarizes the taxonomic groups and foraging classes associated with the selected group of representative species.

Algae, macrophytes, and aquatic Invertebrates

Taxonomic groups that reflect the base of the food chain for aquatic receptors have been selected. These include algae, aquatic plants, and aquatic invertebrates (planktonic and benthic). These receptors were evaluated because they are found in sediments and surface water where COPECs may be present. Further, these receptors comprise the base of the food chain for higher trophic level receptors.

Fish Community

The pumpkinseed (*Lepomis gibbosus*) was selected to represent lower trophic level forage fish. Pumpkinseed are members of the sunfish family and are often found in slow-moving rivers and lakes. They are found in the Hoosic River in the vicinity of the site. Pumpkinseed diet is principally comprised of invertebrates such as chironomids, beetles, gastropods, and amphipods. However, they are known to ingest smaller fish such as minnow fry and smaller pumpkinseeds. For the BERA exposure assessment, it is assumed that the pumpkinseed diet is comprised of 9% macrophytes or algae, 78% invertebrates, and 13% fish. Dietary composition estimation for pumpkinseed utilized in the BERA were based on measured stomach contents of moderate-size pumpkinseeds (Sadzikowski & Wallace, 1976).

The brown bullhead (*Ameiurus nebulosus)* was selected to represent omnivorous bottom feeding fish. Brown bullhead are a type of catfish that are found in slow moving water, often with soft sediments (Kline & Wood, 1996; Scott & Crossman, 1973; Turner & Kelley, 1966). Mature brown bullheads have an average length of 9-12 inches (Mugford, 1969). Bottom feeding omnivorous fish such as the brown bullhead are known to feed relatively indiscriminately on benthic invertebrates, vegetation, detritus, and occasionally smaller fish. Per Kline & Wood (1996), diet of brown bullhead can vary considerably depending on the size of the fish. For the BERA exposure assessment, it is assumed that the brown bullhead diet is comprised of 6% macrophytes or algae, 88% invertebrates, and 6% fish. Dietary composition estimation for brown bullhead utilized in the BERA were based on measured stomach contents of juvenile/adult brown bullheads (Kline & Wood, 1996).

The brown trout (*Salmo trutta)* was selected to represent invertivorous/piscivorous higher trophic level fish. Brown trout has a diet and ecological niche similar to the state fish of New York, the brook trout (*Salvelinus fontinalis*), and as such, may be representative of brook trout. Such fish generally feed at high trophic levels as compared to lower trophic level forage fish such as the pumpkinseed or bottom feeding omnivorous fish such as brown bullhead. Brown trout diets can vary considerably by water body but are predominantly aquatic invertebrates and other fish. For the BERA exposure assessment, it is assumed that the brown trout diet is comprised of 75% invertebrates and 25% fish. Dietary composition estimations for brown trout utilized in the BERA were based on measured stomach contents of brown trout in Taughannock Creek, New York (Evans, 1952).

In discussions with NYSDEC and USEPA regarding the CSM for the BERA (see Appendix C), two additional small-bodied fish species were recommended to represent the variety of forage fish that may be present in the Hoosic River: creek chub (*Semotilus atromaculatus*) and blacknose dase (*Rhinichthys atratulus*). Creek chub is a highly adaptable fish in small streams found throughout the eastern U.S. Surveys of stomach contents of chub collected from streams in Iowa suggest the chubs consume roughly equal proportions of plant material, insects, and small fish (for larger creek chub) (Dinsmore, 1962). Blacknose dace feed on a variety of aquatic invertebrates, terrestrial insects, and algae, prefer swift flowing gravelly streams, and are common forage fish for trout and bass species as well as piscivorous birds and mammals (Trial et al. 1983).

Because three fish species (pumpkinseed, brown bullhead, and brown trout) have already been selected to represent the range of fish in the aquatic foodweb, these two species were not added at this time. Furthermore, NYSDEC fish sampling of the Hoosic River identified pumpkinseed and brown trout, but no chub or dace. If the toxicity assessment in the BERA relies on concentration-based toxicity values for primary COPECs, then potential effects for these additional species will be considered in the risk characterization. However, if a dose-based approach is used, supported by reliable dose-based toxicity values, then differences in body weight and food preferences between pumpkinseed and these two species will be evaluated to determine if risks calculated for pumpkinseed are likely to represent these additional species adequately.

Aquatic Mammals

The American mink (*Neovison vison*) was selected for evaluation as a receptor in the BERA to represent semi-piscivorous/carnivorous aquatic mammals. The American mink is a semi-aquatic mammal in the weasel family. American minks generally need access to water such as streams, lakes, marshes, swamps, or estuaries. Minks are opportunistic feeders, and their prey varies by location and season. Their diet consists of fish, small mammals, amphibians, and aquatic invertebrates. For the BERA exposure assessment, it is conservatively assumed the American mink diet is comprised of 34% fish, 16.5% aquatic invertebrates, and 49.5% non-aquatic prey, as utilized by previous Region 2 BERAs in the Hudson River watershed (TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

The muskrat (*Ondatra zibethicus*) is a semiaquatic herbivorous mammal selected to represent lower trophic level aquatic mammals in the BERA. Muskrats prefer areas of slow-flowing water with abundant vegetation such as marshes, lakes, ponds, and streams, and frequently construct their dens within one meter of the water's edge; dens are typically dug to a depth of 0.5 – 1.2 meters (Allen and Hoffman 1984). Mean population densities reported for muskrat in Iowa range from 2.6 to 9.3 individuals per hectare (Clay and Clark, 1985). Muskrats prefer to consume the shoots, bulbs, roots and leaves of aquatic plants such as cattail, sedges, sweetflag, and wild rice (Berry's Creek Study Area Cooperating PRP Group, 2017). For the purposes of the BERA, the diet of the muskrat is assumed to be 100% aquatic plants, consistent with published values (Neal 1968, as cited by Allen and Hoffman 1984).

Aquatic Birds

The mallard (*Anas platyrhynchos*) was selected for evaluation as a receptor in the BERA to represent herbivorous/invertivorous aquatic birds. The mallard has been found year-round in the Hudson river watershed, of which the Hoosic River is a part of (Stanne et al., 1996). The mallard is a surface-feeding duck that feeds on aquatic vegetation, seeds, and aquatic invertebrates. The mallard also dabbles and filters sediments for food, which can result in the ingestion of sediment (Drilling, Titman, and McKinney, 2020). For the BERA exposure assessment, it is conservatively assumed the Mallard diet is comprised of 50% plants and 50% invertebrates, as utilized by previous Region 2 BERAs in the Hudson River watershed (TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

The spotted sandpiper (*Actitis macularius*) was selected for evaluation as a receptor in the BERA to represent shorebirds because of their high propensity for sediment ingestion. Habitat for the spotted sandpiper includes streambanks, river, beaches, ponds, and lakes. During an August 2020 site visit, spotted sandpipers were observed in the Hoosic River in the vicinity of the site. The percent of sediment ingested relative to diet intake by the spotted sandpiper can range from approximately 7 to 30%, with an average of 18% (Beyer et al., 1994). For the BERA exposure assessment, the spotted sandpiper diet is comprised entirely of invertebrates, based on a literature review and as utilized by previous Region 2 BERAs (Berry's Creek Study Area Cooperating PRP Group, 2017; Maxson & Oring, 1980; Reed et al., 2013; Sandilands, 2011).

The belted kingfisher (*Megaceryle alcyon*) is a medium-sized piscivorous bird that was selected for evaluation as a receptor in the BERA to represent piscivorous birds that ingest small fish. Belted kingfisher habitat includes clear water with limited vegetation. The belted kingfisher is a medium-sized bird that generally forages for fish in shallow water, but is also known to ingest aquatic invertebrates, and even small vertebrates. For the BERA exposure assessment, it is assumed that the belted kingfisher diet is comprised of 78% fish and 22% invertebrates, as utilized by previous Region 2 BERAs in the Hudson River watershed (TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

The great blue heron (*Ardea Herodias*) was selected for evaluation as a receptor in the BERA to represent wading birds. Great blue herons are found in shallow shores of lakes, ponds, streams, and marshes. The great blue heron is the largest wading bird found along the Hoosic River. During an August 2020 site visit, a great blue heron was observed in the Hoosic River in the vicinity of the site. Fish is the preferred food source of great blue herons, but they are also known to eat amphibians, invertebrates, reptiles, and even small mammals. While sediment ingestion was the principal driver of risk for the spotted sandpiper, ingestion of fish possibly exposed to site-related COPECs is the risk driver for the great blue heron. For the BERA exposure assessment, it is conservatively assumed that the great blue heron diet is comprised of 98% fish, 1% invertebrates, and 1% non-aquatic prey, as utilized by previous Region 2 BERAs in the Hudson River watershed (TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

The bald eagle (*Haliaeetus leucocephalus*) is a piscivorous/carnivorous bird selected for evaluation as a receptor in the BERA to represent piscivorous birds that ingest large fish. The bald eagle is also the national bird of the United States and is listed on the New York Endangered and Threatened Species List. Bald eagles are predominantly associated with large marine environments, but some inland lakes and rivers are capable of supporting bald eagle populations. Bald eagles nesting sites are normally found in areas with limited human presence, and in close proximity to, shallow open water with an abundance of fish. The Hudson river watershed has a substantial presence of overwintering bald eagles (Peter Nye, 1999; TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000; USGS, 2003). Bald eagles feed on fish, mammals, carrion, and small birds. However, as opportunistic eaters, bald eagles will primarily eat the food most easily obtainable. For the BERA exposure assessment, it is conservatively assumed the bald eagle diet is comprised entirely of fish, as utilized by previous Region 2 BERAs in the Hudson River watershed (TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

5.2.2 Terrestrial Ecosystem Receptors

The following terrestrial receptors were selected after considering local habitat (Figure 4), land uses (Figure 5), site-specific conditions observed during site visits, and selection of the same or similar species in BERAs for sites with similar environmental settings (e.g., Hudson River in NY, Housatonic River in MA, Stony Creek in Noblesville, Indiana). Table 7 summarizes the taxonomic groups and foraging classes associated with the selected group of representative species.

Terrestrial Plants and Invertebrates

Taxonomic groups that reflect the base of the food chain for terrestrial receptors have been selected. This includes terrestrial plants and terrestrial invertebrates. These receptors were evaluated because they are found in surface and subsurface soil where COPECs may be present. Further, these receptors comprise the base of the terrestrial food chain and provide a source of food for the higher terrestrial receptors. For the Biota SAP, both earthworms and soil arthropods will be targeted. Concentrations in composite samples will inform site-specific estimates of bioaccumulation as well as dietary exposure estimates for invertivorous receptors.

Terrestrial Mammals

The northern short-tailed shrew (*Blarina brevicauda*) was selected for evaluation as a receptor in the BERA to represent terrestrial invertivorous mammals. The northern short-tailed shrew is a terrestrial mammal found throughout the northeastern United States. Northern short-tailed shrews favor damp habitat with heavy vegetation. Their diet primarily consists of insects, worms, snails, and slugs, but may also eat fungi and small mammals (USEPA, 1993). For the BERA exposure assessment, it is assumed the northern short-tailed shrew diet is comprised of 82% aquatic invertebrates, 13% plants, and 5% non-aquatic prey, as utilized by previous Region 1 BERAs (USEPA, 1993; Weston Solutions, Inc., 2004).

The meadow vole (*Microtus pennsylvanicus*) was selected for evaluation as a receptor in the BERA to represent terrestrial herbivorous mammals. The meadow vole is found across the northern parts of the United States and is the most abundant vole species in New York. They favor habitat consisting of dense grassland with relative groundcover (Birney et al., 1976). Meadow vole diet primarily consists of grasses, flowering plants, seeds, and roots. They will also infrequently eat insects and gastropods. For the BERA exposure assessment, it is assumed that the meadow vole diet is comprised of 95% plant material and 5% invertebrates (Sample & Sutter, 1994; USEPA, 1993).

The red fox (*Vulpes vulpes*) was selected for evaluation as a receptor in the BERA to represent omnivorous terrestrial mammals. The red fox is one of the most widespread members of the carnivora order. It is also an ideal receptor for the BERA as the habitat surrounding the site is suitable for supporting red foxes. The red fox has a highly varied diet, but primarily feeds on mice and voles. It is also known to eat fruits, seeds, berries, and insects. For the BERA exposure assessment, it is assumed that the red fox diet is comprised of 85% non-aquatic prey such as small mammals, 5% invertebrates, and 10% plants and fruits (ENVIRON International Corp, 2010; TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000)

The little brown bat (*Myotis lucifugus*) was selected for evaluation as a receptor in the BERA to represent insectivorous terrestrial mammals. The little brown bat has a small body, with a total body length of approximately 3 to 4 inches. The little brown bat is widely distributed throughout North America, and is found in the Hudson Valley watershed (Dzal et al., 2011). Little brown bats feed in open shorelines, rivers, lakes, streams and marshes. They feed nocturnally and feeds almost exclusively on invertebrates, particularly flying insects. In habitats such as the Hoosic River, some invertebrates that comprise little brown bat diet such as trichoptera, plecoptera, and ephemeroptera may have spent the first portion of their lives in the aquatic ecosystem, where they may be exposed to site-related COPECs. For the BERA exposure assessment, it is assumed the little brown bat diet is comprised exclusively of invertebrates as utilized in previous Region 2 BERAs (TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

Terrestrial Birds

The tree swallow (*Tachycineta bicolor)* was selected for evaluation as a receptor in the BERA to represent insectivorous terrestrial birds. The tree swallow is a migratory bird distributed throughout a large portion of the United States and found across the Hudson River watershed. Tree swallows favor habitat near water such as marshes, shorelines, swamps and fields. Tree swallows almost exclusively eat flying insects, but occasionally will prey upon insects at the water surface. In habitats such as the Hoosic River, some invertebrates that comprise tree swallow diet may have spent the first portion of the lives in the aquatic ecosystem, where they may be exposed to site-related COPECs. For the BERA exposure assessment, it is assumed the tree swallow diet is comprised exclusively of invertebrates (Secord & McCarty, 1997; TAMS Consultants, Inc & Menzie-Cura & Associates, Inc, 2000).

The American robin (*Turdus migratorius*) was selected for evaluation as a receptor in the BERA to represent omnivorous terrestrial songbirds. The American robin is found throughout the United States and in a variety of habitats, including habitat found in the vicinity of the site. American robin home range is relatively small, with territory ranging from 0.1 to 0.8 hectares. American robin diet varies considerably by season. They predominantly forage for worms and invertebrates, with less than 10% of the diet being comprised of fruits. In habitats such as the Hoosic River, some invertebrates that comprise a portion of the American robin diet may have spent the first portion of their lives in the aquatic ecosystem, where they may be exposed to site-related COPECs. However, their diet in the fall and early winter is comprised of greater than 80% fruit. For the BERA exposure assessment, it is assumed the American robin diet is comprised of 72% invertebrates and 28% plant material such as fruits and seeds (ENVIRON International Corp, 2010; USEPA, 1993).

The red-tailed hawk (*Buteo jamaicensis*) was selected for evaluation as a receptor in the BERA to represent carnivorous terrestrial birds. The red-tailed hawk is a bird of prey that is found year-round throughout much of the northeast United States. Red-tailed hawks occupy a wide range of habitats, but prefer fields, wetlands, prairies, woodlands, and pastures with trees available for nesting and perching (DeGraaf & Rudis, 1986). Their territory size can vary, with estimated home ranges from a few hundred hectares to nearly 2,000 hectares (Andersen & Rongstad, 1989; Janes, 1984). Their diet is primarily comprised of small terrestrial mammals such as mice, voles, rabbits, and shrews, but they are also known to eat smaller birds and reptiles. For the BERA exposure assessment, it is assumed that the red-tailed hawk diet is comprised exclusively of non-aquatic prey (USEPA, 1993).

5.3 Ecological Exposure Assessment

The goal of the exposure assessment is to estimate intakes and doses for each of the COPECs, for each potential receptor that may be present in an exposure unit (EU). A preliminary exposure assessment was conducted as part of the screening level risk assessment to evaluate the potential exposure pathways at the McCaffrey Street Site. The exposure assessment identifies the way an ecological receptor may be exposed to constituents at a site, guides development of the CSM, and ultimately results in a calculation of a media-specific exposure point concentration (EPC) for each COPEC (See Section 5.3.2).

For the BERA, COPECs were identified for each medium based on findings from the SLERA presented in Appendix B and summarized in Table 4. Therefore, all media will be evaluated. Similarly, for the BERA, soil, sediment, and surface water will be evaluated for potential risk to ecological receptors.

The RI investigation has focused on characterizing the nature and extent of chemicals present and potentially transported both on-and off-site, and these data will be used in the exposure assessment. The exposure assessment is the process by which exposure point concentrations (EPCs) are estimated for each exposure medium identified for a receptor in the CSM. Both abiotic media and dietary/prey items are generally considered but biota sampling has not been conducted and remains a data gap.

Based on preliminary discussions with USEPA Region 2 and NYSDEC, a supplemental Biota Sampling and Analysis Plan (Biota SAP) is being developed to collect biota samples within the Primary Project Area and a local reference area with comparable habitat. This supplemental investigation will be guided by the preliminary list of COPECs presented in the SLERA (Table 4 and Appendix B, Tables B1.1 through B1.4), the preliminary list of COPCs in the BHHRA Work Plan, an assessment of spatial patterns of primary COPECs and COPCs, and representativeness of the biota given the receptor list and habitat conditions during the anticipated period of collection. The field program is expected to occur in summer/fall of 2021, and include upland and in-water locations. Biota data will include analytical chemistry results for aquatic invertebrates and plants, fish, terrestrial invertebrates and plants, and small mammals. Fish sampling will target multiple size classes to support exposure assessments for both the BHHRA (fillet tissue dataset) and BERA (whole-body tissue dataset). For large fish (greater than 12 inches), both fillet and whole-body measurements will be evaluated to support site-specific estimates of ratios or regression equations to estimate concentrations in tissues. Results will be evaluated in the context of literature-reported whole body-to-fillet relationship for PFOS (e.g., (Babut et al., 2017; de Vos et al., 2008; Fair et al., 2019; Fliedner et al., 2018; Mazzoni et al., 2019; Munoz et al., 2017) and other potentially bioaccumulative metals and organics (Bevelhimer et al., 1997).

Separate EPCs will be calculated for each EU / medium / receptor scenario combination, as discussed below. If at least 8-10 observations are present within an EU, the EPC will be defined by the 95 percent upper confidence limit for the arithmetic mean (95UCL), consistent with USEPA guidance (USEPA, 2002b, 2015). If fewer samples are available, the maximum concentration will be selected and additional evaluation will be conducted to determine if the spatial structure of the concentrations supports spatial weighting methods to leverage patterns in concentrations across EUs.

5.3.1 Exposure Units

An EU is a subarea of a site, sometimes defined by the entire site boundary, within which receptors may contact an exposure medium for a period of time that is relevant for assessing toxicity and risk. For practical purposes, risk assessments typically focus on a specific set of EUs defined by a fixed area and depth interval. For ecological receptors, the size of the EU is determined by published studies of habitat preferences, home ranges, and feeding territories. Table 8 provides a summary of the home ranges for aquatic and terrestrial receptors. Based on this information, square grids of the following sizes are used to inform the exposure assessment for specific receptors: 0.1 acres, 0. 5 acres, 1 acre, and 8 acres. For the remaining receptors, the habitat and/or foraging areas exceed the size of the Primary Project Area.

Examples of grids of EUs are provided in Figures 7 (8 acre) and 8 (1 acre).

For smaller grids, the sampling density is insufficient to yield direct measurements in every grid cell. Such data gaps will be addressed in the risk characterization. A fundamental assumption is that the spatial coverage of sampling is sufficient to characterize exposures in a set of EUs, and that collectively, the risks calculated for those EUs inform the assessment endpoints for populations and communities of receptors throughout the Primary Project Area.

5.3.2 Exposure Point Concentration

For each EU and chemical, an EPC will be calculated based on the subset of sampling points that are within the EU. Since multiple EU grids are needed to evaluate different receptor scenarios as discussed above, some EUs will not have samples located within the grid boundary. This is a common source of uncertainty for Superfund risk assessments and two options, not mutually exclusive, will be examined:

1. Extrapolate risk characterization across the Primary Project Area. Calculate exposure and risk for the subset of EUs with data and assume that conditions in these EUs are representative of other EUs that do not have data.
2. Apply spatial weighting methods to estimate conditions in unsampled locations based on the data (Thayer et al., 2003; USEPA, 2001c).

