Ecological Risk Assessment and Expert Report of Helen R. Connelly, Ph.D.

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al., Hayes Oil & Gas Field, Calcasieu and Jefferson Davis Parish, Louisiana

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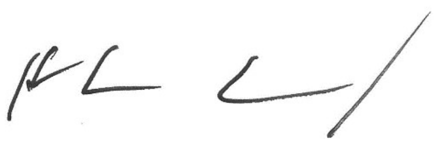

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CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

An ecological risk assessment (ERA) was performed by Dr. Helen Connelly for Areas 1, 2, 4, 5, 6, and 8 (site) within the Henning property (property), located in the Hayes Oil and Gas Field. This ERA has been prepared in accordance with U.S. Environmental Protection Agency (USEPA) and Louisiana Department of Environmental Quality (LDEQ) guidance (e.g. USEPA, 1997, 1998; LDEQ, 2003). The ERA evaluates whether oilfield exploration and production (E&P) operations within the site have damaged the ecology (flora and fauna) on the site. The ERA demonstrates that there are no unacceptable risks to ecological receptors on the site from E&P operations and that remedial action based on ecological risk is not warranted. This conclusion is supported by the following information and evidence:

- Site inspections and evaluations performed in 2019, 2021, and 2022 by Connelly (2022), Angle/Levert/Purdom (2019, 2021, 2022), Holloway/Ritchie (2021), ICON (2019, 2021, 2022), and Coastal Environments, Inc. (CEI; 2021);
- Data from investigations in 2019, 2021, and 2022 of soil and groundwater samples (chemical concentrations), vegetation, and wildlife (ERM, Holloway/Ritchie, ICON, and CEI);
- A Screening-Level Ecological Risk Assessment (SLERA); and
- A site-specific Baseline Ecological Risk Assessment (BERA).

The site supports a variety of aquatic and terrestrial habitats important to the Western Gulf Coastal Plain Ecoregion in which the site is located, including emergent and forested wetlands, croplands, early successional grasslands and scrub-shrub, drainage ditches, ponds, and Bayou Lacassine. The habitats on site are exceptionally diverse, supporting 193 vegetative taxa, with 108 forb/herbs, 40 grasses, and 35 species of woody plants (trees, shrubs) observed, and which are commonly associated with freshwater marsh, bottomland forest, and early successional communities throughout Louisiana.

Site vegetative diversity was compared to a reference location, Management Units A and B of Lacassine National Wildlife Refuge (NWR), 3 miles south of the site. The comparison shows that the site has a community structure of grasses, forbs/herbs, trees and shrubs similar to the NWR, and that the species present on site are typical and representative of the region. This favorable comparison to a protected area is a line of evidence that the ecosystem is healthy and as expected for the region.

The site supports an intact food web, 70 species of birds, and 62 non-avian taxa, including insects, aquatic invertebrates, reptiles, amphibians, fish, and mammals. The site bird population compares favorably to the avian trophic structure at the NWR, and includes 10 birds listed as Species of Greatest Conservation Need (SGCN) by the Louisiana Department of Wildlife and Fisheries (LDWF). Species of all levels of the terrestrial and aquatic food webs are represented on site.

The site is providing services that are expected for mixed habitats in the Western Gulf Coastal Plain Ecoregion. The forested and scrub-shrub area provide ecosystem services including the dissipation of storms, soil stabilization, erosion and flood control, water purification, biological productivity and diversity, carbon sequestration, and provision of habitat. The services provided by the grassy and cropland areas include habitat and diet for wildlife, protection of soil from erosion, sequestration of carbon, nutrient recycling, preservation of genetic diversity, and water purification.

Based on observed vegetation and wildlife, and the site's ecological connectivity to the nearby NWR, the site is providing exceptionally diverse, functioning habitat for flora and fauna, and is a valuable ecosystem within the larger landscape and ecoregion.

Based on the results of the Screening Level Ecological Risk Assessment (SLERA), barium, lead, and mercury were retained as Constituents of Potential Ecological Concern (COPECs) for a more in-depth assessment in a site-specific Baseline Ecological Risk Assessment (BERA). The BERA was completed using site-specific data and receptor factors for the ecological populations observed and expected on site. The BERA quantitatively confirms that historical E&P activities by defendants on this site do not pose an unacceptable risk to wildlife and the environment.

1. INTRODUCTION

Dr. Helen Connelly of Environmental Resources Management (ERM) has prepared this ecological risk assessment (ERA) pertaining to the Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al. matter, in which ERM was retained by Chevron U.S.A. Inc. (Chevron).

The Henning property (property) consists of multiple tracts on both sides of Louisiana Highway 14 totaling approximately 1,262 acres within Sections 16, 17, 18, 19, 20, and 21 of Township 11 South, Range 05W, and Section 24 of Township 11 South, Range 06W in the Hayes Oil and Gas Field, Calcasieu and Jefferson Davis Parishes, Louisiana (Figure 1 and Figure 2). Approximately 29 acres of the property have been used for oil and gas development by Chevron and others (ERM, 2022). The focus of the ERA is Chevron former operational areas (site) within the property. For ease of discussion, nine sampling areas have been designated at the property, with Chevron former operational areas corresponding to sampling areas 1, 2, 4, 5, 6, and 8 (Figure 2). Sampling areas 3 and 7 are associated with E&P activities unrelated to Chevron. Sampling area 9 is approximately 3,500 to 5,000 feet from Area 8 and is not identified as an area of former E&P operations (see ERM Expert Report, 2022).

The site supports a variety of aquatic and terrestrial habitats important to the Western Gulf Coastal Plain Ecoregion, including emergent and forested wetlands, croplands, and early successional grasslands and scrub-shrub. There are a number of shallow ditches traversing the site, and Bayou Lacassine and its associated alluvial forest intersect the easternmost border of the site (Figure 2). The site supports a wide variety of wildlife, including waterfowl, grassland birds, and raptors, terrestrial mammals, such as rabbits and white-tailed deer, and aquatic species such as crawfish and American alligator.

This ERA has been performed to evaluate the claim that oilfield E&P operations by the defendant have damaged the ecology (flora and fauna) on the site and whether remediation is required to protect the ecology. An ERA evaluates the ecological effects of chemical, physical or biological actions on an ecosystem by quantifying adverse effects on individuals, populations, communities, or ecosystems. This ERA has been performed in accordance with USEPA and LDEQ guidance (e.g. USEPA, 1997; LDEQ, 2003).

ERA, per USEPA guidance, begins with a screening level assessment and progresses to a more site-specific ecological risk assessment, if needed, to estimate if there is unacceptable risk to ecological receptors due to exposure to COPECs in site media.

The conclusions in this ERA are supported by the following data:

- Site inspections and evaluations performed by Connelly (2022), Angle/Levert/Purdom (2019, 2021, 2022), Holloway/Ritchie (2021), ICON (2019, 2021, 2022), and Coastal Environments Inc. (CEI; 2021);
- Data from 2019, 2021, and 2022 investigations of soils, groundwater, wildlife, and vegetation (ERM, ICON, Holloway/Ritchie, and CEI);
- The results of a SLERA of the site, which compares soil COPEC concentrations with ecological screening values (ESVs); and
- The results of a site-specific BERA for the site for COPECs that exceeded screening values in the SLERA.

The purpose of this ERA, which includes a SLERA and a more site-specific BERA, is to determine if 1) additional investigation and studies are needed, 2) remediation is needed, or 3) no further action is required.

1.1 Purpose of Report and Sources of Information

This report documents my opinions regarding the ecological conditions of the site and provides: 1) a review of site background information and data; 2) an ERA; 3) recommendations for a scientifically reliable course of action for the site; and 4) a response to plaintiffs' expert reports.

Fundamental principles of toxicology have been used to evaluate the site and prepare this report. Basic principles of toxicology that govern the evaluation process include: 1) there must be an exposure to elicit a sufficient dose, response, and subsequent risk; and 2) an implemented remedy, if any, should not cause harm to a functioning ecosystem.

Information reviewed to prepare this report, other than the data in this report and the literature cited, include an expert report by Mr. David Angle, Ms. Angela Levert, and Mr. Michael Purdom as well an expert report by Dr. Luther Holloway and Mr. Patrick Ritchie.

Additional information may be reviewed and added to this report, if additional information becomes available.