No spatial weighting will be applied in the initial set of calculations; however, spatial patterns will be examined to assess the degree of uncertainty in extrapolating findings across the Primary Project Area. Factors that will be considered include: covariance among chemicals and chemical classes, homogeneity as a function of vertical depth and habitat type, statistical spatial autocorrelation, sampling design methodology (e.g., targeted/non-random sample, stratified random sample), and subareas where elevated or lower concentrations are clustered. Each of these considerations will inform the degree to which extrapolation assumptions and alternative spatial weighting methods may apply.

EPCs for direct exposure are typically equal to a statistically representative concentration of the constituent detected in a specific medium. Exploratory data analysis and statistics will be used to evaluate the distribution, frequency of detection, and potential outliers, for constituents in soil horizontally across the Primary Project Area, and also vertically across depth profiles for a given sample location. The BERA will include a one-page tabular and graphical summary of the properties of the dataset for each analyte/EU combination.

Consistent with USEPA guidance (USEPA, 1989a, 2002b), the EPC will be represented by an estimate of the arithmetic mean concentration, assuming that a receptor has an equal chance of contacting the exposure medium within the EU over time. To account for sources of uncertainty, including both the use of a sample to estimate the population parameter as well as the assumption that receptor has an equal chance of contacting all areas of the EU, the 95UCL is used to represent the EPC (USEPA, 2001c, 2002b). The ProUCL software developed by USEPA (USEPA, 2015) will be used to calculate 95UCLs and R will be applied to compile ProUCL results. The ProUCL software evaluates a wide range of potential statistical methods to estimate a 95UCL for a dataset, and also provides recommendations on one or more results that are most appropriate given the properties of the dataset, including the probability distribution, sample size, frequency of detection, potential outliers, and range of ND detection limits relative to detects. USEPA (2015) guidance notes that there are no general procedures that are applicable in all cases. For example, in some cases, the 95UCL is greater than the sample maximum concentration and, consistent with USEPA guidance, the lesser of the sample maximum concentration and the 95UCL will be used to represent the EPC. For cases when multiple 95UCLs are recommended, this range of values will be considered and discussed in the uncertainty analysis of the baseline risk assessment.

5.3.3 Wildlife Exposure Calculations

In the baseline risk assessment, exposure for mammals, birds, and higher trophic level fish will be represented by the average daily dose (mg per kg body weight per day), calculated using a series of dose equations. The general equations for average daily dose are provided below and are adapted from the Wildlife Exposure Factors Handbook (USEPA, 1993). Exposure parameter values are summarized by receptor in Tables 9.1 through 9.17.

Cumulative Average Daily Dose

Average daily dose (ADD) is determined by the cumulative (summed) daily doses from exposure to COPECs in diet and water:

$$ADD_{Cumulative} = ADD_{diet} + ADD_{water}$$

where:

$ADD_{Cumulative}$	=	average daily dose (mg/kg BW per day)
ADD_{diet}	=	average daily dose via diet (food plus soil and/or sediment (mg/kg BW per day)
ADD_{water}	=	average daily dose via water (mg/kg BW per day)

Average Daily Dose from Diet

The following dose equation will be used to estimate exposure to COPECs through diet:

$$ADD_{diet} = \frac{(IR_{diet} \times C_{diet}) + \left(IR_{soil/sed} \times C_{soil/sed}\right) \times AUF \times SUF}{BW}$$

where:

ADD_{diet}	=	average daily dose via diet (food plus soil or sediment) (mg/kg BW per day)
IR_{diet}	=	average daily ingestion rate of diet (fresh weight) (kg/day)
C_{diet}	=	concentration in diet (mg/kg)
$IR_{soil/sed}$	=	average daily ingestion rate of soil or sediment (kg/day)
$C_{soil/sed}$	=	concentration in soil and/or sediment (mg/day)
AUF	=	area use factor (unitless)
SUF	=	seasonal use factor (unitless)
BW	=	body weight (kg)

The dietary average daily dose equation incorporates receptor-specific diet, soil and/or sediment ingestion rate, area use factor (AUF), seasonal use factor (SUF), and body weight. The AUF reflects an assumption regarding the size of the receptor's home range and/or foraging range relative to the size of the EU or Primary Project Area. Likewise, the SUF is used to provide more explicit assumption regarding potential migratory behavior of a receptor species. For screening level assessments, these factors are set equal to 1.0; however, for the BERA, alternative assumptions may apply to introduce realism. For example, given the Primary Project Area (326 acres) is much smaller than the average home range of a red-tailed hawk (575 acres, see Table B3), use of AUF=1 is likely to overestimate the dietary dose for this representative receptor species.

As noted in the ecological CSM (see Figures 6a and 6b), ingestion is expected to be the primary exposure pathway for both aquatic and terrestrial ecological wildlife receptors. Therefore, it is assumed that the cumulative average daily dose, particularly for upper trophic level receptors and potentially bioaccumulative COPECs, is largely defined by the dietary average daily dose.

Concentration in Diet

The following equation will be used to estimate the EPC (fresh-weight concentration) for diet:

$$C_{diet} = (C_{fish} \times F_{fish}) + (C_{plants} \times F_{plants}) + (C_{invert} \times F_{invert}) + (C_{terr\_prey} \times F_{terr\_prey})$$

where:

C_{diet} = concentration in diet (mg/kg)
C_{fish} = concentration in fish (whole body) (mg/kg)
F_{fish} = fraction of diet consisting of fish (kg tissue per kg of diet)
C_{plants} = concentration in macrophytes, algae or plants (mg/kg)
F_{plants} = fraction of diet consisting of macrophytes, algae or terrestrial plants (kg tissue per kg of diet)
C_{invert} = concentration in invertebrate (mg/kg)
F_{invert} = fraction of diet consisting of invertebrates (kg tissue per kg of diet)
C_{terr_prey} = concentration in terrestrial prey (mg/kg)
F_{terr_prey} = fraction of diet consisting of terrestrial prey (kg tissue per kg of diet)

The concentration in diet (C_{diet}) is calculated for each ecological receptor. Some receptors are expected to consume a mixed diet. Each fraction of a diet item is mathematically representative of the mass (fresh weight) of the item divided by the total mass (fresh weight) of all items consumed per day. This approach represents a simplifying assumption, subject to uncertainty, since diet composition is expected to vary as a function of multiple inter-related factors for a site-specific food web (e.g., abundance of prey relative to the density of the receptor population; energy requirements relative to temperature and life stage). Consistent with USEPA guidance (USEPA, 2001c), this source of variability may be explicitly represented using probabilistic modeling techniques in a higher tier of the baseline risk assessment.

For each receptor, dietary items are separated into four categories: fish, plants (includes algae and macrophytes), invertebrates, and terrestrial prey. Terrestrial prey may include vertebrates such as mammals, reptiles, and amphibians. The EPC from all diet components is essentially the weighted average of EPCs of each diet item. Site-specific empirical COPEC concentrations from each food item will be utilized when available. Model-based estimates (e.g., bioconcentration factor, bioaccumulation factor) will be applied if empirical measurements are not available.

Average Daily Dose from Water

The following dose equation will be used to estimate exposure via drinking water:

$$ADD_{water} = \frac{(C_{water} \times WIR)}{BW} \times (AUF)$$

where:

ADD_{water} = average daily dose via ingestion of water (mg of COPEC/kg BW-day)
C_{water} = mean concentration in water (mg/L)
WIR = water ingestion rate (L/day)
BW = body weight (kg)
AUF = area use factor (unitless)

The EPC for water will be based on surface water samples collected from the Hoosic River throughout the Primary Project Area. The average daily dose is proportional to the receptor-specific average daily water ingestion rate (WIR), described below.

Water Ingestion Rate

The WIR for mammals and birds will be estimated as follows:

Mammal: $$WIR = (0.099 \times BW^{0.90})$$

Avian: $$WIR = (0.059 \times BW^{0.67})$$

where:

WIR = average daily water ingestion rate (L/day)
BW = body weight (kg)

WIR for wildlife are based on allometric equations developed by (Calder & Braun, 1983) using paired body weights and drinking water values from Skadhauge (1975) and Calder (1981).

Soil and Dust Ingestion Rate

The soil and/or sediment ingestion rate ($IR_{soil/sed}$) is the mass of soil (or sediment) ingested per day. As it is assumed soil and/or sediment is ingested by receptors while foraging and consuming food each day, the $IR_{soil/sed}$ is calculated by multiplying the dry-weight (dw) diet ingestion rate by the fraction of sediment in the diet:

$$IR_{soil/sed} = IR_{diet} \times F_{soil/sed}$$

where:

$IR_{soil/sed}$ = soil and/or sediment ingestion rate (kg soil/sed dw per day)
IR_{diet} = average daily ingestion rate of diet (kg diet dw per day)
$F_{soil/sed}$ = proportional fraction of diet that is soil/sediment (kg soil/sed per kg diet dw)

5.4 Ecological Toxicity Criteria

The effects assessment is the second part of the analysis phase of an ERA and it includes identification and development of ecological toxicity criteria, or toxicity reference values (TRVs), representing threshold concentrations or doses for adverse effects for each relevant environmental medium, COPEC, and ecological receptor. The benchmarks used for preliminary screening (ERA Process Step 1, per USEPA, 1997) for this Work Plan are summarized in Tables B.2.1 through B.2.4. Chemicals with maximum concentrations (or detection limits) that exceed these lower benchmarks (summarized in Tables B1.1 to B1.3) "screen in" with the understanding that concentrations that exceed the low-end benchmarks are not necessarily predictive of adverse effects. The COPECs identified at this step warrant further assessment in the BERA. This section describes sources of additional benchmarks that are intended for use in refined screening (Step 2) and baseline risk calculations (Step 7).

Federal and state agencies have developed a range of benchmarks to support the different objectives at each step of the ecological risk assessment (see Section 7.1). For example, USEPA Region 4 (USEPA, 2018b) provides both ecological soil screening values (ESVs) and refined screening values (RSVs). The ESVs are appropriate for Step 1 (and comprise many of the benchmarks presented in Attachment B), and the RSVs are appropriate for Steps 2 and 7 of the BERA. Similarly, NYSDEC (2014) groups sediment guideline values (SGVs) into three categories:

- **Class A** – chemicals with maximum concentrations below the SGV for this class can be considered to present little or no potential for risk to aquatic life. For equilibrium partitioning (EqP) model-based values, SGVs were derived using chronic NAWQCs; for empirical-based SGVs, a Class A threshold is based on a reported threshold effects concentration (TEC) or Effects Range Low (ERL) value (where toxicity is observed infrequently).
- **Class B** – chemicals with concentrations between SGVs for Class A and C require additional information to assess potential risk to aquatic life.
- **Class C** – chemicals with concentrations above this SGV have a high potential for sediments to be toxic to aquatic life. For EqP model-based values, SGVs were derived using acute NAWQCs; for empirical-based SGVs, a Class C threshold was derived from the probable effects concentration (PEC) or Effects Range Medium (ERM) value (where toxicity is observed frequently).

5.4.1 Refined Evaluation of COPECs

The following steps will be conducted to refine the screening level assessment (Step 2 of the BERA) of COPECs:

- Using the same hierarchy of sources as was used in the SLERA (see Appendix B), identify the range of screening levels, as discussed above (e.g., ESV and RSVs; Class A and Class C SGVs; NOAEL-based screening level and LOAEL-based screening level – see Section 5.4.2);

- Group refined screening levels by taxonomic category (e.g., plants, invertebrates, avian wildlife, mammalian wildlife) rather than selecting the lowest value across categories;

- Calculate HQs (see Section 5.5) for each EU, using each sample result as well as media-specific EPCs estimated by the lower of the maximum concentration and 95UCL by EU.

The extent of overlap between the range of benchmark values and the range of sample results by EU (along with the EPC) will be presented graphically as well as on maps displaying EU grids for specific receptor scenarios. This approach will yield a refined COPEC list that guides subsequent exposure assessment and toxicity assessment approaches in the baseline risk assessment.

5.4.2 Wildlife Toxicity Reference Value

A wildlife TRV is a risk-based benchmark for birds or mammals that is expressed in units of milligrams COPEC per kilogram body weight per day (mg/kg-day). Both low- and high-TRVs are recommended by many of the same federal and state agencies identified in the hierarchy of sources used for the SLERA. Low TRVs are generally based on chronic no-observed-adverse-effect-levels (NOAELs), with an emphasis on studies that measured effects on survival, reproduction, growth and development endpoints, applicable to the protection of wildlife populations. A NOAEL is defined as the highest level (or dose) at which no adverse effects are observed. If NOAELs are not available or reported, the lowest-observable-adverse-effects-levels (LOAELs) can be used to estimate NOAELs by applying an uncertainty factor (UF) of 10 following USEPA guidance (USEPA, 1997).

Tables 10.1 (avian TRVs) and 10.2 (mammalian TRVs) lists NOAEL and LOAEL TRVs compiled from USEPA Ecological Soil Screening Level (EcoSSL) documents (USEPA, 2018a), ORNL (Sample et al., 1996), and the open literature. Some of the USEPA EcoSSL TRVs are actually geometric means of multiple NOAELs for growth and reproductive study endpoints. High TRVs are generally based on LOAELs, defined as the lowest level (or dose) at which adverse effects are observed.

The approach to estimating the NOAEL and LOAEL values varied by chemical, depending on the available study data regarding effects on growth, reproduction, and/or survival. The following methods were applied, with additional details provided in Tables 10.1 and 10.2:

- If a LOAEL was reported for the study used to derive the NOAEL-based TRV, that LOAEL value was used;
- In the case where a geometric mean of several NOAELs for growth and reproduction endpoints (from the USEPA Eco-SSLs) was used as the low TRV, the geometric mean of the LOAELs for growth and reproduction was calculated and used for the high TRV; and
- In cases where there was a single NOAEL used for the low TRV and there was no corresponding LOAEL, the upper-bound LOAEL for growth and reproduction was used.

For TRVs not based on the EcoSSL TRVs, the following approach was used:

- If a LOAEL was reported for the study used to derive the NOAEL-based TRV, that LOAEL value was used; and
- If there was no paired LOAEL, a factor of 10 was applied to the NOAEL to estimate a LOAEL.

For PFAS, SERDP (2020) summarizes available avian and mammalian TRVs for selected PFAS chemicals. The authors of the SERDP report indicate that they followed USEPA soils screening level methodology in terms of evaluating data usability and calculating final TRVs. Sufficient study data were available to generate avian TRVs for two PFAS (PFBS and PFOS) and mammalian TRVs for five PFAS (PFBS, PFHxS, PFOS, PFOA, and PFNA) on the target analyte list. Specific details regarding the methodology applied by SERDP (2020) are provided below (SERDP, 2020):

NOAEL TRVs for PFAS

The minimum data requirements to derive a NOAEL TRV were (1) at least three toxicity data (either NOAEL or LOAEL) with growth, reproduction, or mortality as the endpoint and (2) at least two species tested. If the geometric mean of the NOAELs based on growth or reproduction was lower than the lowest bounded LOAEL, the geometric mean was selected as the basis of the NOAEL. If not, the highest bounded NOAEL with a reproduction or growth endpoint below the lowest bounded LOAEL was selected. In a few instances, the number of appropriate NOAELs was less than three and a geometric mean could not be calculated. As the NOAELs available were below the lowest bounded LOAEL, the lowest NOAEL with a growth, reproduction, or mortality endpoint was selected as the basis of the NOAEL TRV.

LOAEL TRVs for PFAS

The minimum data requirements to derive a LOAEL TRV were (1) at least three toxicity data (NOAEL or LOAEL) with growth, reproduction, or mortality as the endpoint and (2) at least two species tested. The LOAEL selected as the basis of a LOAEL TRV was the lowest bounded LOAEL in the data set with growth, reproduction, or mortality as the endpoint.

5.5 Risk Characterization and Uncertainty Assessment

Risk characterization combines potential site-related exposures and the potential for ecotoxicological effects to estimate the likelihood of ecological risks. The risk characterization is conducted for each COPEC and receptor scenario to evaluate potential effects for each assessment endpoint.

Risk is expressed as the ratio of EPC (or Dose) divided by the TRV (in comparable units), otherwise known as a Hazard Quotient (HQ). HQs are calculated using the following equation:

$$HQ = \frac{EPC\ (or\ Dose)}{TRV}$$

where:

HQ	=	hazard quotient (unitless)
EPC	=	exposure point concentration (mass/mass or mass/volume)
Dose	=	average daily dose (mg/kg)
TRV	=	toxicity reference value (same units as EPC or Dose)

If the HQ is less than one, then it is concluded that the potential for impacts to ecological receptors is absent or minimal. If the HQ is equal to or greater than one, then it is concluded that a *potential* for impacts to ecological receptors exists. When the TRV is based on a NOAEL- or LOAEL-approach, the magnitude of the risk cannot be characterized in terms of the magnitude of the probability of an adverse effect. A higher tier of analysis that provides this information would involve probabilistic modeling (USEPA, 2001c, 2010, 2014), discussed below.

5.5.1 Probabilistic Risk Assessment

With probabilistic risk assessment (PRA) approaches such as Monte Carlo Analysis, the same dose and risk equations are applied, but one or more of the exposure factors, and/or the toxicity value can be expressed as probability distributions rather than point estimates. USEPA guidance on probabilistic risk assessment (USEPA, 2001c, 2010, 2014) includes the following key steps:

- Identify exposure factors for which data support developing probability distributions that characterize uncertainty or variability in exposure;
- Identify toxicity studies for which dose-response data are available to describe a dose-response curve; and
- Combine the exposure and dose-response information using Monte Carlo random sampling methods.

Because PRA has been available and used for more than two decades, many risk assessors and risk managers are familiar with the general concepts, and several continue to provide leadership on the development and application of probabilistic modeling tools. Table 11 provides examples of risk assessments that have incorporated PRA to inform risk management decisions, many of which were authored by (or on behalf of) a regulatory agency rather than a responsible party (e.g., ARCADIS, 2014; Berry's Creek Study Area Cooperating PRP Group, 2017; CDTSC, 2011; Goodrum et al., 1996; Griffin et al., 1999; Integral Consulting Inc, 2013; Maddaloni et al., 2005; ORDEQ, 2015; Simpson et al., 2016; Tittabawassee and Saginaw River Team, 2020; USEPA, 2001a, 2004, 2016a, 2017, 2020; USEPA et al., 2002; WIDNR & USEPA, 2002a, 2002b). These examples span nearly every USEPA region, including sites in Region 2 where USEPA and state agencies have provided regulatory oversight.

PRA tends to be most informative when the primary COPECs have low TRVs relative to the concentrations that can be detected in the environment. Historically, this has included sites where risk management decisions have focused on addressing dioxin, PCBs, methyl mercury, lead, arsenic, and radionuclides. Today, we can include PFAS to this list given that advisory levels and criteria under development are approaching similarly low (e.g., part per billion and part per trillion) levels. In these cases, risk management decisions can be informed by using PRA to provide one or both of the following:

- A quantitative estimate of the distribution of risks, from which the findings of a risk assessment can include statements regarding the likelihood and magnitude of exceeding various risk thresholds;
- A sensitivity analysis, which provides an improved understanding of the subset of exposure and toxicity variables that have the greatest effect on variability and uncertainty in risk estimates.

PRA is most helpful as a refinement to the risk characterization step when the outcome of the point estimate (deterministic) approach is “close” to a decision threshold. For this BERA, application of PRA methods will be considered for COPECs for which the HQ is within an order of magnitude (above or below) of a decision threshold. If a PRA is applied, a supplemental work plan will be submitted, for USEPA and NYSDEC to review that outlines the goals, COPECs, basis for probability distributions, and key elements of the proposed risk characterization methodology.

5.5.2 Uncertainty Analysis

The process of evaluating ecological risks involves multiple steps, each with inherent uncertainties. Uncertainties may exist, for example, in the environmental chemistry sampling and analysis used to conduct the risk assessment, the exposure parameters and assumptions, the toxicological information used, and the quantitative risk characterization.

Each of the main sources of uncertainty will be evaluated in the final uncertainty analysis of the BERA. Particular focus will be on, but is not limited to, the following topics:

- Uncertainties in toxicity values including use of a surrogate chemical’s toxicity information for a particular analyte, outdated or uncertain toxicity values themselves, and lack of chemical-specific PFAS data.
- Uncertainty in use of screening levels when toxicity reference values are missing.
- Uncertainty in the use of NOAEL-or LOAEL-based risk estimates in lieu of full dose-response curves.
- Uncertainties with the selection of hypothetical receptors and potential exposure pathways.
- Uncertainties with measured and modeled concentrations in biota (e.g., bioaccumulation factors, regression equations).
- Uncertainties associated with sampling and analytical limitations inherent in the Primary Project Area characterization. Uncertainties arise from the limits on the number of locations that can be sampled.
- Uncertainties due to low frequency of detection or uneven distribution of a chemical to a particular exposure unit.
- Uncertainty in inferences based on alternative ND handling methods.