1.2 Qualifications, Areas of Expertise, and Compensation

Dr. Helen Connelly is a toxicologist and ecological and human health risk assessor. She has a Bachelor of Science degree in geology from Louisiana State University and a Ph.D. from Louisiana State University School of Veterinary Medicine, Department of Physiology, Pharmacology and Toxicology. Dr. Connelly is an adjunct professor at Louisiana State University in the Department of Environmental Science. She has taught graduate and undergraduate classes in environmental science, environmental sampling, conservation biology, ecology, biology, and environmental risk assessment (ERA) at Louisiana State University and Baton Rouge Community College. For almost 20 years, Dr. Connelly has been involved with research and investigation of the effects of oil and gas production and exploration on aquatic and terrestrial life in Louisiana wetlands, lakes, bayous, estuaries, and other water bodies. Her research investigations have been a part of her consulting work and have been focused on ERA of the effects of organic and inorganic compounds, including metals and hydrocarbons associated with oil and gas production and exploration, on vegetation and wildlife. A copy of Dr. Connelly's Curriculum Vitae is provided as Appendix A. ERM's hourly rate for Dr. Connelly is $248.

2. LISTING OF OPINIONS

1. The data clearly show that the Chevron former operational areas provide habitat for wildlife species and vegetation. The site contains a diverse range of habitats, including emergent freshwater marsh, forested/scrub wetland, croplands, and early successional habitat. During the site investigations, we observed numerous plants, animals, and signs of wildlife, which indicate a fully-functioning mosaic of grassland, marsh, scrub-shrub, and forest ecosystems. There is clear evidence of a healthy ecosystem, and there is no evidence of adverse effects on wildlife or vegetation populations from past E&P activities by Chevron. The site is providing habitat and services that would be damaged or destroyed by unnecessary and intrusive actions, including the remediation proposed by ICON (ICON, 2021).
2. The reported concentrations, locations, and forms of constituents (COPECs) in the surface soils of the Henning Management, L.L.C. property in the vicinity of Chevron former operational areas that are of potential ecological concern are not at concentrations or in forms that currently or potentially provide exposures presenting unacceptable risks to ecological receptors or their habitats.
3. Site ecosystems are functioning as expected for the region, and there is no evidence of adverse impact to ecosystem health or structure. There is also no evidence to predict that adverse health effects to site ecological species will occur in the future, and no remediation is required to protect site species or habitats.
4. Soil was not designated for remediation by ERM (2022; Angle/Levert/Purdom Expert Report), and therefore consideration of the risk posed by a proposed remedy is not necessary for this assessment.
5. Plaintiffs' experts' conclusions regarding potential ecological risks to wildlife are not substantiated and were not observed during site investigations.
6. Intrusive remedial actions or disturbances such as the plan proposed by the Plaintiffs' experts would damage and cause unjustified harm to this ecosystem. The remediation proposals of the Plaintiffs' experts would not serve to remediate any adverse ecological impacts and would remove acres of flourishing forested and early successional grasslands and scrub-shrub areas.

3. SITE ECOLOGY

The condition, physical structure, and ecology of the site ecosystem was assessed during a site field investigation of vegetation and wildlife performed by Dr. Helen Connelly on January 12, 2022. There is sufficient literature data, field evidence, and soil concentration data (2019, 2021, 2022) to evaluate site ecosystem health.

3.1 Ecoregion

The site is located in the Western Gulf Coastal Plain Ecoregion of Louisiana, which is an area of fertile croplands, just north of the coastal marshes. The original ecosystem in this area is grassy prairies dominated by grasses such as little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), yellow Indiangrass (*Sorghastrum nutans*), brownseed paspalum (*Paspalum plicatulum*), and switchgrass (*Panicum virgatum*), as well as gallery forests along waterways (Daigle, 2006; LDEQ, 2014).

Almost all of the coastal prairie grasslands have been converted to cultivated cropland, pasture/hay, crawfish aquaculture, and urban land uses. Soils in this area are poorly drained silt loams and silty clay loams (Daigle, 2006; LDEQ, 2014).

3.2 Ecological Communities

The site contains emergent and forested/shrub wetlands, croplands (rice fields), early successional grasslands and scrub-shrub, and waterbodies (shallow drainage ditches and Bayou Lacassine) (Figure 3). Biota that are expected to occur in these types of ecological habitats is described in Section (3.2), and a discussion of the diversity of biota actually observed at the site during my January 12, 2022 field investigation, as well as other site survey events, is detailed in Section 4.

3.2.1 Wetlands

The U.S. Fish and Wildlife (USFWS) National Wetlands Inventory (NWI) indicates the presence of freshwater emergent and forested/shrub wetlands on site (Figure 4). The emergent wetlands are categorized by the NWI as persistent and semi-permanently flooded, indicating that the wetlands are dominated by species that normally remain standing until the beginning of the next growing season, and that surface water is persistent through the growing season. The forested/shrub wetlands are characterized as semi-permanently flooded needle- and broad-leaved deciduous communities, represented by bald cypress (*Taxodium distichum*) and various species of oak (*Quercus* spp.). Evidence of these wetland communities was observed during the January 2022 site visits, and the composition of the wetland vegetation on site is further characterized in Section 4.1 below.

Wetlands provide important habitat for a range of wildlife and supports a complex pyramid of species across the detrital food chain. At this site and in many wetlands, the detrital food chain begins with aquatic invertebrates, such as crawfish, that consume detritus along with other plant and animal materials such as small fish, worms, plankton, and plants. These aquatic invertebrates then provide sustenance for secondary consumers, such as fish, snakes, frogs, and many species of birds. These species subsequently provide diet for higher trophic level species, such as hawks (*Buteo* spp.) and American alligator (*Alligator mississippiensis*). The presence of this functioning food chain on site is evidence of the ecosystem services currently being provided by site species.

The documentation of different trophic levels at a site is part of the ecological risk assessment process (USEPA, 1997). Further detail regarding the avian and wildlife communities on site is provided in Section 4.2 and 4.3, respectively.

3.2.2 Croplands

A large portion of the site is dominated by active and fallow rice fields. Rice is grown under flooded conditions in small ponds, which offer excellent feeding grounds for a wide range of herbivorous birds, as well as mammals, reptiles, amphibians, and crustaceans (Gosselink, 1979).

Despite regular cultivation activities, a variety of wildlife lives and feeds in rice fields (Gosselink, 1979; Czech and Parsons 2002). In particular, rice fields provide ideal habitat for many species of shorebirds and wading birds, as well as geese and ducks (Dillon, 1958; Gosselink, 1979; Remsen et al., 1991; Foley, 2015). Flourishing detrital and grazing food chains were evidenced by the large volume of omnivorous and herbivorous birds observed in the rice fields on site (Wharton, 1982). A variety of waterfowl, marshbirds, and shorebirds such as Virginia Rail (*Rallus limicola*), King Rail (*Rallus elegans*), and White-faced Ibis (*Plegadis chihi*) were observed on site foraging on aquatic invertebrates and plant material.

Photographs of birds utilizing the site rice fields for habitat are provided in Appendix B-3. The site is providing a diet for all trophic levels of the avian food chain, from the Northern Cardinal (*Cardinalis cardinalis*) which are seed eating birds to the Barred Owl (*Strix varia*) which is a bird of prey. The composition and diet breakdown of all bird species documented on site are described in Section 4.2.

3.2.3 Early Successional Communities

The site contains “successional” and scrub-shrub vegetation, which is the vegetation that grows following a change, such as the clearing of cropland. The new vegetation that occurs after soils are cleared or grazed is called successional growth, because the plants are part of a natural “succession” of growth. The succession may proceed through intermediate stages of growth, and then ultimately result in a plant community with a different composition. Successional grasslands and woody scrub-shrub vegetation (shrubs and trees less than 20’ tall) are expected in areas where there has been anthropogenic activity such as agriculture, mowing, and grazing.

Early successional plant communities are characterized by vigorously growing grasses, forbs, shrubs, and trees, which make up the grasslands, scrub-scrub and young forests that evolve into mature forest if left undisturbed over a long period of time (NRCS, 2012). Early successional habitats are a result of both natural (e.g., fire, grazing) and anthropogenic (e.g., mowing, crop cultivation) changes to the landscape, and provide excellent food and cover for a wide variety of wildlife (Harper, 2007).

The fruiting grasses, forbs, herbs, and shrubs that dominate these areas of the site constitute a significant food resource for herbivorous birds observed on site such as American Goldfinch (*Spinus tristis*), Mourning Dove (*Zenaida macroura*), and Northern Cardinal (*Cardinalis cardinalis*), whose diets consist primarily of seeds. These herbivorous primary consumers subsequently provide diet for higher trophic level consumers, such as the Peregrine Falcon (*Falco peregrinus*) observed on site that feeds primarily on other birds.

Successional grassland and scrub-shrub habitats also provide important refuge for a range of mammals, including but not limited to rodents, rabbits, feral hogs (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*), and coyote (*Canis latrans*), all of which have been observed directly or indirectly on site. The presence of higher trophic mammals, such as coyote, provides evidence that its habitat needs (sufficient access to food, shelter, water) are being met on site, and demonstrates that the lower levels of the food chain are present.

The complete list of non-avian wildlife documented on site are discussed in Section 4.3 and listed in Table 3.

3.2.4 Waterbodies

The USFWS NWI indicates the presence of a number of waterbodies on site, including a variety of riverine features, mainly shallow ditches and Bayou Lacassine, as well as three small freshwater ponds. The shallow, linear ditches traverse the site from north to south and east to west, creating boundaries between the different agricultural plots throughout the site. An oxbow meander of Bayou Lacassine intersects the site in the east, where there is a riparian buffer zone consisting of freshwater forested and emergent wetlands.

Based on comparison of site soil concentrations to sediment ecological screening values, concentrations are protective of ecological receptors potentially interacting with sediment. If site soils were to wash into the waterbodies on site (a hypothetical scenario), this route of constituent transport is not estimated to pose ecological risk to the waterbody inhabitants. Soil overland flow into site waterbodies is also insufficient to cause health risk to people consuming fish, as soil concentrations are similar to background or are in poorly bioavailable forms (see Section 5.2.3.1).

Drainage ditches and Bayou Lacassine receive upstream agricultural and urban land use and runoff, therefore the water quality of these features is related to the larger landscape, rather than to oil field operations at the site.

Data do not indicate that E&P related constituents are of ecological or human health concern to the waterbodies on site.

3.2.4.1 Pond and Shallow Ditches

The pond and shallow ditches on site are expected to support aquatic invertebrates and fish that are found in the rice and crawfish ponds in the region, such as crawfish (Family Cambaridae), bluegill (*Lepomis* sp), bullhead (*Ameiurus* sp.), and black bass (*Micropterus salmoides*) (Foley, 2015). The pond and shallow ditches on site support the frogs and snakes that are typical of the rice and crawfish ponds of the region, such as American bullfrog (*Lithobates catesbeianus*) and cottonmouth (*Agkistrodon piscivorous*), observed on site.

3.2.4.2 Bayou Lacassine

Bayou Lacassine and its associated forested and emergent wetlands define the easternmost portion of the site. Bayou Lacassine is a state-jurisdictional waterway that flows southward from the convergence of the East and West Bayou Lacassine tributaries in Jefferson Davis Parish to Grand Lake in Cameron Parish.

3.3 Ecosystem Services

Due to historic activity (e.g. former oil and gas E&P, etc.) on the site and claims by the plaintiffs' expert (CEI, 2021), the site has been evaluated for evidence of services and functions. The site is providing services that are expected for croplands, early successional, wetland, and waterbody habitats (Barbier, 2013). The expected and observed ecological services provided by the emergent and forested wetland habitats on site include: dissipation of storms (trees provide buffering), soil stabilization (roots hold soil in place), erosion and flood control (soils absorb water), water purification (surface water is cleaned via interactions with plants), biological productivity and diversity (habitat produces diverse vegetative biomass), carbon sequestration (carbon stored in abundant vegetation), and provision of habitat (presence of diverse vegetative species). The ecosystem services provided by the early successional grasslands and scrub-shrub areas includes habitat and diet for wildlife, protection of soil from erosion, sequestration of carbon, preservation of genetic diversity (diverse grasses), nutrient recycling, pollinator support, and seed dispersal (USFS, 2022). The waterbodies on site provide additional supporting and regulating ecosystem services, including breeding grounds and habitat provision for aquatic and semi-aquatic species.

The observations documented on site of the expected ecosystem functions and services are a line of evidence supporting the conclusion of no adverse impacts to species or their habitats from Chevron's oil field operations.

4. SITE INSPECTIONS AND OBSERVATIONS

Dr. Helen Connelly performed a site investigation and collected wildlife and vegetation data on January 12, 2022. These data, along with wildlife and vegetation data collected by Mr. Jody Shugart (ERM, March 25-26, 2021, and January 11-13, 2022), Mr. Patrick Ritchie (ERM, March 24, 2021), Mr. Patrick Ritchie (ERM, December 1-3, 2021) and Dr. Luther Holloway (Holloway Environmental Services, Inc. (HES), December 1-3, 2021), Ms. Emily Martin (ERM, January 13, 2022), and Mr. Walker Wilson (CEI, March 24-26, 2021) were used to prepare the ERA.

The focus of the ERA is the former Chevron operational areas within the Henning property. A discussion of the findings and analyses resulting from the site investigations is included in the following Sections 4.1 through 4.5.

Site and reference area locations investigated during vegetation/wildlife surveys are shown on Figure 5A and Figure 5B, respectively. The site supports croplands, early successional grasslands and scrub-shrub, emergent and forested wetlands, and natural and manmade waterbodies that are providing ecological services to native wildlife species and humans (Figure 3). Photographs taken of habitat, vegetation, and wildlife are included in Appendix B and field notes are in Appendix C. LDEQ's Risk Evaluation/Corrective Action Program (RECAP) Form 18 is included in Appendix D.

4.1 Vegetation Characterization and Assessment

The site supports a variety of terrestrial and aquatic vegetative communities, including croplands (rice fields), early successional grasslands and scrub-shrub, and forested and emergent wetlands. The USFWS NWI indicates the presence of freshwater emergent and forested/shrub wetlands on site, and the presence of these habitats was confirmed during the January 2022 site visit (Figure 4).

4.1.1 Site Vegetation

Vegetation is exceptionally diverse throughout the early successional and wetland habitats on site. Across all surveys (ERM, CEI, HES; 2021-2022), 193 vegetative taxa were observed and recorded on site. This is an exceptionally large number of vegetative species and indicates that soils and conditions are offering a productive and non-toxic setting for ecological habitats. A complete list of vegetative taxa observed on site is included in Table 1. Photographs of the natural communities, vegetation survey areas, and site flora at the site and at the reference area are provided in Appendix B.

4.1.1.1 Wetlands

The natural communities present in the wetland areas on site are best characterized as freshwater marsh and sweetgum-water oak bottomland forest (LDWF, 2009). These areas are dominated by hydrophytic species, or those plants that have adapted to living in aquatic environments.

One hundred and fourteen (114) hydrophytic plants (as classified by the USDA) were observed on site, including 46 obligate wetland species, which almost always occur in wetlands. Examples of obligate tree species observed on site include bald cypress (*Taxodium distichum*), black willow (*Salix nigra*), and water tupelo (*Nyssa aquatica*). Other hydrophytic species documented on site include forbs and herbs such as alligator weed (*Alternanthera philoxeroides*), broadleaf arrowhead (*Sagittaria latifolia*), butterweed (*Packera glabella*), pickerelweed (*Pontederia cordata*), seven sisters (*Crinum americanum*), smooth beggartick (*Bidens laevis*), and southern cattail (*Typha domingensis*), as well as grasses, including Baldwin's spikerush (*Eleocharis baldwinii*), common rush (*Juncus effusus*), common threesquare (*Schoenoplectus pungens*), giant cutgrass (*Zizaniopsis miliacea*), narrow plumegrass (*Saccharum baldwinii*), and woolly rosette grass (*Dichanthelium scabriusculum*).

The surface waters of the wetlands and waterbodies on site also host a variety of submerged, floating, and rooted aquatic vegetation. Examples of aquatic species observed on site include Carolina mosquitofern (*Azolla caroliniana*), Columbian watermeal (*Wolffia columbiana*), ducklettuce (*Ottelia alismoides*), duckweed (*Lemna* spp.), swamp smartweed (*Polygonum hydropiperoides*), twoheaded water-starwort (*Callitriche heterophylla*), water spangles (*Salvinia minima*), and yellow pond-lily (*Nuphar lutea*), among others. The aquatic vegetation on site serves as an important food resource for waterfowl, provides refuge for fish fry and aquatic invertebrates, and acts as breeding grounds for various amphibians.

Based on the Louisiana Department of Wildlife and Fisheries (LDWF) descriptions, the freshwater emergent and forested wetlands on site are characterized as Freshwater Marsh and Sweetgum-Water Oak Bottomland Forest natural communities. Louisiana's Freshwater Marsh natural communities are dominated by hydrophytic grasses, forbs, and herbs, and are usually categorized by low salinity (usually less than 2 ppt) remarkable plant diversity, and high levels of soil organic matter (LDWF, 2010a). Contrastingly, Sweetgum-Water Oak Bottomland Forest natural communities are defined as alluvial wetlands flanking large river systems dominated by a mixture of broadleaf deciduous, needleleaf deciduous, and evergreen trees and shrubs (LDWF, 2010b). The plants most commonly associated with Louisiana's Freshwater Marsh and Sweetgum-Water Oak Bottomland Forest natural communities are provided in Inset Table 4-1 and Inset Table 4-2, respectively.