- Uncertainty associated with data processing steps, including an RPD analysis to demonstrate the quantitative impact on risk characterization if field duplicates were considered in the calculation of EPCs (i.e., if the maximum concentration was selected between field duplicate and parent sample.)
- Uncertainties associated with high MDLs or SQLs.
- Uncertainties associated with wildlife exposure parameters and the quantification of average daily dose.
- Uncertainties in receptor area use factors, home ranges, and sizes of foraging areas, including consideration of the larger RISA.

6.0 PROJECT ORGANIZATION AND SCHEDULE

Once the analysis of the BERA for the McCaffrey Street Site is complete, a draft report will be prepared for the USEPA and NYSDEC review. The BERA report will be comprised of the following major subsections:

Introduction

Summary of Site Characterization

Problem Formulation

COPECs

Receptors and CSMs

Assessment and Measurement Endpoints

Exposure Assessment

Toxicity Assessment

Risk Characterization

Uncertainty Analysis

Summary and Conclusions

Methods and results for the SLERA will be included as an appendix to the BERA.

6.1 Schedule

The following is the anticipated schedule for the BERA:

- 12 February 2021 – Submission of revised BHHRA and BERA Work Plans
- 19 February 2021 – Submission of draft Biota Sampling and Analysis Plan (Biota SAP)
- 11 June 2021 – Submission of revised BHHRA and BERA Work Plans
- Summer/Fall 2021 – Field program to collect additional site-specific samples of surface water, sediment, soil, aquatic invertebrates and plants, fish, terrestrial invertebrates and plants, and small mammals
- Fall/Winter 2021 – Data validation and use in BHHRA and BERA
- Late 2021 – Submission of supplemental Work Plan for Probabilistic Risk Assessment (optional)
- Winter 2021/2022 – Submission of draft BHHRA and BERA for agency review as part of the draft RI Report

The schedule for completion of the BHHRA and BERA depends on the extent of comments received from USEPA and NYSDEC.

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WORK PLAN FOR BASELINE ECOLOGICAL RISK ASSESSMENT

McCAFFREY STREET SITE
(Site No. 442046, USEPA ID# NYD004986741)

EXHIBITS

Exhibit 1: Photographs of Hoosic River Greenway

Exhibit 2: Photographs Illustrative of Project Area Habitat

Exhibit 3: Photographs Illustrative of Hoosic River

EXHIBIT 1

Photographs of Hoosic River Greenway

Looking North and South adjacent to tax parcel property

GSI Job No.: 5316
Issued: 11 June 2021

EXHIBIT 2

Photographs Illustrative of Project Area Habitat

GSI Job No.: 5316
Issued: 11 June 2021

EXHIBIT 3

Photographs Illustrative of Hoosic River

WORK PLAN FOR BASELINE ECOLOGICAL RISK ASSESSMENT

McCAFFREY STREET SITE
(Site No. 442046, USEPA ID# NYD004986741)

TABLES

TABLE 1
Key Regulatory Guidance on Ecological Risk Assessment
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Federal (all authors are USEPA program offices)
Risk Assessment Guidance for Superfund (RAGS) Volume I (1989 – 2001)
· Part B: Development of Risk-based Preliminary Remediation Goals (Risk Equations and Parameters) (1991)
· Part C: Risk Evaluation of Remedial Alternatives (1991)
· Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (2001)
RAGS Volume II – Environmental Evaluation Manual (1989)
· Framework for Ecological Risk Assessment (1992)
· Role of the Ecological Risk Assessment in the Baseline Risk Assessment. OSWER Directive No. 9285.7-17 (1994)
· Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for Conducting Ecological Risk Assessments (1997)
· Guidelines for Ecological Risk Assessment (1998)
· Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites (1999)
· Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment (2000)
· The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Risk Assessments. ECO Update Series (2001)
· Ecological Soil Screening Levels for PAHs (2007)
· Generic Ecological Assessment Endpoints for Ecological Risk Assessment: Second Edition with Generic Ecosystem Services Endpoints Added (2016)
· Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides (2020)
RAGS Volume III, Part A: Process for Conducting Probabilistic Risk Assessment (2001)
· Policy for Use of Probabilistic Analysis in Risk Assessment (1997)
· Use of Probabilistic Techniques (including Monte Carlo Analysis) in Risk Assessment (1997)
· Risk Assessment Forum White Paper: Probabilistic Risk Assessment Methods and Case Studies (2014)
· Probabilistic Risk Assessment to Inform Decision Making: Frequently Asked Questions (2014)
Data Quality Assessment and Exposure Assessment
· Wildlife Exposure Factors Handbook (1993 and updates)
· Supplemental Guidance to RAGS: Calculating the Concentration Term (1992)
· Final Soil Screening Guidance, May 17, 1996. Soil Screening User's Guide (1996)
· Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (2002)
· Data Quality Assessment: Statistical Methods for Practitioners (EPA QA/G-9S) (2006)
· On the Computation of the 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations (2006)
· ProUCL Version 5.1.002 Technical Guide (2015)
Risk Characterization
· Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions (1991)
· Guidance for Risk Characterization (1995)
· Policy for Risk Characterization (1995)
· Guidance on Cumulative Risk Assessment. Part 1. Planning and Scoping (1997)
· Risk Characterization Handbook (2000)
· Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (2002)
· Role of Background in the CERCLA Cleanup Program (2002)
· EPA Risk Assessment Principles and Practices (2004)
· Performance of Statistical Tests for Site Versus Background Soil Comparisons When Distributional Assumptions are not Met (2007)
New York State
· NYSDEC. Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (FWIA) (1994)
· NYSDEC. Technical Guidance for Screening Contaminated Sediments (1999)
· NYSDEC and NYSDOH. New York State Brownfield Cleanup Program, Development of Soil Cleanup Objectives – Technical Support Document (2006)
· NYSDEC. CP-51 Soil Cleanup Guidance (2010)
· NYSDEC. Guidelines for Sampling and Analysis of PFAS Under NYSDEC's Part 375 Remedial Programs (2020)

TABLE 2
Summary of Fresh Water Use Classifications based on 6 NYCRR § 701

McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Class (1, 2)	Human Use				Aquatic Life		Hoosic River Classifications based on Table 1 of 6 NYCRR § 940.4 (9, 10)
	Drinking (3, 4)	Food Preparation (5)	Recreation (6)	Fishing and Shellfishing	Propagation and Survival (7)	Survival (7, 8)	
N	X	X	X	X	X	X	
AA-S	X	X	X	X	X	X	
A-S	X	X	X	X	X		
AA	X	X	X	X	X		
A	X	X	X	X	X		
B			X	X	X		
C			X*	X	X		River reach adjacent to Project Area
D			X*	X		X	Downriver classification changes (see footnote 8)

Abbreviations

6 NYCRR = New York Codes, Rules, and Regulations Title 6

Footnotes

(1) Class N is the same as Class AA-Special (AA-S), except that Class N includes a 200 ft buffer for inputs of substances that may contribute to eutrophication or toxicity.

(2) Class AA-Special (AA-S) is the same as Class A-S, except that Class AA-S has fewer nutrient loadings (e.g., sewage), industrial inputs, and alteration to flow that may impair uses.

(3) For Class AA Waters (6 NYCRR § 701.5(b)), water treatment to achieve drinking water standards may include "approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities".

(4) For Class A Waters (6 NYCRR § 701.6(b)), water treatment to achieve drinking water standards may include, "coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to reduce naturally present impurities".

(5) 6 NYCRR § 701 refers to "culinary or food processing purposes".

(6) Primary and secondary contact recreation. Asterisk on Classes C (6 NYCRR § 701.8) and D (6 NYCRR § 701.9) indicate "other factors may limit the use for these purposes".

(7) Applies to fish, shellfish, and wildlife.

(8) Class D (6 NYCRR § 701.9) may not support fish propagation "due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions".

(9) Table 1, Water Index No. H-264 description for Project Area: "From south corporation line of the Village of Hoosick Falls to the highway bridge on Route NY 7, 0.75 mile southwest of the hamlet of Hoosick."

(10) Table 1, Water Index No. H-264 description for down river area: "From the highway bridge on Route NY 7 to the New York-Vermont State line, 250 feet north of highway bridge on Route NY 346."

TABLE 3
Assessment and Measurement Endpoints for Baseline Ecological Risk Assessment
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Assessment Endpoint	Representative Receptor	Measures of Exposure	Measures of Effect
Aquatic plant and invertebrate community structure as food source for local fish and wildlife	• Filamentous algae, phytoplankton • Aquatic invertebrates	• Measured concentrations in surface water and sediment	• Exceedance of ambient water quality criteria (AWQC) and other applicable surface water and sediment guidelines • Hoosic River bioassessment (HRWA 2007)
Survival, growth, and reproduction of local forage fish populations	• Pumpkinseed	• Measured concentrations in surface water • Modeled dietary dose	• Exceedance of AWQC and applicable guidelines • Estimated exceedance of TRVs
Survival, growth, and reproduction of local piscivorous/omnivorous fish populations	• Brown bullhead • Brown trout	• Measured concentrations in surface water • Modeled dietary dose	• Exceedance of AWQC and applicable guidelines • Estimated exceedance of TRV • Hoosic River bioassessments
Protection (i.e., survival and reproduction) of waterfowl	• Mallard duck	• Modeled concentrations in prey items • Measured concentrations in abiotic media	• Estimated exceedance of TRVs • Exceedance of AWQC for the protection of wildlife
Protection of piscivorous/semi-piscivorous birds and mammals	• Belted kingfisher • Great blue heron • Bald eagle • Mink	• Modeled concentrations in prey items • Measured concentrations in abiotic media	• Estimated exceedance of TRVs • Exceedance of AWQC for the protection of wildlife
Terrestrial plant and invertebrate community structure as a food source for local wildlife	• Plants • Earthworms	• Measured concentrations in soil	• Exceedance of soil guidelines protective of plants and invertebrates
Protection of herbivorous and invertivorous mammals	• Northern short-tailed shrew • Meadow vole • Muskrat	• Measured concentrations in soil and water • Modeled concentrations in prey items	• Exceedance of soil guidelines protective of wildlife • Estimated exceedance of TRVs
Protection of insectivorous birds and mammals	• Tree swallow • Little brown bat	• Measured concentrations in soil and water • Modeled concentrations in prey items	• Exceedance of soil guidelines protective of wildlife • Estimated exceedance of TRVs
Protection of omnivorous birds and mammals	• American robin • Red tailed hawk • Red fox	• Measured concentrations in soil and water • Modeled concentrations in prey items	• Exceedance of soil guidelines protective of wildlife • Estimated exceedance of TRVs

Abbreviations
TRV = toxicity reference value (mg/kg body weight/day)

Supporting References
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TABLE 4
Ecological Risk Screening - Preliminary Contaminants of Potential Ecological Concern
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	CAS Number	Chemical	Potential Bioaccumulation (2)	Exposure Media (1)			
				On-site Soil	Off-site Soil	Sediment (3)	Surface Water
PAHs	205-99-2	Benzo[b]fluoranthene	B	**P**	**P**		
	191-24-2	Benzo[g,h,i]perylene	B	**P**	**P**		S
	207-08-9	Benzo[k]fluoranthene	B	**P**	**P**		S
	218-01-9	Chrysene	B		**P**		
	53-70-3	Dibenzo[a,h]anthracene		**P**	**P**		S
	132-64-9	Dibenzofuran		**P**	**P**		
	206-44-0	Fluoranthene			**P**		
	86-73-7	Fluorene	B				
	193-39-5	Indeno[1,2,3-cd]pyrene		**P**	**P**		S
	91-20-3	Naphthalene		**P**	**P**		
	85-01-8	Phenanthrene	B		**P**		S
	129-00-0	Pyrene			**P**		
		Total LMW PAHs			**P**		S
		Total HMW PAHs		**P**	**P**		S
PCBs	12674-11-2	Aroclor 1016	B	S	S		S
	11104-28-2	Aroclor 1221	B	S	S		S
	11141-16-5	Aroclor 1232	B	S	S		S
	53469-21-9	Aroclor 1242	B	S	S		S
	12672-29-6	Aroclor 1248	B	S	S		S
	11097-69-1	Aroclor 1254	B	S	S		S
	11096-82-5	Aroclor 1260	B	S	S		S
	37324-23-5	Aroclor 1262		S	S		S
	11100-14-4	Aroclor 1268	B	S	S		S
	1336-36-3	Total PCB Aroclors		**P**	**P**		S
Pesticides	72-54-8	4,4'-DDD	B				S
	72-55-9	4,4'-DDE	B				
	50-29-3	4,4'-DDT	B		**P**		S
	309-00-2	Aldrin	B				
	319-84-6	alpha-Benzenehexachloride	B				S
	1912-24-9	Atrazine		S	S		S
	319-85-7	beta-Benzenehexachloride	B	S	**P**		**P**
	86-74-8	Carbazole		**P**	**P**		
	5103-71-9	cis-Chlordane			**P**		S
	319-86-8	delta-Benzenehexachloride	B				
	60-57-1	Dieldrin	B		**P**		
	959-98-8	Endosulfan I	B	**P**	S		
	33213-65-9	Endosulfan II	B				
	1031-07-8	Endosulfan sulfate		S	**P**		
	72-20-8	Endrin	B	**P**	**P**		
	7421-93-4	Endrin aldehyde			S		
	53494-70-5	Endrin ketone			S		S
	58-89-9	gamma-Benzenehexachloride	B		**P**		
	76-44-8	Heptachlor	B	**P**	**P**		**P**
	1024-57-3	Heptachlor epoxide	B	**P**	**P**		S
	72-43-5	Methoxychlor	B	S	S		S
	8001-35-2	Toxaphene	B	S	S		S
	5103-74-2	trans-Chlordane					S
Phenols	58-90-2	2,3,4,6-Tetrachlorophenol		S	S		S
	95-95-4	2,4,5-Trichlorophenol					S
	88-06-2	2,4,6-Trichlorophenol					S
	120-83-2	2,4-Dichlorophenol		S	S		
	95-57-8	2-Chlorophenol		S	S		
	87-86-5	Pentachlorophenol			S		
Semi-Volatiles	120-82-1	1,2,4-Trichlorobenzene	B		S		
	95-50-1	1,2-Dichlorobenzene	B	S	S		
	541-73-1	1,3-Dichlorobenzene	B	S	S		
	106-46-7	1,4-Dichlorobenzene	B				
	105-67-9	2,4-Dimethylphenol		S	S		
	51-28-5	2,4-Dinitrophenol		S	S		

TABLE 4

Ecological Risk Screening - Preliminary Contaminants of Potential Ecological Concern

McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	CAS Number	Chemical	Potential Bioaccumulation (2)	Exposure Media (1)			
				On-site Soil	Off-site Soil	Sediment (3)	Surface Water
	121-14-2	2,4-Dinitrotoluene					
	606-20-2	2,6-Dinitrotoluene					
	91-58-7	2-Chloronaphthalene		S	S		S
	95-48-7	2-Methylphenol		S	S		
	88-75-5	2-Nitrophenol					
	91-94-1	3,3'-Dichlorobenzidine		S	S		S
	534-52-1	4,6-Dinitro-2-methylphenol		S	S		S
	101-55-3	4-Bromophenyl-phenylether	B	S	S		S
	59-50-7	4-Chloro-3-methylphenol					S
	106-47-8	4-Chloroaniline			S		S
	7005-72-3	4-Chlorophenyl-phenyl ether	B	S	S		S
	106-44-5	4-Methylphenol		S	S		
	100-02-7	4-Nitrophenol		S	S		
	98-86-2	Acetophenone					S
	100-52-7	Benzaldehyde		S	S		
	85-68-7	Benzyl n-butyl phthalate		S	S		
	111-91-1	bis(2-Chloroethoxy)methane		S	S		S
	111-44-4	Bis(2-chloroethyl)ether					
Semi-Volatiles	117-81-7	bis(2-Ethylhexyl)phthalate		S	S		S
	105-60-2	Caprolactam		S	S		S
	84-66-2	Diethyl phthalate		S	S		
	131-11-3	Dimethyl phthalate					
	84-74-2	Di-n-butyl phthalate		S	S		
	117-84-0	Di-n-octylphthalate		S	S		
	118-74-1	Hexachlorobenzene	B	S	S		S
	87-68-3	Hexachlorobutadiene	B	S	S		S
	77-47-4	Hexachlorocyclopentadiene	B	S	S		S
	67-72-1	Hexachloroethane		S	S		
	78-59-1	Isophorone					
	98-95-3	Nitrobenzene					
	621-64-7	N-Nitrosodi-n-propylamine			S		S
	86-30-6	N-Nitrosodiphenylamine			S		
	108-95-2	Phenol			**P**		
	71-55-6	1,1,1-Trichloroethane		S	S		
	79-34-5	1,1,2,2-Tetrachloroethane		S	S		
	79-00-5	1,1,2-Trichloroethane			S		
	75-34-3	1,1-Dichloroethane		S	S		
	75-35-4	1,1-Dichloroethene		S	S		
	87-61-6	1,2,3-Trichlorobenzene					
	95-94-3	1,2,4,5-Tetrachlorobenzene	B	S	S		
	96-12-8	1,2-Dibromo-3-chloropropane		S	S		S
	106-93-4	1,2-Dibromoethane					S
	107-06-2	1,2-Dichloroethane					
	78-87-5	1,2-Dichloropropane			S		
	123-91-1	1,4-Dioxane		S	S		
	78-93-3	2-Butanone					
	591-78-6	2-Hexanone		S	S		
Volatiles	108-10-1	4-Methyl-2-pentanone					
	67-64-1	Acetone		**P**	**P**		
	71-43-2	Benzene		**P**	S		
	39638-32-9	Bis(2-chloroisopropyl) ether		S	S		S
	74-97-5	Bromochloromethane		S	S		S
	75-27-4	Bromodichloromethane					
	75-25-2	Bromoform		S	S		
	74-83-9	Bromomethane		S	S		
	75-15-0	Carbon disulfide		**P**	S		
	56-23-5	Carbon tetrachloride		S	S		
	108-90-7	Chlorobenzene					
	75-00-3	Chloroethane		S	S		S

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TABLE 4
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McCaffrey Street Site
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NYSDEC Site # 442046

Chemical Class	CAS Number	Chemical	Potential Bioaccumulation (2)	Exposure Media (1)			
				On-site Soil	Off-site Soil	Sediment (3)	Surface Water
Volatiles	67-66-3	Chloroform		S	S		
	74-87-3	Chloromethane					S
	156-59-2	cis-1,2-Dichloroethene		S	S		
	10061-01-5	cis-1,3-Dichloropropene		S	S		S
	110-82-7	Cyclohexane		S	S		
	124-48-1	Dibromochloromethane					
	75-71-8	Dichlorodifluoromethane					S
	100-41-4	Ethylbenzene			S		
	98-82-8	Isopropylbenzene		S	S		S
	179601-23-1	m,p-Xylene		S	S		S
	79-20-9	Methyl acetate		S	S		S
	1634-04-4	Methyl tert-butyl ether		S	S		
	108-87-2	Methylcyclohexane		S	S		
	75-09-2	Methylene Chloride		S	S		S
	95-47-6	o-Xylene		S	S		S
	100-42-5	Styrene					
	127-18-4	Tetrachloroethene		S	S		
	108-88-3	Toluene		S	S		
	156-60-5	trans-1,2-Dichloroethene		S	S		
	10061-02-6	trans-1,3-Dichloropropene		S	S		S
	79-01-6	Trichloroethene		**P**	S		S
	75-69-4	Trichlorofluoromethane					S
	76-13-1	Trichlorotrifluoroethane		S	S		S
	75-01-4	Vinyl chloride		S	S		S

Abbreviations

B = potential to bioaccumulate in upper trophic level receptors in aquatic or terrestrial food webs

P = primary COPEC, shaded in gray in this table, screened in because the maximum concentration (detect or nondetect) exceeds the screening level. Designated with note "A" in Attachment B, Tables B1.1 to B1.4.

S = secondary COPEC, retained for refined screening and assessment due to one of the following outcomes of the SLERA (Tables B1.1 to B1.4): 1) maximum detect >SL, but the frequency of detection was low (<5%) ("B"); 2) maximum nondetect > SL ("C"); or no screening level is available for the given analyte/media combination ("D").