Table 4-1: Plants Associated with Louisiana Freshwater Marsh Natural Communities

Common Name	Scientific Name	Taxa Observed on Site
Alligatorweed	*Alternanthera philoxeroides*	✓
Herb-of-grace	*Bacopa monnieri*	✓
Coon's tail	*Ceratophyllum demersum*	
Flatsedge	*Cyperus spp.*	✓
Common water hyacinth	*Eichhornia crassipes*	✓
Spikerush	*Eleocharis spp.*	✓
Hydrocotyle	*Hydrocotyle spp.*	✓
Duckweed	*Lemna spp.*	✓
Watermilfoil	*Myriophyllum spp.*	
American white waterlily	*Nymphaea odorata*	
Maidencane	*Panicum hemitomon*	✓
Green arrow arum	*Peltandra virginica*	
Common reed	*Phragmites communis*	
Pickerelweed	*Pontederia cordata*	✓
Broafleaf arrowhead	*Sagittaria lancifolia*	✓
Saltmeadow cordgrass	*Spartina patens*	✓

Common Name	Scientific Name	Taxa Observed on Site
Cattail	*Typha spp.*	✓
Bladderwort	*Utricularia spp.*	
Hairypod cowpea	*Vigna luteola*	
Giant cutgrass	*Zizaniopsis miliacea*	✓
Total Taxa	20	13

LDWF. 2010a. "Freshwater Marsh." Natural Communities Fact Sheets. Available: https://www.wlf.louisiana.gov/page/natural-communities. Accessed March 2022.

Table 4-2: Plants Associated with Louisiana Sweetgum-Water Oak Bottomland Forest Natural Communities

Common Name	Scientific Name	Taxa Observed on Site
Sweetgum	*Liquidambar styraciflua*	✓
Sugarberry	*Celtis laevigata*	✓
American Elm	*Ulmus americana*	✓
Red Maple	*Acer rubrum*	✓
Possumhaw	*Ilex decidua*	✓
Switchcane	*Arundinaria gigantea*	✓
Water oak	*Quercus nigra*	✓
Green ash	*Fraxinus pennsylvanica*	
Cherrybark oak	*Quercus pagoda*	✓
Dwarf palmetto	*Sabal minor*	✓
Green hawthorn	*Crataegus viridis*	✓
Total Taxa	11	10

LDWF. 2010b. "Bottomland Hardwood Forest." Natural Communities Fact Sheets. Available: https://www.wlf.louisiana.gov/page/natural-communities. Accessed March 2022.

Of the 20 species identified by the LDWF as associated with Freshwater Marsh natural communities in Louisiana, 13 (65%) were observed on site, indicating that the emergent wetlands on site host a similar composition of species to freshwater marshes throughout the state (Inset Table 4-1). The forested wetlands on site are also consistent with regional expectations for bottomland hardwoods, as 10 of 11 (91%) tree and shrub species associated with the Sweetgum-Water Oak Bottomland Forest natural community were also observed on site (Inset Table 4-2).

It should be noted that the site is providing two categories of wetland habitat: marsh and forest. This is evidenced in the exceptional site diversity of more than 100 hydrophytic plant species on site.

The diverse vegetation documented in the freshwater emergent and forested wetlands during the field investigation is a line of evidence that the site is providing a healthy setting for two of Louisiana's important natural wetland communities.

4.1.1.2 Croplands

The active agricultural fields on site are primarily used for the commercial cultivation of rice (*Oryza sativa*). As site investigations occurred in the winter months, the rice fields on site were observed in a fallow state. Photographs of the fallow rice fields are included in Appendix B.

Area 8 is a portion of the site characterized as rice field. Between the March 2021 and January 2022 site visits, 45 unique species were observed in Area 8 (between 4 and 24 species per sampling location within that area). In addition to rice (*Oryza sativa*), the species present in Area 8 include herb-of-grace (*Bacopa monnieri*), sawtooth blackberry (*Rubus argutus*), alligatorweed (*Alternanthera philoxeroides*), delta arrowhead (*Sagittaria platyphylla*), and low spearwort (*Ranunculus pasillus*), among others. The presence and diversity of healthy vegetation in this area is a line of evidence that vegetation is not impacted by past E&P operations, and that rice can be expected to thrive in the area during the growing season.

Vegetative cover in these areas is purposefully limited to allow the land to recover and store organic matter while retaining moisture (Wojtkowski, 2008). Active and fallow rice fields in southwest Louisiana provide one of the largest habitats for migrating birds each year (Molino, 2021). Migrating birds including the Greater White-fronted Goose (*Anser albifrons*) and White Ibis (*Eudocimus albus*) were observed by Dr. Connelly during her site visit. The importance of site rice fields to bird populations is discussed in detail in Section 4.2.

4.1.1.3 Early Successional Communities

The site hosts a number of early successional grasslands and scrub-shrub habitats, defined by the presence of vigorously growing grasses, forbs, shrubs, and trees that have colonized the inactive agricultural fields.

Of the 193 vegetative taxa recorded on site, there were 110 different forb/herbs, 40 grasses, and 35 species of woody plants (trees, shrubs) observed. This level of diversity is among the highest diversity observed in south Louisiana ecosystems, and is strong evidence that the site is providing a healthy soil source for plants that is not negatively impacted by E&P operations. Examples of non-hydrophytic forbs/herbs documented on site include annual yellow sweetclover (*Melilotus indicus*), burclover (*Medicago polymorpha*), Canada goldenrod (*Solidago altissima*), crowpoison (*Nothoscordum bivalve*), dogfennel (*Eupatorium capillifolium*), ebony spleenwort (*Asplenium platyneuron*), Indian strawberry (*Duchesnea indica*), lyreleaf sage (*Salvia lyrata*), and spiny sowthistle (*Sonchus asper*). Terrestrial grasses and trees on site include annual bluegrass (*Poa annua*), Bermuda grass (*Cynodon dactylon*), Indian goosegrass (*Eleusine indica*), Johnsongrass (*Sorghum halepense*), and sugarcane (*Saccharum officinarum*), as well as live oak (*Quercus virginiana*) and white mulberry (*Morus alba*).

These post-agricultural natural communities occur in areas that historically contained coastal prairie. Although remnant Louisiana coastal prairies once covered an estimated 2.5 million acres, they have since been reduced to less than 1% of the original extent and are now restricted to railroad right-of-ways and between highways (LWDF, 2010c). Of the 40 different types of grasses documented in Louisiana's few remaining Coastal Prairie natural communities, 11 (28%) were observed in the grassland and scrub-shrub early successional communities on site. Site grasses and forb/herbs include: broomsedge (*Andropogon* spp.), sedge (*Carex* spp.), flatsedge (*Cyperus* spp.), thoroughworts (*Eupatorium* spp.), spurges (*Euphorbia* spp.), primrose-willow (*Ludwigia* spp.), panic grass (*Panicum* spp.), crowngrass (*Paspalum* spp.), goldenrod (*Solidago* spp.), wire grass (*Spartina* spp.), and dropseeds (*Sporobolu*s spp.). These grasses are serving to preserve historic diversity and represent vegetation that was dominant prior to agriculture.

The exceptionally diverse assemblage of vegetation documented in the early successional grasslands and scrub-shrub habitats is a line of evidence that the site is providing a healthy setting for grasses of historic coastal prairies as well as opportunistic species. The immense benefits of early successional habitat to wildlife and regional biodiversity are highlighted in Sections 4.2 and 4.3 below.

4.1.2 Reference Area Vegetation

Lacassine National Wildlife Refuge is a protected area owned by the USFWS. The refuge is located approximately 3 miles south of the site, and its landscape includes freshwater marshes, forested/shrub wetlands, coastal prairies, and croplands, making it a comparable setting to the site (USFWS, 2011). The 34,724-acre refuge is divided into 15 management units of various size and habitat composition. Units A, B, C, and F3 are managed for cropland, moist soil, and unimpounded marsh, and therefore provide the most appropriate point of comparison for site habitats. Photographs of the vegetation and natural communities observed in the reference area are provided in Appendix B.

During a reference site investigation on February 24, 2022, Mr. Shugart (ERM) identified 39 plant species in Unit A, and 56 plant species in Unit B (Figure 6). Notable species observed in both units include: American black elderberry (*Sambucus nigra*), annual bluegrass (*Poa annua*), birdeye speedwell (*Veronica persica*), black medick (*Medicago lupulina*), bushy bluestem (*Andropogon glomeratus*), Carolina geranium (*Geranium carolinianum*), Eastern baccharis (*Baccharis halimifolia*), hairy buttercup (*Ranunculus sardous*), and Louisiana vetch (*Vicia ludoviciana*). Of the 71 total plant taxa observed at Lacassine NWR (Units A and B), 56 (79%) were also observed on site, indicating strong similarly between the vegetation composition of the site and the nearby protected area. A comparative list of vegetative taxa present at the Lacassine NWR is included as Appendix E-1.

A comparison of the wetland classification and growth habit breakdown of the plant species observed at the site and NWR reference area are shown in Inset Figure 4-1. The results indicate that the proportion of observed wetland species (including obligate wetland, facultative wetland, and facultative species) is nearly identical at the site and at the NWR (site 60%; NWR 59%). The growth habits are also nearly identical, as both the site and NWR are dominated by non-woody vegetation (grasses, forb/herb, and subshrubs) (site 83%; NWR 86%). There is also the same proportion of trees at the site and NWR (15%), which is the expected percentage for a site with limited areas of forested wetlands.

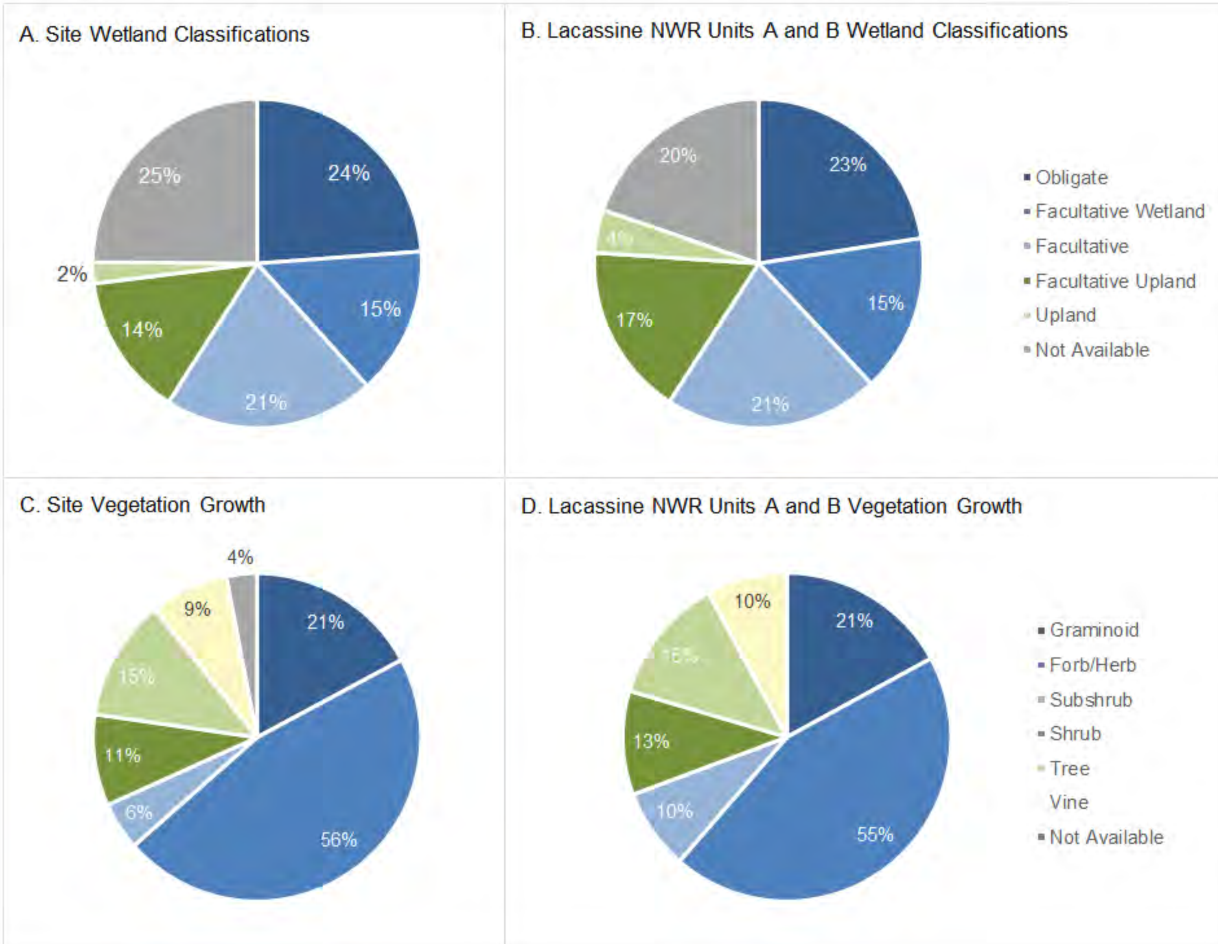


Figure 4-1: Comparison of wetland classification (top) and growth habit (bottom) between the site (left) and a nearby protected area, Lacassine National Wildlife Refuge (NWR) Units A and B (right)

Site and NWR taxa include all those identified during multiple site investigations (ERM, CEI, Holloway and Ritchie, 2021-2022, as described above) and reference area visits (ERM, 2022). In the wetland classification graphs, the hydrophytic wetland species (Obligate, Facultative Wetland, and Facultative) are shown in shades of blue, and non-hydrophytic upland species (Facultative Upland, Upland) are shown in shades of green (USDA, 2012). In the growth habit graphs the mid- and top-story woody vegetation (Tree, Shrub, Subshrub) is shown in shades of blue, and understory herbaceous species (Forb/herb) and grasses (Graminoid) are shown in shades of green. Vines can be either herbaceous or woody and are shown in yellow. Note that some species have multiple growth forms, so community structure percentages add up to greater than 100. Taxa identified to the genus level have a status that is considered “not available” (grey) as species within genera may vary in wetland classification.

These favorable comparisons of the site to a comparable protected area, including similar proportions of wetland and upland species, similar percentages of trees, and similarity in the specific species present demonstrate that the vegetation on site is as expected for early successional habitats, emergent marsh, and forested wetlands. The similarity between the site and the NWR is a line of evidence that the ecosystem is functioning as expected, and that the vegetation at the site is as expected for the region.

4.2 Avian Community Characterization and Assessment

The entirety of the site is contained within the globally designated Coastal Prairie Important Bird Area (IBA) (Appendix E-2). The Coastal Prairie IBA is named after the formerly predominate habitat type, which once dominated approximately 2.5 million acres of coastal and Cajun prairie (Audubon, 2022a). Today, more than half of the IBA is used for rice and crawfish cultivation, which provides ample food, water, and cover for several categories of birds, including shorebirds, wading birds, waterfowl, and blackbirds. This IBA occurs at the convergence of the Central and Mississippi Flyways, and therefore the site and the IBA play an important role in sustaining habitat for more than 300 species of migratory birds (BirdlLife International, 2022).

4.2.1 Site Avian Community

Seventy species of birds were documented on site across multiple site investigations (ERM, CEI, Holloway and Ritchie, 2021-2022, as described above). A complete list of birds observed on site is included in Table 2. Photographs of site birds are included in Appendix B.

Ten of the bird species observed are listed as Species of Greatest Conservation Need (SGCN) by the LDWF (LDWF, 2020a; Inset Table 4-3). Species listed on the LDWF list of SGCN are selected based on a variety of criterion, including global and state rarity ranks, threats to the population, extent of historical range, percent of habitat remaining, and amount of data available (or ecological knowledge level) (Holcomb et al., 2015). The SCGN species observed on site range in state rarity from S1, or at high risk of extirpation in the state, to S5, very low risk of expiration in the state. The presence of and diversity of SCGN species observed on site is a line of evidence that the ecosystems present are providing a variety of nourishing habitats that sustain biodiversity in the region.