Footnotes

(1) Analyte designations "P" and "S" are preliminary, based on conservative (health protective) combinations of exposure (e.g., use of maximum detect or nondetect) and toxicity (e.g., use of NOAELs and other benchmarks that provide high confidence of no adverse effects if not exceeded); these designations may change following more refined analysis in the BERA.

(2) Refer to bioconcentration factors and bioaccumulation factors summarized in Tables 5, 6.1, and 6.2.

(3) The initial screening of sediment was conducted on data available for PFAS. A supplemental screen will be performed on site-specific samples for other analytes following the field sampling program in 2021.

TABLE 5
Analytes Considered Bioaccumulative by USEPA and/or NYSDEC & NYSDOH
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	CAS Number	Chemical	USEPA 2000 (1)	NYSDEC and NYSDOH 2006 (2)
Metals	7440-38-2	Arsenic	X	
	7440-39-3	Barium		X
	7440-43-9	Cadmium	X	
	7440-47-3	Chromium*	X	X
	7440-50-8	Copper	X	X
	7439-92-1	Lead	X	
	7439-96-5	Manganese		X
	22967-92-6	Methylmercury	X	
	7440-02-0	Nickel	X	X
	7782-49-2	Selenium	X	X
	7440-22-4	Silver	X	
	56-35-9	Tributyltin (oxide)	X	
	7440-66-6	Zinc	X	X
PAHs	634-66-2	1,2,3,4-Tetrachlorobenzene	X	
	95-94-3	1,2,4,5-Tetrachlorobenzene	X	
	120-82-1	1,2,4-Trichlorobenzene (TCB)	X	
	95-50-1	1,2-Dichlorobenzene	X	
	541-73-1	1,3-Dichlorobenzene	X	
	106-46-7	1,4-Dichlorobenzene	X	
	83-32-9	Acenaphthene	X	
	208-96-8	Acenapthylene	X	
	120-12-7	Anthracene	X	
	56-55-3	Benzo(a)anthracene	X	
	50-32-8	Benzo(a)pyrene	X	X
	205-99-2	Benzo(b)fluoranthene	X	
	191-24-2	benzo(g,h,i)perylene	X	
	207-08-9	Benzo(k)fluoranthene	X	
	218-01-9	Chrysene	X	
	53-70-3	Dibenzo(a,h)anthracene	X	
	206-44-0	Fluoranthene	X	
	86-73-7	Fluorene	X	
	118-74-1	Hexachlorobenzene (HCB)	X	
	87-68-3	Hexachlorobutadiene	X	
	77-47-4	Hexachlorocyclopentadiene	X	
	67-72-1	Hexachloroethane	X	
	193-39-5	Indeno(1,2,3-c,d)pyrene	X	
	29082-74-4	Octachlorostyrene	X	
	608-93-5	Pentachlorobenzene	X	
	85-01-8	Phenanthrene	X	
	129-00-0	Pyrene	X	
	25322-20-7	Tetrachloroethane	X	
Pesticides	309-00-2	Aldrin	X	
	959-98-8	alpha-Endosulfan2	X	
	319-84-6	alpha-Hexachlorocyclohexane	X	
	33213-65-9	beta-Endosulfan	X	
	319-85-7	beta-Hexachlorocyclohexane	X	
	57-74-9	Chlordane	X	
	2921-88-2	Chlorpyrifos	X	

TABLE 5
Analytes Considered Bioaccumulative by USEPA and/or NYSDEC & NYSDOH
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	CAS Number	Chemical	USEPA 2000 (1)	NYSDEC and NYSDOH 2006 (2)
Pesticides	319-86-8	delta-Hexachlorocyclohexane	X	
	333-41-5	Diazinon	X	
	115-32-2	Dicofol	X	
	60-57-1	Dieldrin	X	X
	298-04-4	Disulfoton	X	
	72-20-8	Endrin	X	
	55283-68-6	Ethalfluralin	X	
	563-12-2	Ethion	X	
	58-89-9	gamma-Hexachlorocyclohexane	X	
	1024-57-3	Heptachlor epoxide	X	
	76-44-8	Heptachlor	X	
	72-43-5	Methoxychlor	X	
	2385-85-5	Mirex	X	
	1836-75-5	Nitrofen	X	
	42874-03-3	Oxyfluorfen	X	
	72-54-8	4,4-DDD	X	
	72-55-9	4,4-DDE	X	
	50-29-3	4,4--DDT	X	X
	82-68-8	Pentachloronitrobenzene	X	
	52645-53-1	Permethrin	X	
	66230-04-4	S-fenvalerate	X	
	13071-79-9	Terbufos	X	
	8001-35-2	Toxaphene	X	
	1582-09-8	Trifluralin	X	
Phenols	87-86-5	Pentachlorophenol	X	X
	1825-21-4	Pentachloroanisole	X	
Semi-Volatiles	7005-72-3	4-Chlorophenyl phenyl ether	X	
	101-55-3	4-Bromophenyl phenyl ether	X	

* USEPA (2000) lists "Chromium VI" with the CASRN for Chromium; NYSDEC & NYSDOH (2006) provides a BAF for "Chromium" without specifying which compound.

Footnotes
(1) USEPA (2000). *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment; Status and Needs.* EPA-823-R-00-001. U.S. Environmental Protection Agency. February. Table 4-2.

(2) NYSDEC & NYSDOH (2006). *New York State Brownfield Cleanup Program Development of Soil Cleanup Objectives Technical Support Document.* New York State Department of Environmental Conservation and New York State Department of Health. September. Table 8.3-1 Uptake Factors for Calculation of Bioaccumulation Based ESCOs (marked analytes have BAF values for either plant or earthworm uptake).

TABLE 6.1
Comparison of BCF and BAF Estimates for Fish for PFAS
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical	CAS RN	Carbon Chain Length	# Perfluorinated Carbons	BCF (L/kg ww fish)				BAF (kg ww fish / kg ww diet)			Potentially Bioaccumulative? (Yes/No) (5, 6)
				EPA AQUATOX (1, 2)	Martin et al. 2003a (1)	SERDP 2019 (3)	Species (Tissue Type)	Martin et al. 2003b (4)	SERDP 2019 (3)	Species (Tissue Type)	
PFCAs											
PFBA	375-22-4	C4	3	0.0010	0.0010	0.60	zebrafish (muscle)	0.0066	**0.0066**	rainbow trout (carcass)	No
PFPeA	2706-90-3	C5	4	0.0086	0.0086	0.23	zebrafish (muscle)	0.011	**0.011**	rainbow trout (carcass)	No
PFHxA	307-24-4	C6	5	0.071	0.071	0.69	zebrafish (muscle)	0.019	**0.019**	rainbow trout (carcass)	No
PFHpA	375-85-9	C7	6	0.58	0.58	3.2	zebrafish (muscle)	0.031	**0.031**	rainbow trout (carcass)	No
PFOA	335-67-1	C8	7	4.8	4.8	4.0	rainbow trout (carcass)	0.053	0.038	rainbow trout (carcass)	No
PFNA	375-95-1	C9	8	39	39	**39**	rainbow trout (carcass)	0.089	0.23	rainbow trout (whole body)	No
PFDA	335-76-2	C10	9	322	322	450	rainbow trout (carcass)	0.15	0.23	rainbow trout (carcass)	No
PFUnA	2058-94-8	C11	10	2,642	2,642	2,700	rainbow trout (carcass)	0.25	0.28	rainbow trout (carcass)	Yes
PFDoDA	307-55-1	C12	11	21,707	21,707	18,000	rainbow trout (carcass)	0.42	0.43	rainbow trout (carcass)	Yes
PFTriA	72629-94-8	C13	12	21,707	177,828	21,627	zebrafish (whole)	0.71	**0.71**	rainbow trout (carcass)	Yes
PFSAs											
PFBS	375-73-5	C4	4	0.084	0.0085	1.0	zebrafish (muscle)	0.011	0.020	rainbow trout (whole body)	No
PFHxS	355-46-4	C6	6	9.7	0.58	9.6	rainbow trout (carcass)	0.031	0.14	rainbow trout (carcass)	No
PFHpS	375-92-8	C7	7	104	4.7	--	NA	0.05	--	NA	No
PFOS	1763-23-1	C8	8	1,109	39	1,100	rainbow trout (carcass)	0.09	0.32	rainbow trout (carcass)	Yes
PFDS	335-77-3	C10	10	127,350	2,630	**2,630**	rainbow trout (carcass)	0.25	**0.25**	rainbow trout (carcass)	Yes
FASAs											
PFOSA	754-91-6	C8	8	--	39	**39**	rainbow trout (carcass)	0.089	0.023	rainbow trout (muscle)	No
EtFASAAS and											
NEtFOSA	2991-50-6	C11	8	--	39	**39**	rainbow trout (carcass)	--	**0.089**	rainbow trout (carcass)	No
NMeFOSAA	2355-31-9	C12	8	--	39	**39**	rainbow trout (carcass)	--	**0.089**	rainbow trout (carcass)	No
6:2 FTS	27619-97-2	C8	6	--	--	--	NA	--	--	NA	--
8:2 FTS	39108-34-4	C10	8	--	--	--	NA	--	--	NA	--

Abbreviations

BAF = bioaccumulation factor
BCF = bioconcentration factor
BMF = biomagnification factor (includes diet)
L/kg = liters per kilogram
NA = not applicable
ww = wet weight
-- = no estimate available

Footnotes

(1) For PFCAs, the EPA AQUATOX model (USEPA 2018) implements the same equation as Martin et al. (2003a): BCF = 10^(-5.724+0.9146 x C), where C = number of perfluorinated carbons.
For PFSAs, Aquatox implements: BCF = 10^(-5.195+1.03 x C).

(2) With EPA AQUATOX the modelled BCF for compounds with perfluoroalkyl chain length> 11 is assumed to be the same as the BCF for chain length = 11.

(3) Bolded values are cases in which SERDP (2019) estimated values using equations from Martin et al. 2003a and 2003b. SERDP (2019) refers to BAF from Martin et al. (2003b) as a biomagnification factor (BMF).

(4) For PFCAs and PFSAs, Martin et al. (2003b) implements the following equation: BAF = 10^(-2.86 + 0.226 x C), where C = number of perfluorinated carbons.

(5) Yes = BCF >1000 or BAF > 1; No = BCF ≤1000 and BAF ≤ 1. Compounds that are potentially bioaccumulative in fish are outlined in bolded rectangle and include C10-C12 PFCAs and C8 and C10 PFSAs.

(6) Conclusions for PFOA and PFOS are consistent with BCF estimates in a white paper by Florida Department of Environmental Protection, which conducted a literature search in May 2019 and compiled study values focusing on muscle and fillet tissues. Values are based on ratios of water and tissue concentrations (although they use the term BAF). Geometric means are 68 L/kg ww for PFOA and 2,358 L/kg ww for PFOS.

Supporting References

SERDP. (2019). *Guidance for Assessing the Ecological Risks of PFASs to Threatened and Endangered Species at Aqueous Film Forming Foam-Impacted Sites.* SERDP Project ER18-1614. Produced by Geosyntec & Colorado School of Mines for U.S. Department of Defense, Strategic Environmental Research and Development Program.

Martin, J. W., Mabury, S. A., Solomon, K. R., and Muir, D. C. G. (2003a). Bioconcentration and Tissue Distribution of Perfluorinated Acids in Rainbow Trout (*Oncorhyncus mykiss*). *Environmental Toxicology and Chemistry* 22(1): 196-204.

Martin, J. W., Mabury, S. A., Solomon, K. R., and Muir, D. C. G. (2003b). Dietary Accumulation of Perfluorinated Acids in Juvenile Rainbow Trout (*Oncorhynchus mykiss*). *Environmental Toxicology and Chemistry* 22(1): 189-195.

USEPA. (2018c). *AQUATOX (RELEASE 3.2). Modeling Environmental Fate and Ecological Effects in Aquatic Systems. Volume 2: Technical Documentation.* EPA/600/B-18/241. U.S. Environmental Protection Agency.

TABLE 6.2
BCF, BAF, and BSAF Estimates for Invertabrates and Plants for PFAS
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical	CAS RN	Carbon Chain Length	# Perfluorinated Carbons	SERDP 2019 (1)				
				Aquatic			Terrestrial	
				Invertebrates		Plants	Invertebrates	Plants
				Planktonic	Benthic			
				BCF-PI (L/kg ww PI)	BSAF-BI (g OC/g ww BI)	BCF-AP (L/kg ww AP)	BSAF-TI (g OC/g ww TI)	BAF-TP (g OC/g ww TP)
PFCAs								
PFBA	375-22-4	C4	3	--	--	--	--	0.22
PFPeA	2706-90-3	C5	4	--	--	26	0.021	1.25
PFHxA	307-24-4	C6	5	--	0.040	25	0.071	0.81
PFHpA	375-85-9	C7	6	--	0.18	25	0.075	0.094
PFOA	335-67-1	C8	7	91	0.95	28	0.30	0.017
PFNA	375-95-1	C9	8	152	1.6	58	0.57	0.012
PFDA	335-76-2	C10	9	175	1.0	110	1.6	0.0084
PFUnA	2058-94-8	C11	10	270	0.62	315	2.4	0.0076
PFDoDA	307-55-1	C12	11	380	0.55	581	3.8	0.067
PFTriA	72629-94-8	C13	12	--	0.55	1,281	--	--
PFSAs								
PFBS	375-73-5	C4	4	0.0065	0.34	19	0.58	0.40
PFHxS	355-46-4	C6	6	--	0.86	28	2.1	0.087
PFHpS	375-92-8	C7	7	--	--	--	--	--
PFOS	1763-23-1	C8	8	179	1.2	90	3.5	0.046
PFDS	335-77-3	C10	10		0.50	--	0.017	0.0018
FASAs								
PFOSA	754-91-6	C8	8	--	0.098	--	--	0.038
EtFASAAS and MeFASAAs								
NEtFOSA	2991-50-6	C11	8	--	0.12	--	0.84	--
NMeFOSAA	2355-31-9	C12	8	--	--	--	--	--
6:2 FTS	27619-97-2	C8	6	--	--	--	--	--
8:2 FTS	39108-34-4	C10	8	--	--	--	--	--

Abbreviations

BAF = bioaccumulation factor
BCF = bioconcentration factor
BSAF = biota-sediment accumulation factor
L/kg = liters per kilogram
OC = organic carbon
NA = not applicable
AP = aquatic plant
BI = benthic invertebrate
PI = planktonic invertebrate
TI = terrestrial invertebrate
TP = terrestrial plant
-- = no estimate available
ww = wet weight

Footnotes

(1) Recommended bioaccumulation metrics from SERDP (2019), which gives greater weight to laboratory studies using PFAS-spiked media. No recommended bioaccumuation metric values were derived from field studies.

Supporting References

SERDP. (2019). *Guidance for Assessing the Ecological Risks of PFASs to Threatened and Endangered Species at Aqueous Film Forming Foam-Impacted Sites*. SERDP Project ER18-1614. U.S. Department of Defense Strategic Environmental Research and Development Program.

TABLE 7
Representative Receptors for the Baseline Ecological Risk Assessment – Aquatic and Terrestrial Systems
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

System	Taxonomic Group / Trophic Level	Representative Species (1)	Foraging Class	Rationale	Used in Other BERAs (USEPA Region)
Aquatic	Primary Producer	filamentous algae, phytoplankton	NA	• filamentous algae and diatoms are observed upstream and downstream in Hoosic River (HRWA 2007)	NA
	Primary Consumer	aquatic macroinvertebrates	aquatic insects	• feeding preference for primary fish consumers	NA
	Fish Primary Consumer	pumpkinseed (family *Centrarchidae* /sunfish)	nektonic forage fish - planktivorous, insectivorous	• site-specific sampling of river includes: bluntnose minnow • site-specific sampling of Thayers Pond includes pumpkinseed, black crappie • classified by NYSDEC (1989) as widespread species in Upper Hudson estuary	Hudson (R2); Housatonic (R1)
	Fish Primary Consumer	brown bullhead (family *Ictaluridae* /catfish)	bottom feeder - omnivorous, scavanger, detritivore	• site-specific sampling of Thayers Pond includes bullhead • similar feeding group as amphibians and reptiles	Hudson (R2); Housatonic (R1)
	Fish Secondary Consumer	brown trout (family *Salmonidae*)	predator fish (upper trophic); omnivorous (aquatic feeders)	• state fish of NY • Hoosic River is considered a trout fishery • site-specific sampling events produced a variety of trout (brown, brook, rainbow)	
	Mammalian Primary Consumer	muskrat (*Ondatra zibethicus*)	semi-aquatic herbivore	• representative of mammalian herbivore • prefer marshes with constant water levels for food and den construction; low water levels in winter can result in freeze out and high mortality	Kalmazoo (R5); Cass Lake (R5)
	Mammalian Tertiary Consumer/Predator	American mink (*Neovision vison*)	semi-piscivorous/carnivorous mammal	• extensive toxicity data for bioaccumulative compounds	Hudson (R2); Housatonic (R1), Nyanza (R1); Kalamazoo (R5), Stony Creek (R5)
	Avian Primary Consumer	mallard duck (*Anas platyrhynchos*)	swimming bird - aquatic herbivorous/insectivorous	• representative of avian primary consumer for Hudson River system • similar foraging class as geese, swans, coots	Hudson (R2)
	Avian Tertiary Consumer	belted kingfisher (*Megaceryle alcyon*)	wide ranging river bird - piscivorous	• representative of higher trophic level avian piscovore for Hudson River system • similar foraging class as gulls and other kingfishers	Hudson (R2), Lail (R2); Housatonic (R1), Nyanza (R1)
	Avian Tertiary Consumer	great blue heron (*Ardea herodias*)	wading bird - piscivorous	• greater foraging area than belted kingfisher, also selected for Hudson river system • similar foraging class as other herons, egrets, bitterns, and rails	Hudson (R2), Lail (R2); Nyanza (R1)
	Avian Tertiary Consumer/Predator	bald eagle (*Haliaeetus leucocephalus*)	raptor (bird of prey) - piscivorous/carnivorous/ scavenger	• avian carnivore, also selected for Hudson river system, identified as rare for Hoosic river system • similar foraging class as other raptors - hawks, falcons, osprey	Hudson (R2), Lail (R2)
	Amphibians	NA	NA	not enough tox data yet to explicitly quantify risk foraging class represented by brown bullhead	
	Reptiles	NA	NA	not enough tox data yet to explicitly quantify risk foraging class represented by brown bullhead	

TABLE 7
Representative Receptors for the Baseline Ecological Risk Assessment – Aquatic and Terrestrial Systems
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

System	Taxonomic Group / Trophic Level	Representative Species (1)	Foraging Class	Rationale	Used in Other BERAs (USEPA Region)
Terrestrial	Plants	NA	NA	• present at site	NA
	Primary Consumer	earthworms	organic material, microorganisms, mesofauna	• common terrestrial invertebrate in North America	NA
	Mammalian Secondary Consumer	northern short-tailed shrew (*Blarina brevicauda*)	invertivorous	• small foraging range	Lail (R2); Housatonic (R1); Stony Creek (R5)
	Mammalian Secondary Consumer	meadow vole (*Microtus pennsylvanicus*)	herbivorous	• small foraging range, borrowing	
	Mammalian Tertiary Consumer/Rodentivore	red fox (*Vulpes vulpes*)	ominivorous	• top trophic level, large foraging range, prefers to locate den within 100m of open water • similar foraging class as raccoon, dogs, cats	Housatonic (R1); Kalamazoo (R5), Stony Creek (R5)
	Mammalian Tertiary Consumer/Insectivore	little brown bat (*Myotis lucifugus*)	insectivorous	• several bat species are rare in the Hoosic River watershed	Hudson (R2)
	Avian Secondary Consumer	tree swallow (*Tachycineta bicolor*)	perching bird - insectivorous	• very common for Upstate NY • similar foranging class as thrushes, wrens, sparrows, flycatchers, jays, blackbirds	Hudson (R2); Housatonic (R1), Nyanza (R1)
	Avian Secondary Consumer	American robin (*Turdus migratorius*)	omnivorous (terrestrial feeders)	• very common for Upstate NY • larger foraging area than swallow (i.e., 0.3-2 acres vs 200 meters)	Housatonic (R1); Kalamazoo (R5), Stony Creek (R5)
	Avian Tertiary Consumer/Predator	red tailed hawk (*Buteo jamaicensis*)	raptor (bird of prey) - omnivorous	• very common for Upstate NY • similar feeding group as owls	

Notes
NA = not applicable (no specific species is selected as an assessment endpoint)
(1) Receptor species are surrogates, representative of a wide range of species that may be present in the Hoosic River watershed based on habitat conditions and findings reported from biological surveys.