Table 4-3: Louisiana Bird Species of Greatest Conservation Need Observed on Site

Common Name	Scientific Name	Diet[1]	Global Rank[2]	State Rank[3]
Bald Eagle	*Haliaeetus leucocephalus*	Fish	G5	S3
Crested Caracara	*Caracara plancus*	Omnivore	G5	S1
Eastern Meadowlark	*Sturnella magna*	Insects	G5	S5
King Rail	*Rallus elegans*	Aquatic Invertebrates	G4	S3B, S4N
Little Blue Heron	*Egretta caerulea*	Fish	G5	S3
Mottled Duck	*Anas fulvigula*	Omnivore	G4	S4
Northern Bobwhite	*Colinus virginianus*	Plants	G4	S3
Peregrine Falcon	*Falco peregrinus*	Birds	G4	S3
Sandhill Crane	*Antigone canadensis*	Omnivore	G5	S2
Sedge Wren	*Cistothorus platensis*	Insects	G5	S4
Ranks G = Global S = State B = Breeding N = Non-breeding 1 = Critically Imperiled 2 = Imperiled 3 = Vulnerable 4 = Apparently Secure 5 = Secure	[1] Diets as listed by The Cornell Lab (2022a) Bird Guide. [2] Global ranks are designated by NatureServe (2022). [3] State ranks are determined by the LDWF under Title 56 of the Louisiana Revised Statutes (LDWF, 2021). **Sources** The Cornell Lab. 2022a. All About Birds: Bird Guide. Available: https://www.allaboutbirds.org/guide/. Accessed March 2022. LDWF. 2020. Louisiana's Animal Species of Greatest Conservation Need (SGCN) – Rare, Threatened, Endangered Animals – 2020. Louisiana Department of Wildlife and Fisheries, Wildlife Diversity Program. NatureServe. 2022. NatureServe Explorer. Available: https://explorer.natureserve.org/. Accessed March 2022.			

4.2.1.1 Primary Consumers

Herbivorous birds, which predominately consume plants and plant material (i.e., nuts, seeds, nectar) are categorized as primary consumers. Given their consumption of primary producers (plants), primary consumer species are lower trophic level species, as compared to the secondary and tertiary consumers with omnivorous and carnivorous diets. Examples of primary consumers observed on site include Cedar Waxwing (*Bombycilla cedrorum*), Common Gallinule (*Gallinula galeata*), Greater White-fronted Goose (*Anser albifrons*), Snow Goose (*Anser caerulescens*), Wood Duck (*Aix sponsa*), American Goldfinch (*Spinus tristis*), Brown-headed Cowbird (*Molothrus ater*), Mourning Dove (Zenaida macroura), and Northern Cardinal (*Cardinalis cardinalis*), in addition to the state-vulnerable Northern Bobwhite (*Colinus virginianus*). The abundance and diversity of avian primary consumers on site is a line of evidence indicating that the vegetation present is providing sufficient diet for these populations, and that soils and vegetation are not negatively impacted by E&P operations.

4.2.1.2 Secondary Consumers

Secondary consumers are organisms that consume primary consumers; therefore, their diets may be omnivorous or consist predominately of insects and aquatic invertebrates. Examples of avian secondary consumers observed on site include: American Crow (*Corvus brachyrhynchos*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Carolina Chickadee (Poecile carolinensis), Downy Woodpecker (Dryobates pubescens), Eastern Phoebe (*Sayornis phoebe*), Gray Catbird (*Dumetella carolinensis*), House Wren (Troglodytes aedon), Northern Mockingbird (*Mimus polyglottos*), Red-winged Blackbird (*Agelaius* *phoeniceus*), Sandhill Crane (*Antigone canadensis*), and Wilson's Snipe (*Gallinago delicata*), among others. The 43 secondary consumers observed on site is a line of evidence indicating that the ecosystem is providing sufficient food and habitat resources for multiple species with the same primary diet. For instance, insect populations are sufficient to feed not only the insectivorous Savannah Sparrow (*Passerculus sandwichensis*), but the insectivorous Song Sparrow (*Melospiza melodia*) and Swamp Sparrow (*Melospiza georgiana*) as well.

4.2.1.3 Top Predators

A bird's diet characterizes its trophic level, or position in the food web. Tertiary consumers, or top predators, occupy the highest trophic levels, and have primarily carnivorous diets comprising of carrion (animal carcasses), medium and small mammals, fish, and other birds. Birds of prey observed on site include, Barred Owl (*Strix varia*), Bald Eagle (*Haliaeetus leucocephalus*), Northern Harrier (*Circus hudsonius*), Red-shouldered Hawk (*Buteo lineatus*), American Kestrel (*Falco sparverius*), Cooper's Hawk (*Accipiter cooperii*), Peregrine Falcon (*Falco peregrinus*), and Red-tailed Hawk (*Buteo jamaicensis*), as well as scavengers such as the Black Vulture (*Coragyps atratus*) and Turkey Vulture (*Cathartes aura*). The presence of these top predators with carnivorous diets indicates that the food resources on site are sufficient to support the hunting needs of the top trophic levels. The presence and diversity of top predators is therefore evidence of an intact and functioning food web (Inset Figure 4-2).

Figure 4-2: Example of a terrestrial food chain observed on site

In this example, the yellow thistle (*Cirsium horridulum*) is the primary producer and the Eastern carpenter bee (*Xylocopa virginica*) is the primary consumer (left). The Gray Catbird (*Dumetella carolinensis*) (center) is an insectivorous secondary consumer, known to eat bees. The top predator in this food chain is the Red-tailed Hawk (*Buteo jamaicensis*) (right), which is a known predator of Gray Catbirds. Various food chains such as this observed on site indicate the health of the ecosystem. Photos by Mr. Jody Shugart (March 2021; January 2022).

The complete list of the generalized diets of the birds observed on site is included in Table 2. A discussion of the trophic breakdown of the site bird community is provided in context with the reference area in Section 4.2.2.

4.2.2 Reference Area Avian Community

The cropland, moist soil, and unimpounded marsh habitats found in Units A, B, C, and F3 of Lacassine NWR provide similar bird habitat to those present on site and therefore provide an appropriate reference for bird communities expected to occur in the region (USFWS, 2011).

During a reference site investigation on February 24, 2022, Mr. Shugart (ERM) identified 37 birds in the cropland, moist soil, and impounded marsh areas of the refuge (15 species in Unit A and 26 species in Unit B). The USFWS (2011) Lacassine NWR Wildlife Refuge Habitat Management Plan also provides a list of 45 refuge species with moist soil, unimpounded freshwater marsh, and agricultural habitat needs. A complete list of the 76 bird species using the refuge habitats that are similar to the site is included in Appendix E-3.

The trophic breakdown of the site avian community was compared to the avian communities found at similar habitats at Lacassine NWR. Of the 76 bird species associated with croplands, moist soil areas, and unimpounded marsh habitats at the reference area, 33 (42%) were also observed on site (Appendix E-3). Given that bird abundance at these properties is highly dependent on migratory birds (i.e., species richness fluxes throughout the year), and recreational hunting was observed on site during the January 2022 surveys, this is a favorable comparison of species richness.

The trophic structure of the avian population at the site is similar to the trophic structure at the reference area (Inset Figure 4-3). At the site and Lacassine NWR, between 18-26% of birds are tertiary consumers (carnivorous and piscivorous), which is expected for bird populations in southern Louisiana. The birds of prey on site also represent a wider array of carnivorous diet-types compared to the reference area, as the site supports higher trophic level species that consume carrion, mammals, fish, birds, and small animals, while the reference area is limited to birds that eat carrion, fish, and birds. The presence of species with diverse carnivorous and piscivorous diets is a line of evidence demonstrating that the ecosystem is functioning such that lower trophic levels are providing sufficient food resources for the large population (26% of total) of higher trophic level birds that require a high calorie diet.

In addition, at both sites, the majority of species (60-74%) are secondary consumers, with diets consisting of insect, aquatic invertebrate, or mixed (omnivorous) food sources. The proportion of primary consumers, or herbivorous species, is also similar between the site (14%) and the reference area (8%). The greater percentage of herbivorous and insectivorous birds on site is likely a result of the site's unique mosaic of early successional wetland and upland microhabitats that provide a good source of vegetation diet for birds and insects. The overall similarity between the diversity of bird populations on site and the reference area is a line of evidence that the site's ecosystem is functioning as expected for the region, and sufficiently to support a diverse range of avian diets.