Sources
Nolan, J. K. (2007). *Hoosic River 2006 Bioassessment.* Hoosic River Water Association, Water Quality Monitoring Program.
NYSDEC. (1989). *Fish and their Habitats in the Upper Hudson Estuary.* Prepared by D.M. Carlson, Division of Fish and Wildlife, New York State Department of Environmental Conservation.

Cited BERAs

- Hudson (R2) TAMS Consultants, Inc. and Menzi-Cura & Associates, Inc. (2000). *Phase 2 Report. Further Site Characterization and Analysis, Volume 2E - Revised Baseline Ecological Risk Assessment. Hudson River PCBs Assessment*. Prepared for U.S. Environmental Protection Agency Region 2 and U.S. Corps of Engineers Kansas City District.
- Lail (R2) ARCADIS. 2010. Post-Interim Remedial Measure Ecological Risk Assessment. Former Lail Property, East Greenwich TWP/Paulsboro, NJ (Delaware River Watershed). Prepared for ExxonMobil.
- Housatonic (R1) Weston Solutions, Inc. (2004). *Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River. Volume 6, Appendix H: Assessment Endpoint - Piscivorous Birds; Appendix I: Assessment Endpoint - Piscivorous Mammals; Appendix J: Assessment Endpoint - Omnivorous and Carnivorous Mammals; Appendix K: Assessment Endpoint - Threatened and Endangered Species; Appendix L: Summary of Data Used in the Ecological Risk Assessment.* Prepared for U.S. Army Corps of Engineers New England District and U.S. Environmental Protection Agency New England Region.
- Nyanza (R1) Nobis Engineering, Inc. and Avatar Environmental, LLC. (2008). *Final Supplemental Baseline Ecological Risk Assessment. Volume 1: Sections 1-5, Nyanza OU4 Chemical Waste Dump Superfund Site, Operable Unit 4 - Sudbury River, Ashland MA*. Prepared for U.S. Environmental Protection Agency Region 1.
- Kalamazoo (R5) CDM. (2003). *Final (Revised) Baseline Ecological Risk Assessment, Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site*. Prepared for Michigan Department of Environmental Quality.
- Stony Creek (R5) ENVIRON International Corp. (2010). *Baseline Ecological Risk Assessment, Undeveloped Stony Creek Floodplain, Noblesville, IN*. Prepared for Bridgestone Americas Tire Operations, LLC.

TABLE 8
Ecological Receptor Exposure Units based on Sizes of Foraging Areas and Home Ranges
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Receptor Type	Species	Type of Area	Value	Unit	EU Size [1,2,3] (acres or km)	Depth Interval	Included in CSM of Other BERAs (EPA Region)	Original Source(s)
Aquatic	Mallard	Foraging Territory	580[4] (1400)	hectares (acres)	--	--	Hudson River (R2)	USEPA (1993) cites Kirby et al. (1985)
	Belted Kingfisher	Foraging Territory	0.7	km	1.2 km	--	Hudson River (R2); Lail (R2); Housatonic River (R1)	Davis (1982)
	Spotted Sandpiper	Home Range	0.032 (8)	km^2 (acres)	8 acres	0 - 15 cm	Berry's Creek (R2)	Hayes (1972)
	Great Blue Heron	Foraging Territory	0.98	km	1.2 km	--	Hudson River (R2); Lail (R2)	USEPA (1993) cites Peifer (1979)
	Bald Eagle	Foraging Territory	5.0	km	1.2 km	--	Hudson River (R2); Lail (R2)	USEPA (1993) cites Craig et al. (1988)
	Muskrat	Home Range	0.17 (0.42)	hectares (acres)	0.5 acres	0 - 15 cm	Cass Lake (R5); Kalamazoo (R5)	
	Mink	Home Range	2.65[4]	km	1.2 km	--	Hudson (R2); Housatonic (R1); Kalamazoo (R5); Stony Creek (R5)	Gerell (1970), Mitchell (1961)
Terrestrial	Tree Swallow[5]	Foraging Territory	0.3 - 0.5 (70 - 120)	km^2 (acres)	--	--	Hudson River (R2); Housatonic River (R1)	DeGraaf and Yamaski (2001) Robertson et al. (1992) Martin et al. (1951)
	American Robin	Home Range	0.42 (1)	hectares (acres)	1 acre	--	Housatonic (R1); Kalamazoo (R5); Stony Creek (R5)	Pitts (1984)
	Red-Tailed Hawk[6]	Home Range	233 (575)	hectares (acres)	--	--		ORNL (1994) cites Janes (1984)
	Northern Short-Tailed Shrew	Home Range	0.03 (0.074)	hectares (acres)	0.1 acres	0 - 2 ft	Housatonic River (R1); Lail (2); Stony Creek (R5)	USEPA (1993)
	Meadow Vole	Home range	0.06[4] (0.15)	hectares (acres)	0.1 acres	0 - 2 ft		ORNL (1994) cites Ostfeld et al. (1988)
	Red Fox[7]	Home Range	57 (140)	hectares (acres)	--	0 - 10 ft	Housatonic (R1); Kalamazoo (R5); Stony Creek (R5)	Ables (1969)
	Little Brown Bat	Home Range	143 (353)	hectares (acres)	--	--	Hudson River (R2)	Coleman (2014)

TABLE 8
Ecological Receptor Exposure Units based on Sizes of Foraging Areas and Home Ranges
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Receptor Type	Species	Type of Area	Value	Unit	EU Size [1,2,3] (acres or km)	Depth Interval	Included in CSM of Other BERAs (EPA Region)	Original Source(s)

Abbreviations

BERA = baseline ecological risk assessment
EU = exposure unit
CSM = conceptual site model
-- = not applicable

Footnotes

[1] For the BERA, four square grids are proposed: 0.1, 0.5, 1, and 8 acres. Exposure Units for all other receptors will encompass suitable habitat areas in the full extent of the Project Area boundary (326

[2] Exposure unit dimensions are in length (kilometers) rather than area for aquatic receptors that may be exposed primarily in the river bank corridor (i.e., belted kingfisher, great blue heron, bald eagle, and mink). The full extent of the shoreline adacent to the Project Area (i.e., 1.2 km) is considered a single EU; foraging territories for belted kingfisher and great blue heron are comparable (nearly 1 km) and home ranges for bald eagle and mink are larger than this area.

[3] For receptors with relatively large home ranges/foraging territories, preliminary risk calculations will assume an area use factor of 1.

[4] Average for males and females.

[5] For tree swallow, foraging territory reported as 300-400 m of nest. Area is calculated assuming these distances are the radius of a circle (i.e., area = pi x r^2).

[6] For red-tailed hawk, Janes (1984) also gives a home range of 1,936 hectares.

[7] For red fox, value cited in Ables (1969) is the minimum year-round territory for females.

Other Baseline Ecological Risk Assessments

- Berry's Creek (R2) — Berry's Creek Study Area cooperating PRP Group. (2017). Berry's Creek Study Area Remedial Investigation. Final Appendix L Baseline Ecological Risk Assessment.
- Cass Lake (R5) — Integral. (2007). Human Health and Ecological Risk Assessment. St. Regis aper Company Site, Cass Lake, MN. Appendix E. Sept.
- Hudson River (2) — USEPA Region 2, and USACE. (2000). Revised Baseline Ecological Risk Assessment Hudson River PCBs Reassessment. Phase 2 Report: Volume 2E.
- Lail (R2) — ARCADIS. (2010). Post-Interim Remedial Measure Ecological Risk Assessment. Former Lail Property, East Greenwich TWP/Paulsboro, NJ (Delaware River Watershed). Prepared for ExxonMobil.
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TABLE 8
Ecological Receptor Exposure Units based on Sizes of Foraging Areas and Home Ranges
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Receptor Type	Species	Type of Area	Value	Unit	EU Size [1,2,3] (acres or km)	Depth Interval	Included in CSM of Other BERAs (EPA Region)	Original Source(s)

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TABLE 9.1
Exposure Parameters for Pumpkinseed
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Pumpkinseed	--
Genus	--	*Lepomis*	--
Species	--	*gibbosus*	--
Body Weight	kg (M&F average)	0.28	Wisconsin DNR, 1998
Food Ingestion Rate	kg diet-fw/day	0.019	Utilized equation from Arnot & Gobas 2004. Assumes 16° C water temperature.
Fish as Fraction of Diet	fraction	0.13	Professional Judgement. Based on Sadzikowski & Wallace 1976.
Macrophytes/algae as Fraction of Diet	fraction	0.09	Professional Judgement. Based on Sadzikowski & Wallace 1976.
Invertebrates as Fraction of Diet	fraction	0.78	Professional Judgement. Based on Sadzikowski & Wallace 1976.
Terrestrial Prey as Fraction of Diet	fraction	0	
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
fw = fresh weight
kg = kilograms

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TABLE 9.2
Exposure Parameters for Brown Bullhead
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Brown Bullhead	--
Genus	--	*Ameiurus*	--
Species	--	*nebulosus*	--
Body Weight	kg (M&F average)	0.42	USGS 2006
Food Ingestion Rate	kg diet-fw/day	0.027	Utilized equation from Arnot & Gobas 2004. Assumes 16° C water temperature.
Fish as Fraction of Diet	fraction	0.06	Professional Judgement. Based on juvenile/adult Brown Bullhead diet in Kline & Wood 2011
Macrophytes/algae as Fraction of Diet	fraction	0.06	Professional Judgement. Based on juvenile/adult Brown Bullhead diet in Kline & Wood 2011
Invertebrates as Fraction of Diet	fraction	0.88	Professional Judgement. Based on juvenile/adult Brown Bullhead diet in Kline & Wood 2011
Terrestrial Prey as Fraction of Diet	fraction	0	
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
fw = fresh weight
kg = kilograms

Supporting References

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TABLE 9.3
Exposure Parameters for Brown Trout
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Brown Trout	--
Genus	--	*Salmo*	--
Species	--	*trutta*	--
Body Weight	kg (M&F average)	0.80	Professional judgement. Based on Evans, 1952. BW derived using NY DEC length-to-weight table (https://www.dec.ny.gov/outdoor/9222.html)
Food Ingestion Rate	kg diet-fw/day	0.047	Utilized equation from Arnot & Gobas 2004. Assumes 16° C water temperature.
Fish as Fraction of Diet	fraction	0.25	Professional judgement. Based on Evans 1952.
Macrophytes/algae as Fraction of Diet	fraction	0	Professional judgement. Based on Evans 1952.
Invertebrates as Fraction of Diet	fraction	0.75	Professional judgement. Based on Evans 1952.
Terrestrial Prey as Fraction of Diet	fraction	0	Professional judgement. Based on Evans 1952.
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
fw = fresh weight
kg = kilograms

Supporting References

Arnot, J. A., & Gobas, F. A. (2004). A food web bioaccumulation model for organic chemicals in aquatic ecosystems. *Environmental Toxicology and Chemistry: An International Journal* , 23(10), 2343-2355.

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TABLE 9.4
Exposure Parameters for the Mallard
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Mallard	--
Genus	--	*Anas*	--
Species	--	*platyrhynchos*	--
Body Weight	kg (M&F average)	1.2	Delnicki and Reinecke, 1986 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.18	Nagy et al., 2001. Utilized equation for omnivorous birds
Dietary Ingestion Rate (dw)	kg diet/day	0.056	Nagy et al., 2001. Utilized equation for omnivorous birds
Estimated Soil/Sediment in Diet	fraction	0.020	Beyer, 1994
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0011	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	Average of diet studies in USEPA, 1993
Invertebrates as Fraction of Diet	fraction	0.50	Average of diet studies in USEPA, 1993
Plants as Fraction of Diet	fraction	0.50	Average of diet studies in USEPA, 1993
Terrestrial Prey as Fraction of Diet	fraction	0	Average of diet studies in USEPA, 1993
Water Ingestion Rate	L/day (M&F average)	0.066	Calder and Braun, 1983
Area Use Factor	--	1	--
Seasonal Use Factor	--	1	--

-- = does not apply
F = female
M = male
dw = dry weight
fw = fresh weight
L/day = liters per day
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms

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TABLE 9.5
Exposure Parameters for the Spotted Sandpiper
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Spotted Sandpiper	--
Genus	--	*Actitis*	--
Species	--	*macularius*	--
Body Weight	kg (M&F average)	0.043	Maxson & Oring 1980 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.034	Nagy et al., 2001. Utilized equation for Charadriiformes
Dietary Ingestion Rate (dw)	kg diet/day	0.0090	Nagy et al., 2001. Utilized equation for Charadriiformes
Estimated Soil/Sediment in Diet	fraction	0.18	Beyer et al., 1994. Average for four sandpiper species
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0016	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	Maxson & Oring, 1980 (cited in USEPA 1993)
Invertebrates as Fraction of Diet	fraction	1	Maxson & Oring, 1980 (cited in USEPA 1993)
Plants as Fraction of Diet	fraction	0	Maxson & Oring, 1980 (cited in USEPA 1993)
Terrestrial Prey as Fraction of Diet	fraction	0	Maxson & Oring, 1980 (cited in USEPA 1993)
Water Ingestion Rate	L/day	0.0071	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

Beyer, W. N., Connor, E. E., & Gerould, S. (1994). Estimates of Soil Ingestion by Wildlife. The Journal of Wildlife Management, 58(2), 375. https://doi.org/10.2307/3809405
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TABLE 9.6
Exposure Parameters for the Belted Kingfisher
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Belted Kingfisher	--
Genus	--	*Megaceryle*	--
Species	--	*alcyon*	--
Body Weight	kg (M&F average)	0.15	Brooks & Davis, 1987 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.084	Nagy et al., 2001. Calculated using "carnivorous bird" parameters
Dietary Ingestion Rate (dw)	kg diet/day	0.023	Nagy et al., 2001. Calculated using "carnivorous bird" parameters
Estimated Soil/Sediment in Diet	fraction	0.010	Professional judgement. Based on Davis, 1982.
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.00023	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0.78	USEPA, 1993; Davis, 1982
Invertebrates as Fraction of Diet	fraction	0.22	USEPA, 1993; Davis, 1982
Plants as Fraction of Diet	fraction	0	USEPA, 1993; Davis, 1982
Terrestrial Prey as Fraction of Diet	fraction	0	USEPA, 1993; Davis, 1982
Water Ingestion Rate	L/day	0.016	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male

kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

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TABLE 9.7
Exposure Parameters for the Great Blue Heron
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Great Blue Heron	--
Genus	--	*Ardea*	--
Species	--	*Herodias*	--
Body Weight	kg (M&F average)	2.39	Hartman, 1961 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day (M&F average)	0.73	Nagy et al., 2001. Calculated using "pelacaniformes" parameters
Dietary Ingestion Rate (dw)	kg diet/day (M&F average)	0.20	Nagy et al., 2001. Calculated using "pelacaniformes" parameters
Estimated Soil/Sediment in Diet	fraction	0.02	Professional Judgement. Based on Eckert & Karalus, 1983
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0040	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0.98	Alexander, 1977 (Cited in USEPA, 1993); Cottam & Uhler, 1945
Invertebrates as Fraction of Diet	fraction	0.01	Alexander, 1977 (Cited in USEPA, 1993); Cottam & Uhler, 1945
Plants as Fraction of Diet	fraction	0	Alexander, 1977 (Cited in USEPA, 1993); Cottam & Uhler, 1945
Terrestrial Prey as Fraction of Diet	fraction	0.01	Alexander, 1977 (Cited in USEPA, 1993); Cottam & Uhler, 1945
Water Ingestion Rate	L/day (M&F average)	0.11	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male

kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

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TABLE 9.8
Exposure Parameters for the Bald Eagle
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Bald Eagle	--
Genus	--	*Haliaeetus*	--
Species	--	*leucocephalus*	--
Body Weight	kg (M&F average)	3.75	USEPA, 1993
Dietary Ingestion Rate (fw)	kg diet/day (M&F Average)	0.73	Nagy et al., 2001. Calculated using "carnivorous bird" parameters
Dietary Ingestion Rate (dw)	kg diet/day	0.20	Nagy et al., 2001. Calculated using "carnivorous bird" parameters
Estimated Soil/Sediment in Diet	fraction	0	Professional Judgement. Based on USEPA, 1993
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	1	Nye 1999; Bull, 1998; USEPA, 1993; Nye & Suring, 1978
Invertebrates as Fraction of Diet	fraction	0	Nye 1999; Bull, 1998; USEPA, 1993; Nye & Suring, 1978
Plants as Fraction of Diet	fraction	0	Nye 1999; Bull, 1998; USEPA, 1993; Nye & Suring, 1978
Terrestrial Prey as Fraction of Diet	fraction	0	Nye 1999; Bull, 1998; USEPA, 1993; Nye & Suring, 1978
Water Ingestion Rate	L/day	0.14	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

Calder, W. A., & Braun, E. J. (1983). Scaling of osmotic regulation in mammals and birds. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology* , 244(5), R601–R606. https://doi.org/10.1152/ajpregu.1983.244.5.R601

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TABLE 9.9
Exposure Parameters for the Muskrat
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Muskrat	--
Genus	--	*Ondatra*	--
Species	--	*zibethicus*	--
Body Weight	kg (M&F average)	1.27	Schacher & Pelton, 1978 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.28	Nagy et al., 2001. Calculated using "rodentia" parameters
Dietary Ingestion Rate (dw)	kg diet/day	0.084	Nagy et al., 2001. Calculated using "rodentia" parameters
Estimated Soil/Sediment in Diet	fraction	0.13	Professional judgement. Sample & Suter, 1994. Shrew soil intake conservatively used as surrogate.
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.011	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	--
Invertebrates as Fraction of Diet	fraction	0	--
Plants as Fraction of Diet	fraction	1	USEPA, 1993
Terrestrial Prey as Fraction of Diet	fraction	0	--
Water Ingestion Rate	L/day	0.123	Calder & Braun, 1983; USEPA 1993
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

Calder, W. A., & Braun, E. J. (1983). Scaling of osmotic regulation in mammals and birds. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 244(5), R601–R606. https://doi.org/10.1152/ajpregu.1983.244.5.R601

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TABLE 9.10
Exposure Parameters for the American Mink
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	American Mink	--
Genus	--	*Neovison*	--
Species	--	*vison*	--
Body Weight	kg (M&F average)	0.91	Mitchell, 1961 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.15	Nagy et al., 2001. Utilized equation for carnivorous mammals
Dietary Ingestion Rate (dw)	kg diet/day	0.045	Nagy et al., 2001. Utilized equation for carnivorous mammals
Estimated Soil/Sediment in Diet	fraction	0	Professional Judgement. Based on Hamilton, 1940 (cited in Sample & Suter, 1994)
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0.34	Hamilton, 1936; Hamilton, 1940; Hamilton, 1951
Invertebrates as Fraction of Diet	fraction	0.165	Hamilton, 1936; Hamilton, 1940; Hamilton, 1951
Plants as Fraction of Diet	fraction	0	Hamilton, 1936; Hamilton, 1940; Hamilton, 1951
Terrestrial Prey as Fraction of Diet	fraction	0.495	Hamilton, 1936; Hamilton, 1940; Hamilton, 1951
Water Ingestion Rate	L/day	0.091	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