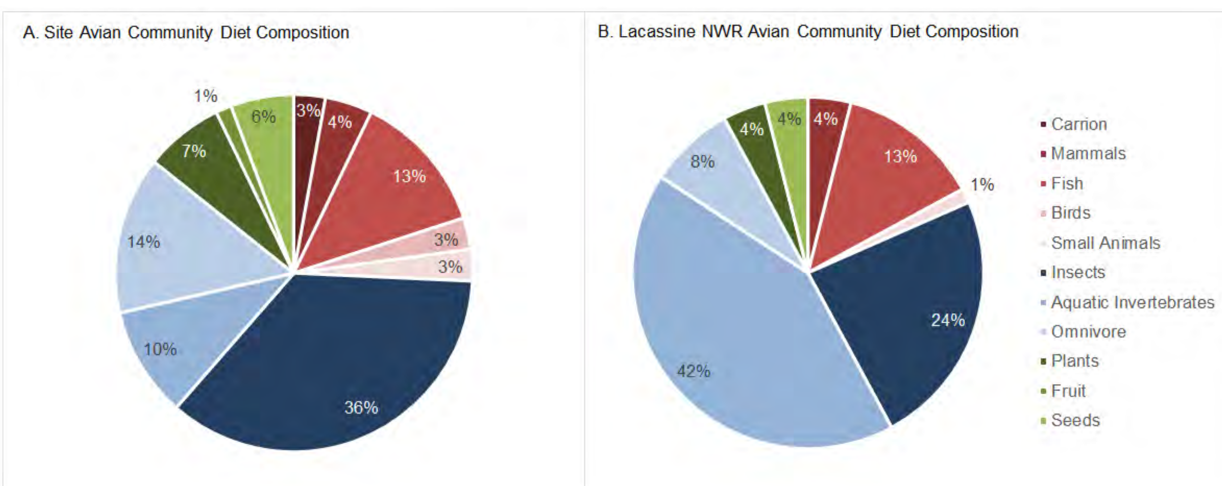


Figure 4-3: Comparison of the avian food web between the site (A) and a nearby protected area, Lacassine National Wildlife Refuge (NWR) Units A, B, and F3 (B)

Site bird species include those identified during multiple site investigations (ERM, CEI, HES, 2021-2022, as described above). Reference area bird species include those observed during the February 2022 reference area survey (Mr. Jody Shugart, ERM) and those species listed as dependent on moist soil, unimpounded marsh, and agricultural habitats in the Lacassine National Wildlife Refuge Habitat Management Plan (USFWS, 2011). Primary consumers, or herbivores, are shown in green. Secondary consumers, including insectivores, aquatic invertebrate consumers, and omnivores are shown in blue. Scavengers and top predators are shown in shades of red and orange.

4.3 Non-Avian Fauna Characterization and Assessment

4.3.1 Site Non-Avian Fauna Community

A total of 62 non-avian taxa were observed by across multiple site investigations (ERM, CEI, HES, 2021-2022, as described above). Herbivorous primary consumers observed on site include pollinating insects (European honey bee [*Apis mellifera*], blue dasher [*Pachydiplax longipennis*], pearl crescent [*Phyciodes tharos*], monarch butterfly [*Danaus plexippus*], and red admiral [*Vanessa atalanta*]), snails (Ramshorn snail [Class Gastropoda] and Apple snail [*Promacea maculata*]), beetles (Order Cleoptera), and ants (Family Formicidae), as well as grazing mammals such as nutria (*Myocastor coypus*), swamp rabbit (*Sylvilagus aquaticus*), and white-tailed deer (*Odocoileus virginianus*). The diverse range of herbivorous species present on site is evidence that the diverse vegetation is providing an abundant diet (plant material, berries, seeds, nectar) for a variety of primary consumers.

In addition, the monarch butterfly is Species of Greatest Conservation Need in Louisiana (LDWF, 2020a), and a candidate for federal listing under the Endangered Species Act. The presence of the monarch on site indicates that the habitats are playing an important role in maintaining the biodiversity of the region and are supporting the continued existence of an at-risk population of pollinators.

Secondary consumers observed on site include aquatic invertebrates (digger crawfish [*Creaserinus fodiens*], devil crawfish [*Lacunicambarus diogenes*], red swamp crawfish [*Procambarus clarkii*], and grass shrimp [*Palaemonetes* sp.]) and terrestrial invertebrates (eastern pondhawk [*Erythemis simplicicollis*], wolf spider [Family Lycosidae], and crickets [Superfamily Grylloidea]), as well as a variety of reptiles and amphibians. Six species of frog were observed on site, including Blanchard's cricket frog (*Acris blanchardi*), green tree frog (*Hyla cinerea*), squirrel tree frog (*Hyla squirrella*), American bullfrog (*Lithobates catesbeianus*), green frog (*Lithobates clamitans*), and leopard frog (*Lithobates sphenocephalus utricularius*), as well as green anole (*Anolis carolinensis*), eastern mud turtle (*Kinosternon subrubrum*), and common five-lined skink (*Plestiodon fasciatus*). The diversity of insectivorous secondary consumers on site is a line of evidence that the insect populations are sufficiently abundant (and supported by the diverse vegetation) to provide sustenance for a variety of wildlife with similar diets.

In addition to the birds of prey described in Section 4.2, tertiary consumers on site include a variety of snakes (cottonmouth [*Agkistrodon piscivorus*], western rat snake [*Pantherophis obsoletus*], and western ribbon snake [*Thamnophis proximus*]), two omnivorous mammals (Virginia opossum [*Didelphis virginiana*] and feral hog (*Sus scrofa*)], and two apex predators (American alligator [*Alligator mississippiensis*] and coyote [*Canis latrans*]). The presence of terrestrial and aquatic top predators on site indicates that both the terrestrial and aquatic food webs are intact and functioning to provide sufficient food resources for those species that require a high calorie diet.

All trophic levels of the terrestrial and aquatic food webs (primary to apex) were directly observed on site, which is a line of evidence supporting good ecosystem health (USEPA, 1997). A complete list of non-avian fauna observed on site is provided in Table 3.

4.3.2 Reference Area Non-Avian Fauna Community

The Lacassine National Wildlife Refuge Comprehensive Conservation Plan provides a list of species that have been observed on the NWR (USFWS, 2007). Of these species listed for the NWR, seven mammals (Virginia opossum, nine-banded armadillo, coyote, raccoon, white-tailed deer, nutria, and swamp rabbit), and ten reptiles and amphibians (America alligator, green anole, five-lined skink, eastern mud turtle, western ribbon snake, rat snake, cottonmouth, green treefrog, American bullfrog, and squirrel tree frog) have also been observed on site (ERM, CEI, HES, 2021-2022). These mammals, reptiles, and amphibians observed on site represent the feeding groups (herbivores, omnivores, and carnivores) and several important keystone species, such as the coyote and alligator, that are also present at the NWR. This is a line of evidence that the site is functioning as expected for the region, by providing habitat for important wildlife also found in the nearby protected NWR.

The habitats on site and between the site and the reference area are recognized by the U.S. EPA as known ecological hubs and corridors under the National Ecological Framework (NEF) (USEPA, 2022a; Appendix E-4). The NEF is a Geographic Information Systems based model that identifies ecological hubs, corridors, and auxiliary connections to demonstrate the connectivity of natural landscapes throughout the contiguous United States (USEPA, 2022b). Given the close proximity of the site to the refuge (approximately 3 miles), and the presence of an NEF corridor and auxiliary connections between the two locations, it is possible that the species on site with larger daily home ranges (alligators, coyotes, birds) travel to and from the refuge for foraging, resting, and denning during their lifetimes. The habitats and natural communities on site therefore enhance the ecological connectivity of the region, thus adding increased habitat area, increased opportunity for colonization, greater habitat accessibility, and increased niche diversity (NRCS, 1999). The function of the site as a wildlife corridor is an important reason to preserve the diversity present and not to disrupt the habitat with unnecessary remediation.

Photo documentation of vegetation, birds, and other wildlife observed on site and in the reference area is provided in Appendix B.

4.4 Habitats in Areas Proposed for Remediation by ICON

Mr. Greg Miller and Mr. Wayne Prejean authored a report dated September 30, 2021, titled *Expert Report and Restoration Plan for the Landowners Henning Management, LLC v Chevron USA, Inc et al; Docket No. 73318; 31st JDC; Division "C", Jefferson Davis Parish LA, Hayes Oil Field, Calcasieu and Jefferson Davis Parish, LA.*

Per the Miller/Prejean report, ICON is proposing to remove approximately 16.4 acres of forest, grassland, scrub-shrub habitat, croplands, and soils to a depth of up to 16 feet. These excavation activities proposed by ICON are ecologically unnecessary and unreasonable for a site that is thriving and supporting more than 130 different species of wildlife and producing an exceptional number (193) of unique vegetative species.

ICON's planned excavation and removal of the treed areas on site is unnecessarily destructive of functioning forested and scrub-shrub ecosystems. These areas with trees and shrubs, planned for removal by ICON, provide important refuge for documented site wildlife such as deer and coyote. The site, which is part of the Western Gulf Coastal Plain Ecoregion, has soils that are very well suited for agriculture. Due to the expansion of agriculture across this region, the forests that remain are fragmented and reduced in size. The areas of the site that remain forested support important natural communities with intact food webs. ICON's planned excavation unnecessarily destroys these functioning forested and scrub-shrub ecosystems, and would remove native trees and shrubs, such as red maple, common persimmon, live oak, American black elderberry, and dogwood. These trees are home to birds such as the Red-bellied Woodpecker, Mourning Dove, and American Goldfinch that would lose their homes and habitat due to ICON's planned removal of trees.