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TABLE 9.11
Exposure Parameters for the Tree Swallow
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Tree Swallow	--
Genus	--	*Tachycineta*	--
Species	--	*bicolor*	--
Body Weight	kg (M&F average)	0.0208	Secord & McCarty, 1997; Robertson et al., 1992
Dietary Ingestion Rate (fw)	kg diet/day	0.015	Nagy et al., 2001. Utilized equation for passerines
Dietary Ingestion Rate (dw)	kg diet/day	0.0050	Nagy et al., 2001. Utilized equation for passerines
Estimated Soil/Sediment in Diet	fraction	0	Robertson et al., 1992
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	Secord & McCarty, 1997; McCarty & Winkler, 1999
Invertebrates as Fraction of Diet	fraction	1	Secord & McCarty, 1997; McCarty & Winkler, 1999
Plants as Fraction of Diet	fraction	0	Secord & McCarty, 1997; McCarty & Winkler, 1999
Terrestrial Prey as Fraction of Diet	fraction	0	Secord & McCarty, 1997; McCarty & Winkler, 1999
Water Ingestion Rate	L/day	0.0044	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male

kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

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TABLE 9.12
Exposure Parameters for the American Robin
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	American Robin	--
Genus	--	*Turdus*	--
Species	--	*migratorius*	--
Body Weight	kg	0.079	Wheelwright, 1986; (cited in USEPA, 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.032	Nagy et al., 2001. Utilized equation for omnivorous birds
Dietary Ingestion Rate (dw)	kg diet/day	0.010	Nagy et al., 2001. Utilized equation for omnivorous birds
Estimated Soil/Sediment in Diet	fraction	0.104	Beyer et al., 1994. Assumed similar to American Woodcock.
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0011	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	USEPA, 1993. Based on spring and summer ingestion diet composition.
Invertebrates as Fraction of Diet	fraction	0.72	USEPA, 1993. Based on spring and summer ingestion diet composition.
Plants as Fraction of Diet	fraction	0.28	USEPA, 1993. Based on spring and summer ingestion diet composition.
Terrestrial Prey as Fraction of Diet	fraction	0	USEPA, 1993. Based on spring and summer ingestion diet composition.
Water Ingestion Rate	L/day	0.011	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male

kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

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TABLE 9.13
Exposure Parameters for the Red-Tailed Hawk
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Red-Tailed Hawk	--
Genus	--	*Buteo*	--
Species	--	*jamaicensis*	--
Body Weight	kg (M&F average)	1.126	Craighead & Craighead, 1956 (cited in USEPA, 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.33	Nagy et al., 2001. Utilized equation for carnivorous birds
Dietary Ingestion Rate (dw)	kg diet/day	0.090	Nagy et al., 2001. Utilized equation for carnivorous birds
Estimated Soil/Sediment in Diet	fraction	0	Sample & Suter, 1994
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	USEPA, 1993
Invertebrates as Fraction of Diet	fraction	0	USEPA, 1993
Plants as Fraction of Diet	fraction	0	USEPA, 1993
Terrestrial Prey as Fraction of Diet	fraction	1	USEPA, 1993
Water Ingestion Rate	L/day	0.064	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male

kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

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TABLE 9.14
Exposure Parameters for the Northern Short-Tailed Shrew
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Northern Short-Tailed Shrew	--
Genus	--	*Blarina*	--
Species	--	*brevicauda*	--
Body Weight	kg	0.015	Schlesinger & Potter, 1974 (cited in USEPA 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.0061	Nagy et al., 2001. Utilized equation for insectivorous mammals
Dietary Ingestion Rate (dw)	kg diet/day	0.0020	Nagy et al., 2001. Utilized equation for insectivorous mammals
Estimated Soil/Sediment in Diet	fraction	0.13	Talmage & Walton, 1993 (cited in Sample & Suter, 1994)
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0003	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	USEPA, 1993
Invertebrates as Fraction of Diet	fraction	0.82	USEPA, 1993
Plants as Fraction of Diet	fraction	0.13	USEPA, 1993
Terrestrial Prey as Fraction of Diet	fraction	0.05	USEPA, 1993
Water Ingestion Rate	L/day	0.0023	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

Calder, W. A., & Braun, E. J. (1983). Scaling of osmotic regulation in mammals and birds. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology* , 244(5), R601–R606. https://doi.org/10.1152/ajpregu.1983.244.5.R601

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TABLE 9.15
Exposure Parameters for the Meadow Vole
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Meadow Vole	--
Genus	--	*Microtus*	--
Species	--	*pennsylvanicus*	--
Body Weight	kg	0.037	Myers & Krebs, 1971 (cited in USEPA, 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.025	Nagy et al., 2001. Utilized equation for herbivorous mammals
Dietary Ingestion Rate (dw)	kg diet/day	0.0083	Nagy et al., 2001. Utilized equation for herbivorous mammals
Estimated Soil/Sediment in Diet	fraction	0.024	Beyer et al., 1994
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0002	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	Professional judgement. Based on USEPA, 1993; Sample & Suter, 1994
Invertebrates as Fraction of Diet	fraction	0.05	Professional judgement. Based on USEPA, 1993; Sample & Suter, 1994
Plants as Fraction of Diet	fraction	0.95	Professional judgement. Based on USEPA, 1993; Sample & Suter, 1994
Terrestrial Prey as Fraction of Diet	fraction	0	Professional judgement. Based on USEPA, 1993; Sample & Suter, 1994
Water Ingestion Rate	L/day	0.005	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male

kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

Beyer, W. N., Connor, E. E., & Gerould, S. (1994). Estimates of Soil Ingestion by Wildlife. The Journal of Wildlife Management, 58(2), 375. https://doi.org/10.2307/3809405

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TABLE 9.16
Exposure Parameters for the Red Fox
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Red Fox	--
Genus	--	*Vulpes*	--
Species	--	*vulpes*	--
Body Weight	kg (M&F average)	4.7	Storm et al., 1976; (cited in USEPA, 1993)
Dietary Ingestion Rate (fw)	kg diet/day	0.50	Nagy et al., 2001. Utilized equation for carnivora order
Dietary Ingestion Rate (dw)	kg diet/day	0.15	Nagy et al., 2001. Utilized equation for carnivora order
Estimated Soil/Sediment in Diet	fraction	0.028	Beyer et al., 1994
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0.0042	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	USEPA, 1993
Invertebrates as Fraction of Diet	fraction	0.05	USEPA, 1993
Plants as Fraction of Diet	fraction	0.10	USEPA, 1993
Terrestrial Prey as Fraction of Diet	fraction	0.85	USEPA, 1993
Water Ingestion Rate	L/day	0.398	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

Beyer, W. N., Connor, E. E., & Gerould, S. (1994). Estimates of Soil Ingestion by Wildlife. The Journal of Wildlife Management, 58(2), 375. https://doi.org/10.2307/3809405

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TABLE 9.17
Exposure Parameters for the Little Brown Bat
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Exposure Factor	Units	Exposure Parameter	Source and Notes
Common Name	--	Little Brown Bat	--
Genus	--	*Myotis*	--
Species	--	*lucifugus*	--
Body Weight	kg (M&F average)	0.0075	Gould et al., 1955 (cited in Sample & Suter, 1994)
Dietary Ingestion Rate (fw)	kg diet/day	0.0045	Nagy et al., 2001. Utilized equation for chiroptera order
Dietary Ingestion Rate (dw)	kg diet/day	0.0014	Nagy et al., 2001. Utilized equation for chiroptera order
Estimated Soil/Sediment in Diet	fraction	0	Professional judgment. No contact with soil
Soil/Sediment Ingestion Rate	kg sed_{dw}/day	0	Derived by multiplying the Diet Ingestion Rate-dw by the estimated soil/sediment in diet
Fish as Fraction of Diet	fraction	0	Anthony & Kunz, 1977; Belwood & Fenton, 1976; Buchler, 1976
Invertebrates as Fraction of Diet	fraction	1	Anthony & Kunz, 1977; Belwood & Fenton, 1976; Buchler, 1976
Plants as Fraction of Diet	fraction	0	Anthony & Kunz, 1977; Belwood & Fenton, 1976; Buchler, 1976
Terrestrial Prey as Fraction of Diet	fraction	0	Anthony & Kunz, 1977; Belwood & Fenton, 1976; Buchler, 1976
Water Ingestion Rate	L/day	0.0012	Calder and Braun, 1983
Area Use Factor	unitless	1	--
Seasonal Use Factor	unitless	1	--

-- = does not apply
F = female
M = male
kg sed_{dw}/day = kilograms of dry weight sediment per day
kg = kilograms
L/day = liters per day

Supporting References

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TABLE 10.1
Avian Toxicity Reference Values
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	Analyte Name	CASRN	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Source	Note
PFAS	Perfluorobutanesulfonic acid	375-73-5	92	153	SERDP, 2020	R, G, S (6)
	Perfluorooctanesulfonic acid	1763-23-1	0.079	0.79	SERDP, 2020	R, G, S (6)
Metals	Aluminum	7429-90-5	110	1,100*	Sample et al., 1996	R
	Arsenic	7440-38-2	2.2	22*	USEPA, 2018a	S, G
	Barium	7440-39-3	42	83	Sample et al., 1996	S (2)
	Cadmium	7440-43-9	1.5	6.3	USEPA, 2018a	M
	Chromium	7440-47-3	2.7	15.6	USEPA, 2018a	M
	Cobalt	7440-48-4	7.6	18.3	USEPA, 2018a	M
	Copper	7440-50-8	4.1	12.1	USEPA, 2018a	R
	Lead	7439-92-1	1.6	3.3	USEPA, 2018a	R
	Manganese	7439-96-5	180	380	USEPA, 2018a	M
	Nickel	7440-02-0	6.7	18.6	USEPA, 2018a	M
	Selenium	7782-49-2	0.29	0.58	USEPA, 2018a	S
	Silver	7440-22-4	2.0*	20.2	USEPA, 2018a	G (1)
	Thallium	7440-28-0	0.085*	0.85	Schafer, 1972	S (3, 4)
	Vanadium	7440-62-2	0.34	0.69	USEPA, 2018a	G
	Zinc	7440-66-6	66	170	USEPA, 2018a	M
PAHs	Total HMW PAHs	NA	2.4	24	Trust et al., 1994	G
Pesticides	4,4'-DDE	72-55-9	0.23	2.3	USEPA, 2018a	G
	4,4'-DDT	50-29-3	0.23	2.3	USEPA, 2018a	G
	beta-Benzenehexachloride	319-85-7	0.56	2.3	Sample et al., 1996	R
	delta-Benzenehexachloride	319-86-8	0.56	2.3	Sample et al., 1996	R
	Endosulfan sulfate	1031-07-8	10	100*	Sample et al., 1996	R
	Endrin	72-20-8	0.3	3.0*	Sample et al., 1996	R
	Endrin aldehyde	7421-93-4	0.3	3.0*	Sample et al., 1996	R
	Endrin ketone	53494-70-5	0.3	3.0*	Sample et al., 1996	R
	Heptachlor	76-44-8	0.044*	0.44	Hill and Camardese, 1986	S (3, 4)
	Heptachlor epoxide	1024-57-3	0.044*	0.44	Hill and Camardese, 1986	S (5)
	Methoxychlor	72-43-5	2.9*	29	USEPA, 2000b	S (1, 3)
Semi-volatiles	bis(2-Ethylhexyl)phthalate	117-81-7	1.1	11*	Sample et al., 1996	R
	Di-n-butyl phthalate	84-74-2	0.11*	1.1	Sample et al., 1996	R (1)

Abbreviations
* = extrapolated TRV
B = Benzenehexachloride
G = Growth
LOAEL = lowest observed adverse effect level
M = multiple endpoints and studies
NOAEL = no observed adverse effect level
R = Reproduction
S = Survival
USEPA = United States Environmental Protection Agency

Footnotes
(1) NOAEL extrapolated from LOAEL using an uncertainty factor multiplier of 0.1.
(2) Chronic LOAEL estimated from result of a subchronic LOAEL multiplied by an uncertainty factor of 0.2.
(3) Chronic NOAEL extrapolated from acute NOAEL using an uncertainty factor multiplier of 0.01.
(4) Chronic LOAEL extrapolated from acute LOAEL using an uncertainty factor multiplier of 0.1.
(5) Result based on heptachlor study.
(6) NOAELs are based on reproduction and growth; LOAELs are based on reproduction, growth, and survival.

TABLE 10.1
Avian Toxicity Reference Values

McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	Analyte Name	CASRN	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Source	Note

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TABLE 10.2

Mammalian Toxicity Reference Values

McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	Analyte Name	CASRN	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Source	Note
PFAS	Perfluorobutanesulfonic acid	375-73-5	50	200	SERDP, 2020	R, G, S (7)
	Perfluorohexanoic acid	307-24-4	84	175	SERDP, 2020	R, G, S (7)
	Perfluorononanoic acid	375-95-1	0.83	1.1	SERDP, 2020	R, G, S (7)
	Perfluorooctanesulfonic acid	1763-23-1	0.1	0.166	SERDP, 2020	R, G, S (7)
	Perfluorooctanoic acid	335-67-1	0.3	0.6	SERDP, 2020	R, G, S (7)
Metals	Aluminum	7429-90-5	1.9*	19	Sample et al., 1996	R (1)
	Antimony	7440-36-0	0.06	0.6	USEPA, 2018a	R
	Arsenic	7440-38-2	1.04	1.66	USEPA, 2018a	G
	Barium	7440-39-3	52	83	USEPA, 2018a	R, G
	Cadmium	7440-43-9	0.77	7.7	USEPA, 2018a	G
	Chromium	7440-47-3	2.4	58	USEPA, 2018a	R, G
	Cobalt	7440-48-4	7.3	19	USEPA, 2018a	R, G
	Copper	7440-50-8	5.6	9.34	USEPA, 2018a	G, S
	Lead	7439-92-1	4.7	8.9	USEPA, 2018a	G
	Manganese	7439-96-5	51.5	150	USEPA, 2018a	R, G
	Nickel	7440-02-0	1.7	3.4	USEPA, 2018a	R
	Selenium	7782-49-2	0.143	0.215	USEPA, 2018a	G
	Silver	7440-22-4	6.0*	60	USEPA, 2018a	G (1)
	Thallium	7440-28-0	0.015*	0.15	Sample et al., 1996	R (1, 2)
	Vanadium	7440-62-2	4.2	8.3	USEPA, 2018a	G
	Zinc	7440-66-6	75.4	280	USEPA, 2018a	R, G
PAHs	Total HMW PAHs	NA	0.62	3.1	USEPA, 2018a	S
Pesticides	4,4'-DDE	72-55-9	0.15	0.74	USEPA, 2018a	R
	4,4'-DDT	50-29-3	0.15	0.74	USEPA, 2018a	R
	beta-Benzenehexachloride	319-85-7	4	20	Sample et al., 1996	G (3)
	delta-Benzenehexachloride	319-86-8	1.6	3.2	Sample et al., 1996	R
	Dieldrin	60-57-1	0.015	0.03	USEPA, 2018a	R
	Endosulfan sulfate	1031-07-8	0.3	3.0*	Sample et al., 1996	R (4)
	Endrin	72-20-8	0.092*	0.92	Sample et al., 1996	R (1)
	Endrin aldehyde	7421-93-4	0.092*	0.92	Sample et al., 1996	R (1, 5)
	Endrin ketone	53494-70-5	0.092*	0.92	Sample et al., 1996	R (1, 5)
	Heptachlor	76-44-8	0.086*	0.86	Sample et al., 1996	R (1)
	Heptachlor epoxide	1024-57-3	0.086*	0.86	Sample et al., 1996	R (1, 6)
	Methoxychlor	72-43-5	4	8	Sample et al., 1996	R
Semi-volatiles	Benzyl n-butyl phthalate	85-68-7	250	750	Tyl et al., 2004	R
	bis(2-Ethylhexyl)phthalate	117-81-7	18	180	Sample et al., 1996	R
	Di-n-butyl phthalate	84-74-2	550	1800	USEPA, 2018a	R

Abbreviations

* = extrapolated TRV
B = Benzenehexachloride
G = Growth
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
R = Reproduction
S = Survival
USEPA = United States Environmental Protection Agency

TABLE 10.2
Mammalian Toxicity Reference Values

McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Chemical Class	Analyte Name	CASRN	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	Source	Note

Footnotes

(1) NOAEL extrapolated from LOAEL using an uncertainty factor multiplier of 0.1.
(2) Chronic LOAEL estimated from result of a subchronic LOAEL multiplied by an uncertainty factor of 0.2.
(3) Result based on study with mixed isomers of benzenehexachloride.
(4) Result based on endosulfan study.
(5) Result based on endrin study.
(6) Result based on heptachlor study.
(7) NOAELs are based on reproduction and growth; LOAELs are based on reproduction, growth, and survival.

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TABLE 11

Examples of Use of Probabilistic Risk Assessment (PRA) to Inform Risk-Management Decisions at Sites in the United States

McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Site	Region	Lead Agencies	Date of Report	Primary Exposure Pathways		Primary Chemical(s) of Interest	Description of Decision Made with PRA Results (1)	References
				Soil and Dust Ingestion	Diet / Food Ingestion			
Housatonic River, MA	1	USEPA, USACE	2005	X	X	PCBs	2016 CERCLA Remedy Selection, PRA is primary basis for Biota Monitoring Performance Standards	Weston Solutions, Inc, 2005; USEPA, 2016a
Hudson River, NY	2	USEPA, USACE	2000		X	PCBs	Phase 2 Reassessment RI/FS; PRA is used in Remedy Selection (Phase 3, FS)	TAMS Consultants, Inc & Menzi-Cura & Associates, Inc, 2000
Berry's Creek Study Area, NJ	2	USEPA, NJDEP	2017	X	X	mercury, methyl mercury, PCBs	PRA applied for HHRA and BERA, used as primary basis for risk characterization	BCSA Cooperating PRP Group, 2017
Southern Wood Piedmont (SWP-Baldwin), FL	4	Florida DEP	2015	X		dioxin	PRA is primary basis for SCTL	Simpson et al., 2016
Lower Fox River and Green Bay, WI	5	USEPA R5, Wisconsin DNR	2001		X	PCBs	ROD (2002) notes PRA and deterministic approaches compare favorably; PRA supports PCB sediment cleanup level, CERCLA Remedy Selection; 2002 Final RI/FS: PRA applied in response to peer review	WIDNR & USEPA, 2002a, b
Tittabawassee River, MI	5	USEPA R5, MI EGLE, USACE	2020	X	X	dioxin	PRA is the primary basis for risk characterization in HHRA; BERA is in progress and also applies PRA	Tittabawassee and Saginaw River Team, 2020
San Jacinto Waste Pits, TX	6	USEPA R6	2013	X	X	dioxin	ROD (2017) notes PRA used to refine BHHRA and set PRGs	Integral Consulting Inc, 2013; USEPA, 2017
Rocky Flats, CO	8	USEPA R8, USDOE, Colorado DPHE	2002	X		radionuclides, uranium	PRA is primary basis for risk-based soil action levels (RBSLs) for radionuclides	USEPA, 2002
St. Helens Fiberboard, OR	10	Oregon DEQ	2014	X		dioxin	PRA completes the RI/FS and defines remedial action objectives for FS	ARCADIS, 2014; ORDEQ, 2015
SHEDS	National	USEPA	2004 - present	X	X	pesticides, lead, arsenic	Monte Carlo analysis is applied to a wide range of dietary exposure scenarios	Multiple references since 2004
All Lead Sites	National	USEPA and California DTSC	1994 - present	X		lead	Probabilistic risk characterization is incorporated in lead risk assessment models used by USEPA (i.e., IEUBK or ALM) and California (i.e., Leadspread) at all sites; a submodel that employs Monte Carlo analysis was applied by USEPA to inform risk management at sites in Regions 3 and 8	USEPA, 2020; CDTSC, 2011; Goodrum et al., 1996; Griffin et al., 1999; Maddaloni et al., 2005
USEPA Office of Pesticide Programs - Tier 2 Models	National	USEPA	2001 - present		X	pesticides	Probabilistic methods applied to exposure and effects assessments; aquatic and terrestrial models coupled with standard exposure scenarios to assess risk to non-target receptors	USEPA, 2001, 2004, 2010

BERA = baseline ecological risk assessment; BHHRA = baseline human health risk assessment; CDPHE = Colorado Department of Public Health and Environment; CDTSC = California Department of Toxic Substances Control; FS = feasibility study; MIEGLE = Michigan Department of Environment, Great Lakes & Energy; ORDEQ = Oregon Department of Environmental Quality; PRG = preliminary remediation goal; RI = remedial investigation; ROD = record of decision; SCTL = Soil Cleanup Target Level; SHEDS = Stochastic Human Exposure and Dose Simulation Model; USACE = US Army Corps of Engineers; WIDNR = Wisconsin Department of Natural Resources

TABLE 11
Examples of Use of Probabilistic Risk Assessment (PRA) to Inform Risk-Management Decisions at Sites in the United States
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Site	Region	Lead Agencies	Date of Report	Primary Exposure Pathways		Primary Chemical(s) of Interest	Description of Decision Made with PRA Results (1)	References
				Soil and Dust Ingestion	Diet / Food Ingestion			

Notes
(1) Each application of PRA listed was used to inform decision by federal or state regulatory agencies.

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TABLE 11
Examples of Use of Probabilistic Risk Assessment (PRA) to Inform Risk-Management Decisions at Sites in the United States
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site # 442046

Site	Region	Lead Agencies	Date of Report	Primary Exposure Pathways		Primary Chemical(s) of Interest	Description of Decision Made with PRA Results (1)	References
				Soil and Dust Ingestion	Diet / Food Ingestion			

SHEDS References

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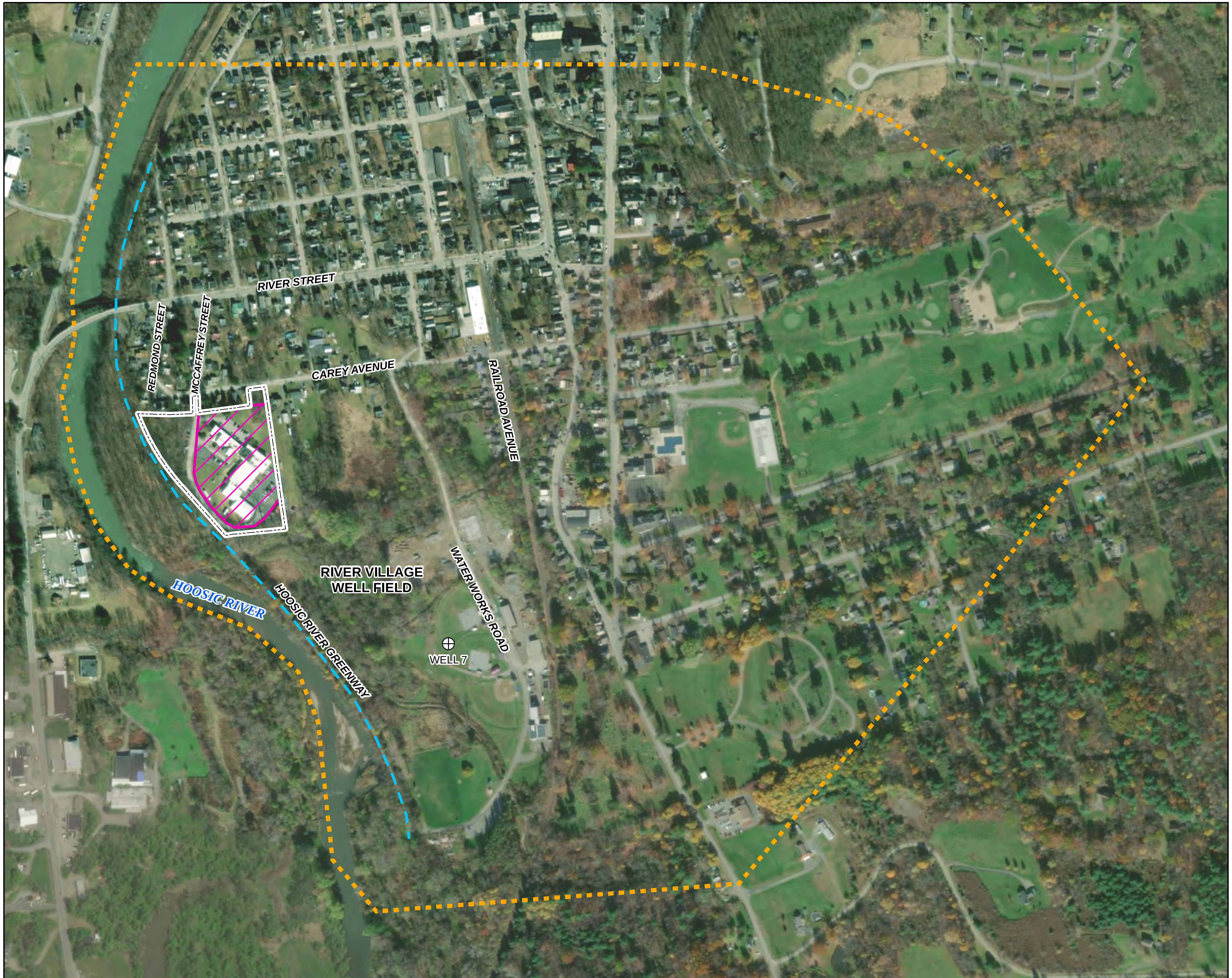
WORK PLAN FOR BASELINE ECOLOGICAL RISK ASSESSMENT

McCAFFREY STREET SITE
(Site No. 442046, USEPA ID# NYD004986741)

FIGURES



LEGEND

- Village of Hoosick Falls Well
- Tax Parcel Boundary - On-Site
- Facility Boundary
- Project Area

Note

Basemap imagery provided by ESRI World Imagery, October 2019.

Feet
0 225 450

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

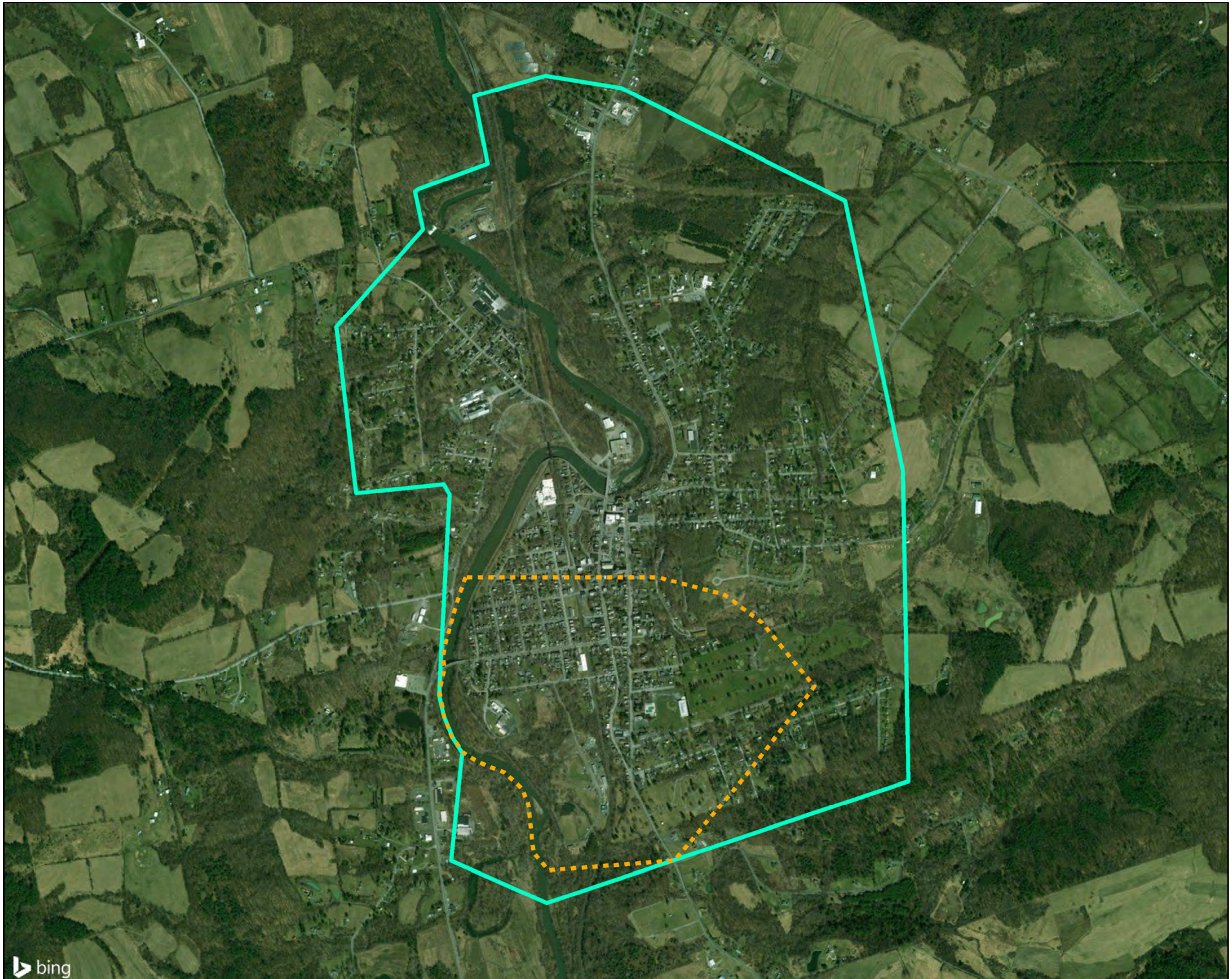
GSI ENVIRONMENTAL

McCAFFREY STREET SITE LOCATION

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

GSI Job No.	5316	Drawn By:	BSS/AV
Issued:	11 June 2021	Chk'd By:	ARD
Map ID:	MS_MSSL	Appv'd By:	PEG

FIGURE 1



LEGEND

- Primary Project Area
- Residential Irrigated Soil Area

Note

Basemap imagery provided by Bing Maps, May 2021.

Feet

0 650 1,300

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

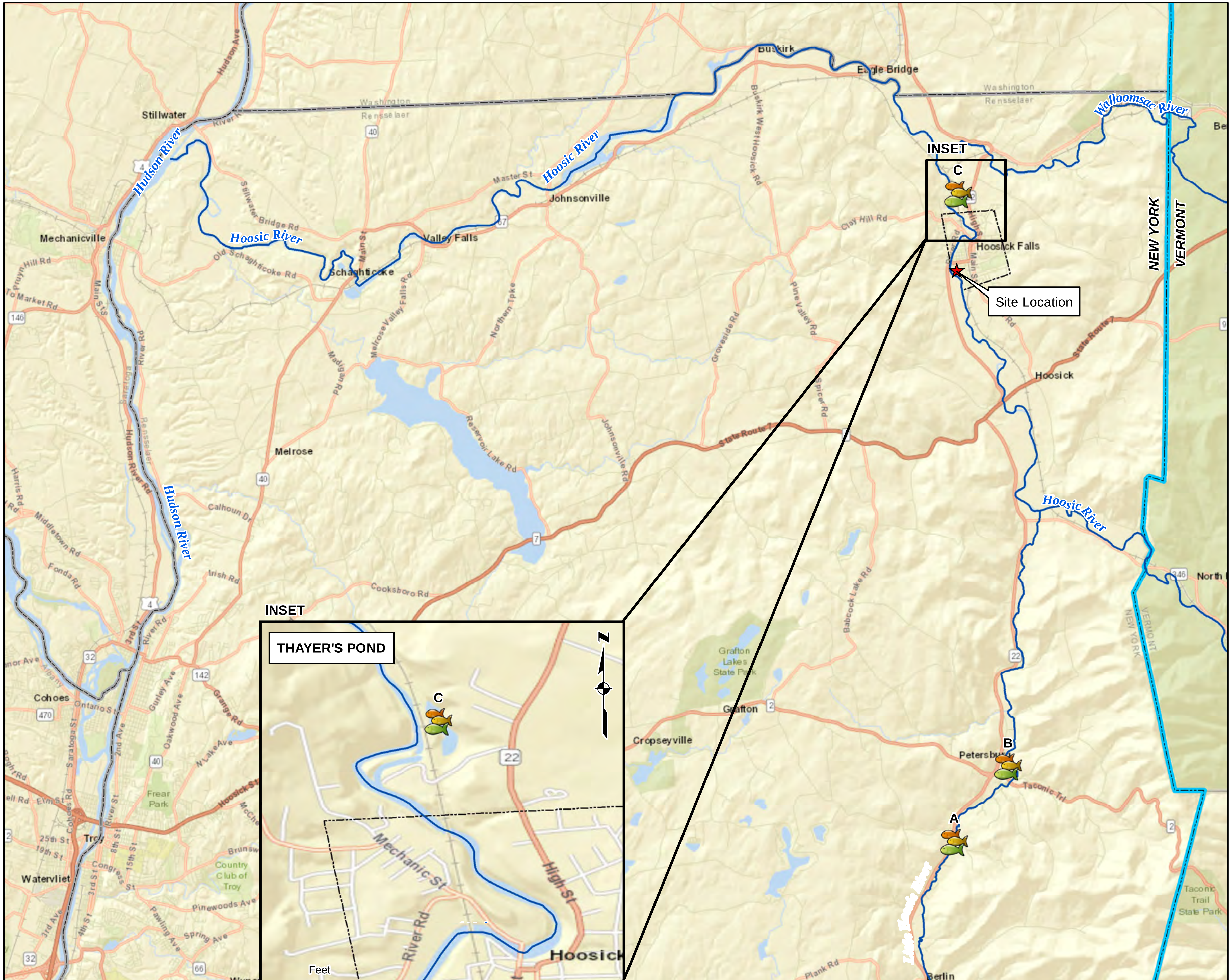
GSI ENVIRONMENTAL

RESIDENTIAL IRRIGATED SOIL AREA

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

GSI Job No.	5316	Drawn By:	AV
Issued:	11 June 2021	Chk'd By:	JKA
Map ID:	MS_RISA	Appv'd By:	PEG

FIGURE 2



LEGEND

- Fish Tissue Sample Location
- Hoosic River
- State Boundary
- Village of Hoosick Falls
- Counties

Notes

1) Basemap imagery provided by Esri ArcGIS Online.
2) Locations A, B, C are sites of fish sampling conducted by NYSDEC.

Feet
0 4,500 9,000

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

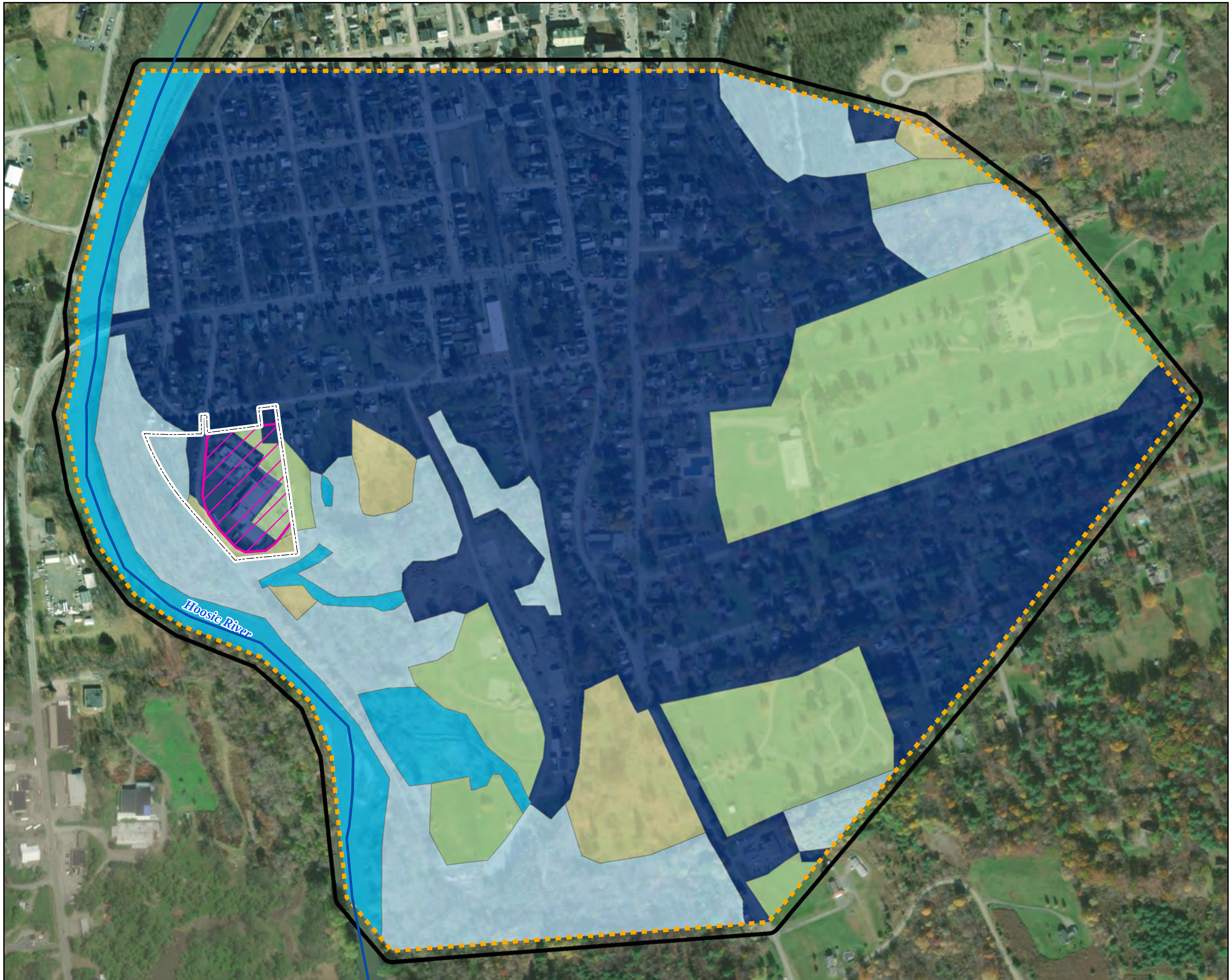
GSI ENVIRONMENTAL

HOOSIC RIVER WATERSHED AND McCAFFREY STREET SITE LOCATION

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

GSI Job No.	5316	Drawn By:	AV
Issued:	11 June 2021	Chk'd By:	ARD
Map ID:	MS_MSSL_HRW	Appv'd By:	PEG

FIGURE 3



N

LEGEND

- Hoosic River
- Tax Parcel Boundary - On-Site
- Facility Boundary
- Project Area
- 50-Foot Buffer around Project Area

Habitat Classification

- Wooded
- Shrub/Scrub
- Open Field
- Wetland
- Other

Note

NLCD Land Cover Classification downloaded from the Multi-Resolution Land Characteristics website https://www.mrlc.gov/data, August 12, 2020.

Feet

0 225 450

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

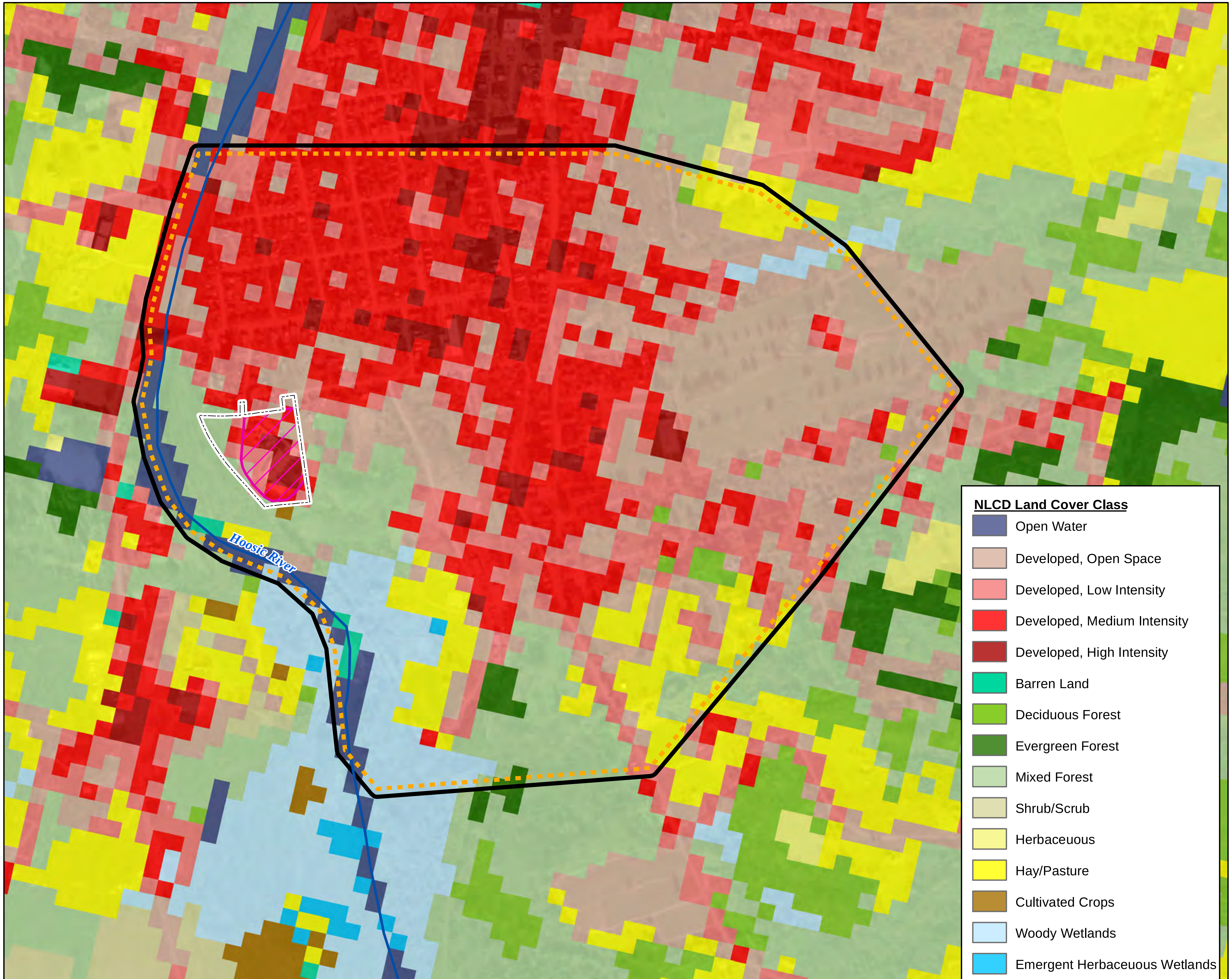
GSI ENVIRONMENTAL

HABITAT CLASSIFICATION FOR PROJECT AREA

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

GSI Job No.	5316	Drawn By:	AV
Issued:	11 June 2021	Chk'd By:	ARD
Map ID:	MS_MSSL_HCPA	Appv'd By:	PEG

FIGURE 4



N

LEGEND

- Hoosic River
- Tax Parcel Boundary - On-Site
- Facility Boundary
- Project Area
- 50-Foot Buffer around Project Area

Note

NLCD Land Cover Classification downloaded from the Multi-Resolution Land Characteristics website https://www.mrlc.gov/data, August 12, 2020.

Feet
0 300 600

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

GSI ENVIRONMENTAL

LAND USE CATAGORIES

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

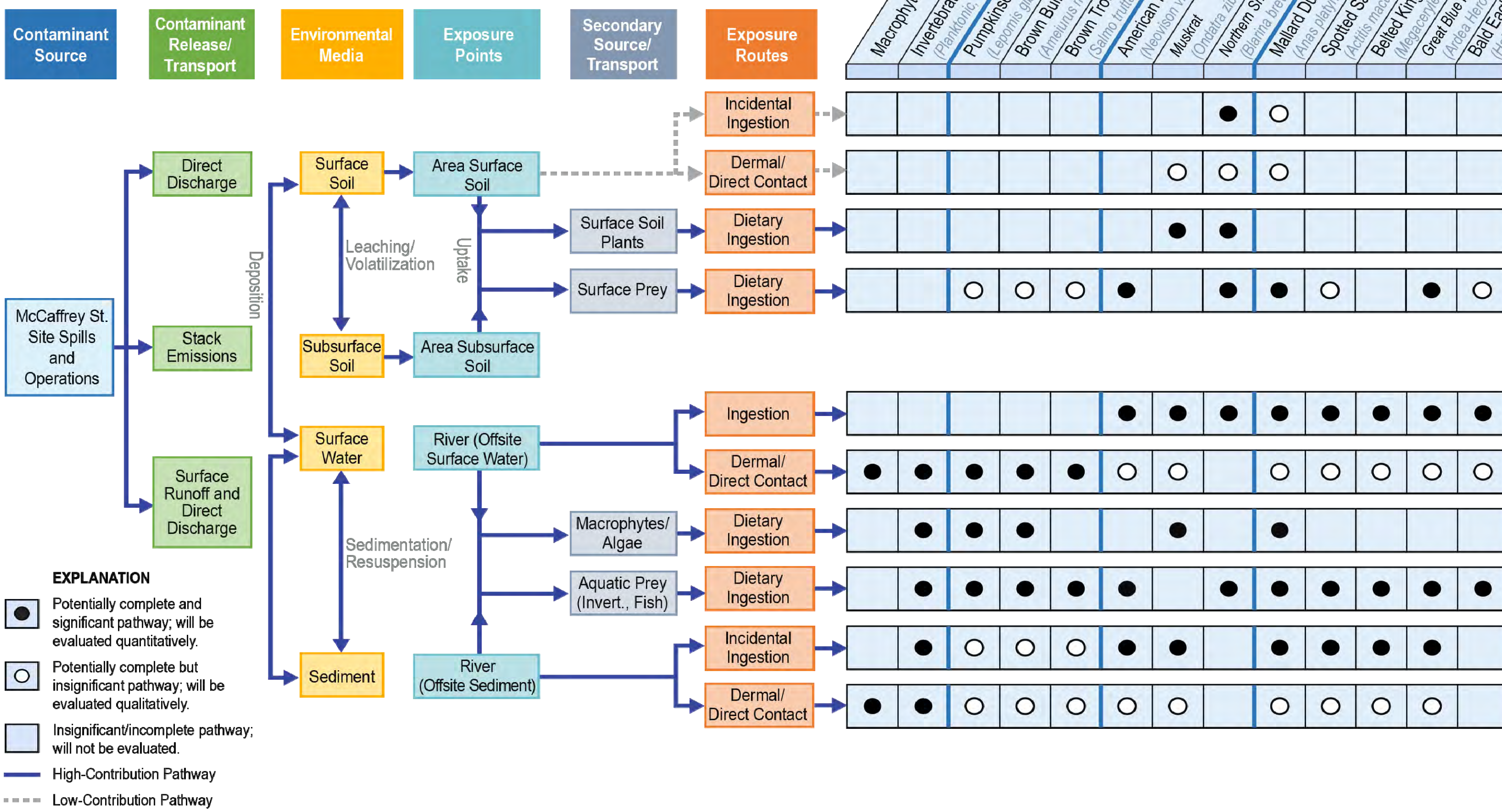
GSI Job No.	5316	Drawn By:	AV
Issued:	11 June 2021	Chk'd By:	ARD
Map ID:	MS_MSSL_LU	Appv'd By:	PEG

FIGURE 5

GSI Job No.: 5316
Issued: 11 June 2021

GSI ENVIRONMENTAL

Aquatic Receptor
Ecological Risk Assessment Conceptual Site Model



Exposure Point / Route	Macrophytes and Algae	Invertebrates (Planktonic, Benthic)	Pumpkinseed (Lepomis gibbosus)	Brown Bullhead (Ameiurus nebulosus)	Brown Trout (Salmo trutta)	American Mink (Neovison vison)	Muskrat (Ondatra zibethicus)	Northern Short-tailed Shrew (Blarina brevicauda)	Mallard Duck (Anas platyrhynchos)	Spotted Sandpiper (Actitis macularius)	Belted Kingfisher (Megaceryle alcyon)	Great Blue Heron (Ardea Herodias)	Bald Eagle (Haliaeetus leucocephalus)
Area Surface Soil – Incidental Ingestion								●	○				
Area Surface Soil – Dermal/ Direct Contact							○	○	○				
Surface Soil Plants – Dietary Ingestion							●	●					
Surface Prey – Dietary Ingestion			○	○	○	●		●	●	○		●	○
River (Offsite Surface Water) – Ingestion						●	●	●	●	●	●	●	●
River (Offsite Surface Water) – Dermal/ Direct Contact	●	●	●	●	●	○	○		○	○	○	○	○
Macrophytes/ Algae – Dietary Ingestion		●	●	●			●		●				
Aquatic Prey (Invert., Fish) – Dietary Ingestion		●	●	●	●	●		●	●	●	●	●	●
River (Offsite Sediment) – Incidental Ingestion		●	○	○	○	●	●		●	●	●	●	
River (Offsite Sediment) – Dermal/ Direct Contact	●	●	○	○	○	○	○		○	○	○	○	

FIGURE 6A. CONCEPTUAL SITE MODEL FOR AQUATIC RECEPTORS
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, NY
NYSDEC Site # 442046

Terrestrial Receptor
Ecological Risk Assessment Conceptual Site Model

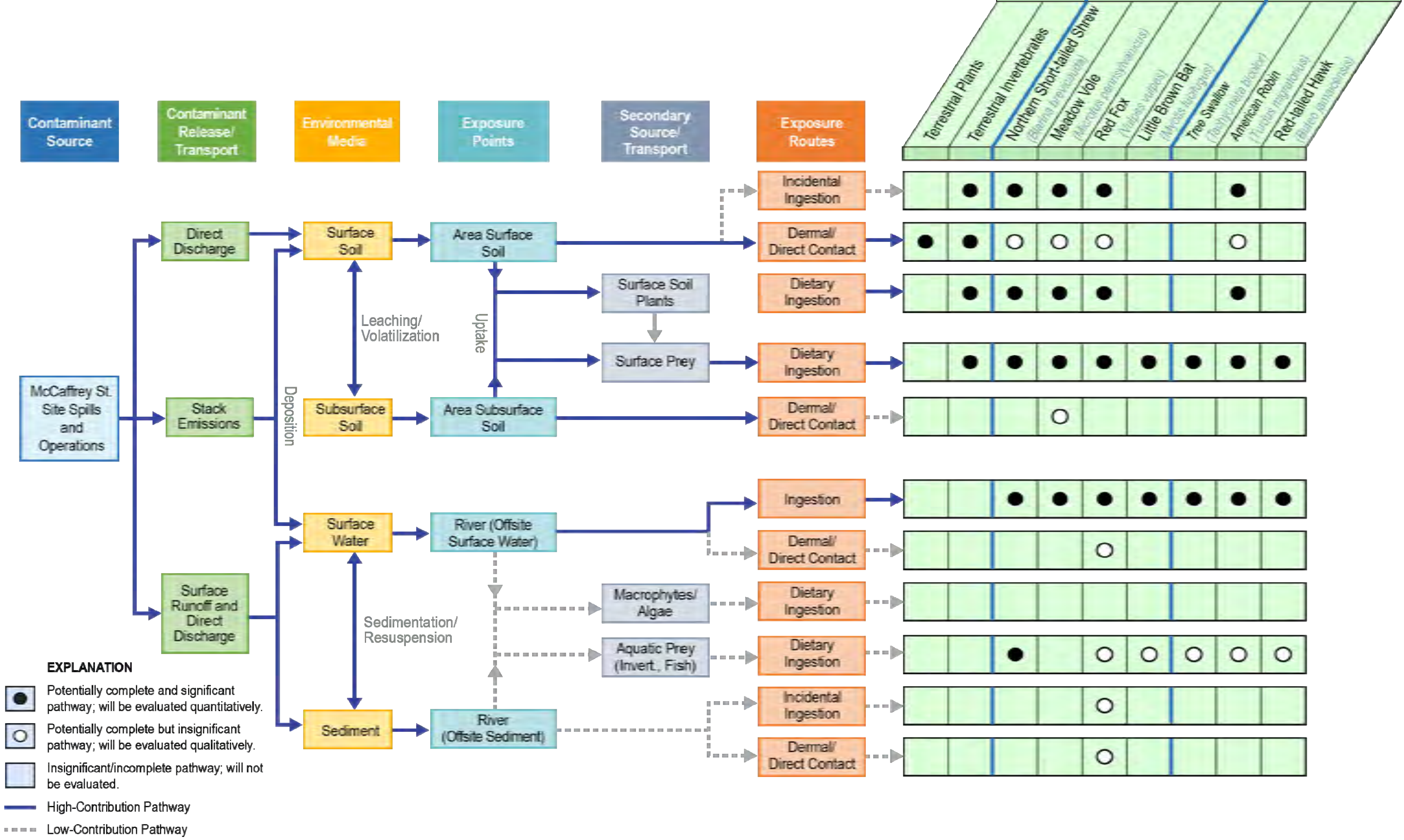
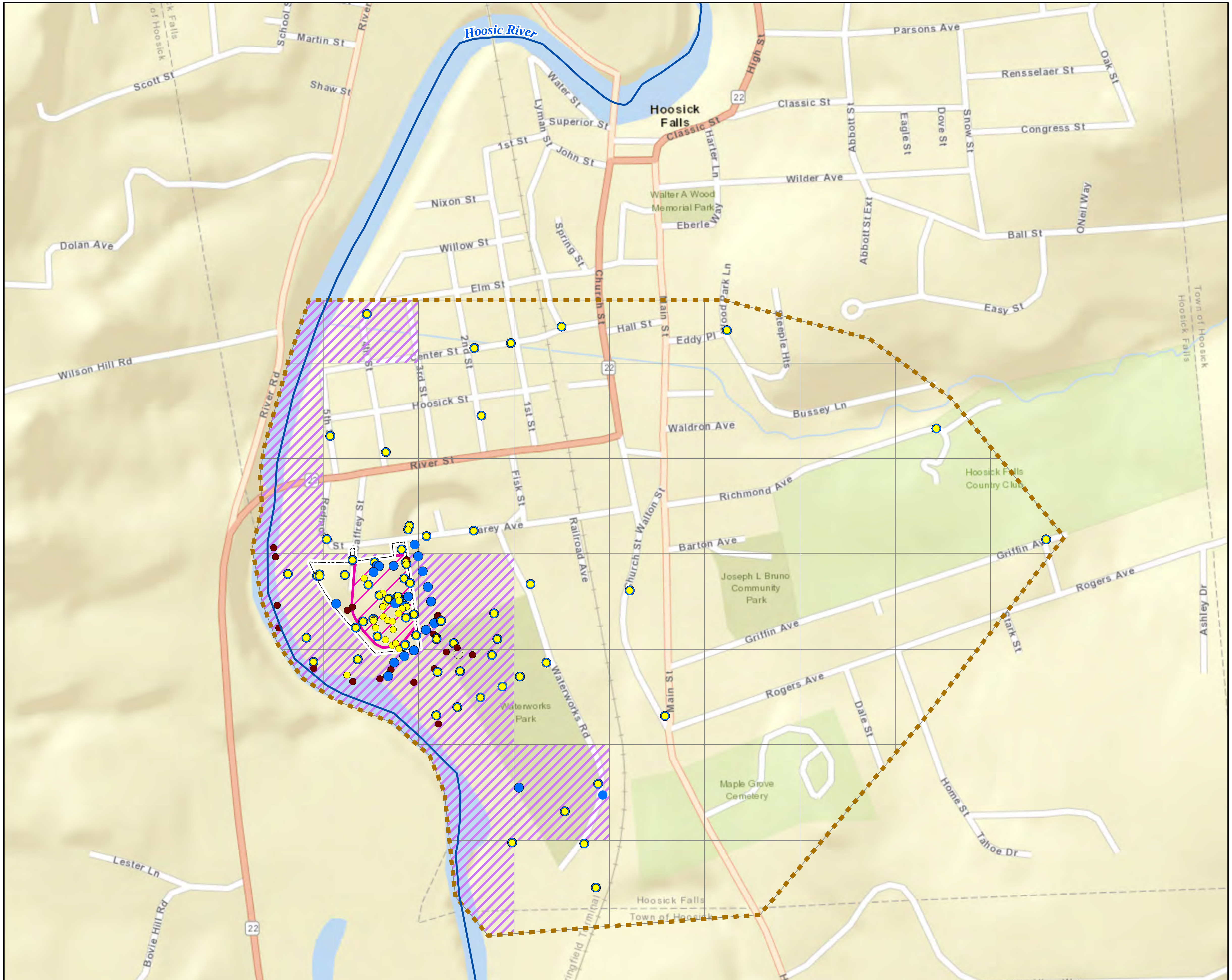


FIGURE 6B. CONCEPTUAL SITE MODEL FOR TERRESTRIAL RECEPTORS
McCaffrey Street Site
14 McCaffrey Street, Village of Hoosick Falls, Rensselaer County, NY
NYSDEC Site # 442046



N

LEGEND

- Sediment Sample Location
- Surface Soil Sample Location (≤ 2 Feet)
- Subsurface Soil Sample Location (> 2 Feet)
- Hoosic River
- Tax Parcel Boundary
- Facility Boundary
- Project Area
- 8-Acre Exposure Unit Grid
- Likely Preferred Habitat for Sandpiper and Similar Waders and Shore Birds

Note

Streetmap imagery provided by Esri ArcGIS Online.

Feet

0 300 600

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

GSI ENVIRONMENTAL

8-ACRE EXPOSURE UNIT GRID FOR SPOTTED SANDPIPER

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

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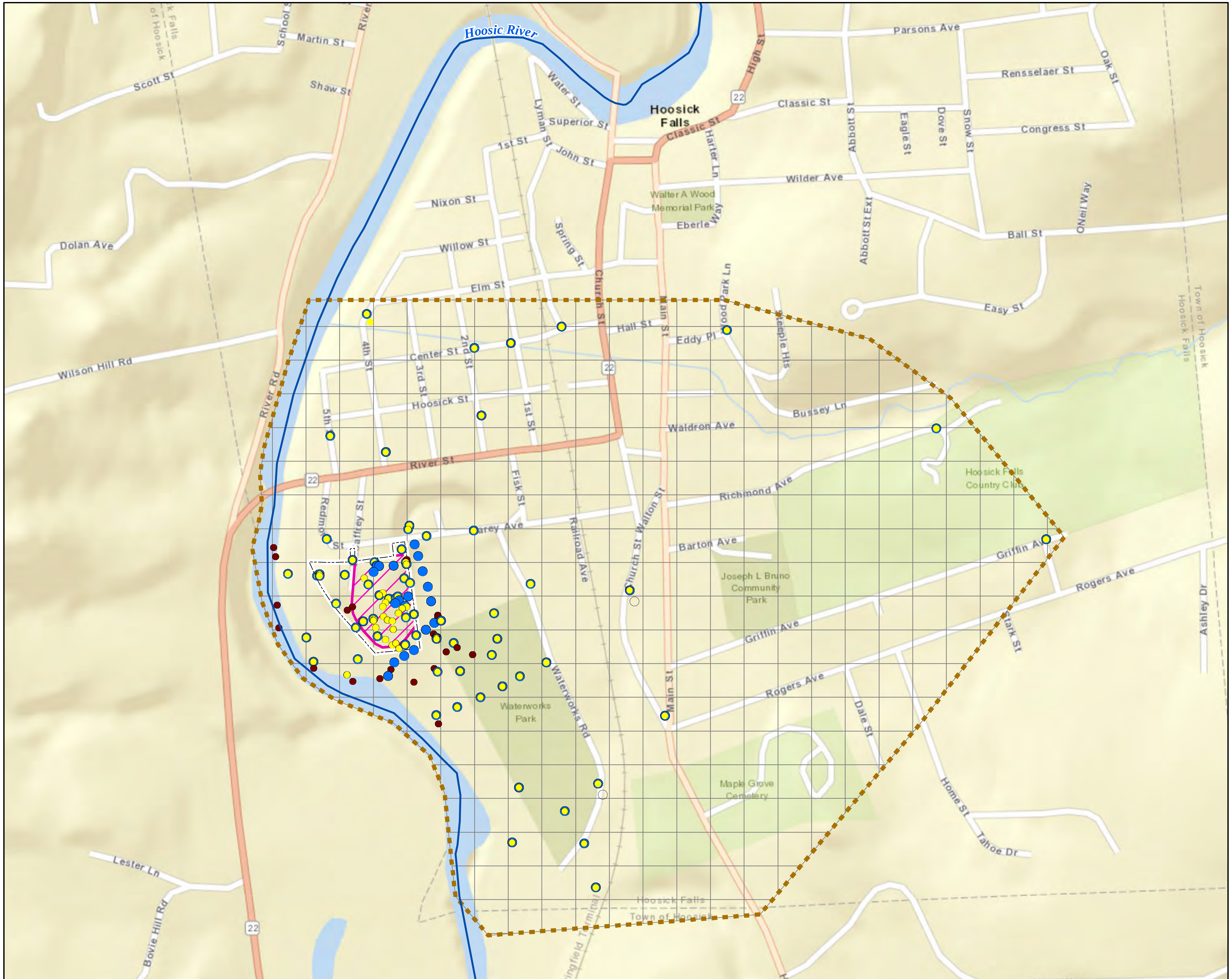
Issued:	11 June 2021	Chk'd By:	ARD
Map ID:	MS_MSSL_EUG_SS	Appv'd By:	PEG

FIGURE 7



N

LEGEND

- Sediment Sample Location
- Surface Soil Sample Location (≤ 2 Feet)
- Subsurface Soil Sample Location (> 2 Feet)
- Hoosic River
- Tax Parcel Boundary - On-Site
- Facility Boundary
- Project Area
- 1-Acre Exposure Unit Grid

Note

Streetmap imagery provided by Esri ArcGIS Online.

Feet

0 300 600

Projected Coordinate System
Datum: NAD 1983
State Plane New York East
Units: Feet

GSI ENVIRONMENTAL

1-ACRE EXPOSURE UNIT GRID FOR AMERICAN ROBIN

McCaffrey Street Site, 14 McCaffrey Street,
Village of Hoosick Falls, Rensselaer County, New York
NYSDEC Site #442046

GSI Job No.	5316	Drawn By:	AV
Issued:	11 June 2021	Chk'd By:	ARD
Map ID:	MS_MSSL_EUG_AR	Appv'd By:	PEG

FIGURE 8