The ICON proposed excavation and removal of grasslands and scrub-shrub habitat, to a depth of up to 16 feet, would destroy unique and valuable early successional ecosystems. These early successional habitats on site are exceptionally diverse, with 108 different forb/herbs, including wildflowers such as buttercup, clovers, goldenrod, and sowthistle, and 40 different grasses, such as annual bluegrass, bushy bluestem, rushes, and sedges. To explain how exceptional this level of diversity is, a comparison can be made to the diversity of the original Louisiana prairie grasslands ecosystems, which are now almost completely gone, due to the prevalence of agriculture. Prairie grasslands in Louisiana, historically, had up to 186 different grass and herbaceous plant species (MacRoberts et al., 2003). The presence at the site of 148 grasses, forbs, and herbs, as compared to historical diversity of 186 species in prairie grasslands, is exceptionally diverse, and represents that the site is serving as an active location of plant genetic diversity preservation. In addition to grassland species on site, there 35 tree species on site, making the total vegetation count an impressive and unusually diverse number of species (193 total species).

The vegetation on site is dense and provides important refuge for mammals with fidelity to grasslands, such as rabbits and rodents, and for birds that are Species of Greatest Conservation Need (10 species, LDWF, 2020a; Table 2). The Eastern Meadowlark, which is one of the special status birds, has fidelity to grasslands and has been documented in four areas on site (Area 1, Area 4, Area 5, and Area 6) (Hull et al., 2019). Site early successional habitats that are currently providing habitat for at-risk bird populations and grassland mammals would be destroyed by the unnecessary and wasteful removal of soils, as planned by ICON.

The excavation of grasses and soils, as proposed by ICON, is environmentally destructive. The silt and loam soils in the region and at the site are uniquely suited to growing grasses and rice, as the entire plains area was formerly grasslands before it was converted to cropland. The grassland in the ICON proposed excavation areas has soils that are uniquely suited to growing grasses and rice. The ICON proposal of excavating the loam and silt soils and replacing them with other soils of different structures will make the site area less productive and will at the same time destroy the soil structure of areas that ICON uses for soil procurement.

ERM has proposed no active remediation of soil or groundwater, and instead has proposed additional work to remove oilfield debris and further delineation of the shallow groundwater. These potential actions, although not required for ecological reasons, are for 29-B and RECAP human health compliance (see Section 10 of the ERM Expert Report). The ERM plan, if performed carefully and with regard for the ecology, should be minimally invasive, of short time duration, and should not cause undue damage to the functioning of the forested, scrub-shrub, and grassland ecosystems on site.

4.5 Ecological Observation Summary

The lines of evidence presented in this ERA show that the natural communities and food webs on site are functioning as expected for the region, including the areas proposed for remediation by ICON. Vegetation observed at the site is expected for the region based on the characterization of natural communities and comparison to similar habitats in a nearby protected area, Lacassine NWR (LDWF, 2010a; LDWF, 2010b). The avian community trophic structure is also as expected for the region, with the expected percentages of insectivores, omnivores, herbivores, and top predators. Numerous birds of prey and apex predators that depend on a sufficient diet of mammals, fish, and birds were observed on site, indicating that the top of the food chain is supported by the lower levels of the food chain. No indicators of effects from salt, metals, hydrocarbons, or other evidence of toxicity were observed in the vegetation in the area planned by ICON for remediation. Based on these findings and all lines of field evidence, the aquatic and terrestrial ecosystems on site are functioning as diverse and productive habitat and there is no evidence that remediation is required for ecological reasons.

Based on analysis of field observations and data, ecological populations on the site do not show evidence of adverse impact by oil and gas E&P activities. The site is exceptionally biologically diverse and functioning as expected for the region.

5. SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT (SLERA)

5.1 ERA Step 1

This ERA includes a SLERA and a BERA. The SLERA includes Steps 1 and 2 from USEPA (1997) guidance: 1) screening-level problem formulation and ecological effects evaluation, and 2) preliminary exposure estimates and risk calculations. The site-specific BERA includes Steps 3-8 from USEPA (1997) guidance. The SLERA (Section 3) and BERA (Section 4) processes, which are the USEPA eight step process for ERA, are described in the following sections and shown on Figure 6.

5.1.1 Screening Level Formulation

The screening-level portions of an ERA (Step 1 and Step 2) are problem formulation and ecological effects evaluation. At the end of Step 2, the decision is made whether: 1) risks are negligible or 2) to proceed to a site-specific BERA.

This SLERA focuses on potential chemical stressors in soils on the site. Soil concentrations are also evaluated in the ERA as sediments to address potential transient inundation events. Soil data are presented in Table 4 and sample locations are presented on Figures 7 through 12. It is appropriate to focus on soils as the primary pathway of concern for site wildlife (USEPA, 1997). There is no current exposure pathway at the site for contact with groundwater for wildlife or other animals. Groundwater is not in communication with surface water at the site (Section 3.5.2 of ERM (Angle/Levert/Purdom) Expert Report, 2022). Surface water ingestion is a minor pathway in mammals and birds as compared to soil, and is not included in the quantitative risk assessment. Surface water concentrations for samples collected at 2' and 13' in the pond in sampling area 2 are less than LDEQ numeric criteria for chronic aquatic life (assuming hardness between 100 – 400 mg/L $CaCO_3$) and LDEQ numeric criteria for the applicable subsegment (#050601).

Considered in the problem formulation portion of the screening assessment are information on the environmental setting, known contaminants, fate and transport mechanisms on site, ecotoxicity of potential contaminants, likely categories of receptors, complete exposure pathways, and identification of endpoints. Information gathered for Step 1 of the SLERA is discussed in the following Sections 4.1.1.1 through 4.1.2.

5.1.1.1 Environmental Setting

Chevron former operational areas (sampling areas 1, 2, 4, 5, 6, and 8) are located within natural and agricultural environments (Figure 2). Area 8 is currently used for agriculture (rice farming), while areas 2, 4, and 5 appear to have historical agricultural activities (potentially rice and sugarcane farming). Former E&P operational areas in area 6 appear to be surrounded by a levee, separating them from the adjacent drainage ditch.

The property is intersected by drainage ditches throughout, including sampling areas, and Bayou Lacassine in the eastern portion (Figure 2). There is a pond within sampling area 2 created by a well blowout in 1941. The drainage ditches are shallow (generally a few feet deep), while the pond in sampling area 2 is approximately 15 feet deep. Bayou Lacassine is approximately 10 feet deep. Shallow groundwater at the site is not connected to these surface water features.

The site lies within LDEQ Drainage Basin Subsegment #050601 Lacassine Bayou - From headwaters to Grand Lake. This subsegment supports primary and secondary contact recreation, fish and wildlife propagation, and agriculture.

The site is situated within the FEMA 100-year flood hazard area. Soils underlying the site and in the region comprise of Allemands muck, Arat Mucky silt, Midland silty clay loam, Edgerly loam, Crowley-Vidrine complex, and Mowata-Vidrine complex.

Current land uses of the site are industrial (former E&P), agricultural, and recreational hunting. Surrounding the site within the property and beyond, land use includes agriculture and E&P activities. There was historical residential use in a small portion of the Henning property, not in the areas of Chevron former operations. Land uses in the surrounding area are similar, including E&P activity, agriculture, and rural residential.

For additional details regarding the environmental setting and land uses discussed above, refer to the ERM Expert Report (2022; Angle/Levert/Purdom).

Plaintiffs have alleged that historical E&P activities have left soil and groundwater contamination on the site that are a health risk or a potential health risk to ecological species. The claim made by the plaintiffs is that constituents have been left on the site in concentrations that could affect ecological populations. This portion of the ERA is a quantitative hazard quotient (HQ) evaluation of the chemical concentrations in soils to determine if risk to the wildlife population is expected.

5.1.1.2 Contaminant Fate and Transport

The primary transport mechanisms possible on site are surface runoff and erosion (soil). The effects of these mechanical actions are assessed in this ERA through chemical analyses of soils and surveys of vegetation and wildlife populations.

5.1.1.3 Ecotoxicity of COPECs

Ecotoxicity of COPECs on the site has been investigated beginning with collecting soil samples (Table 4). The COPECs screened in this level of assessment are arsenic, barium, cadmium, chromium, lead, selenium, silver, strontium, mercury, zinc, and TPH. The potential for these COPECs to cause adverse effects to survival, growth, or reproduction in ecological receptors only exists if the COPECs are: 1) present and bioavailable in toxic concentrations, 2) a complete exposure pathway exists, and 3) exposure occurs.

For the screening portion of this ERA, soils were compared to conservative (protective) USEPA Eco-SSL soil values (USEPA, 2005a, 2005b, 2005c, 2005d, 2005e, 2006, 2007b, 2007c, 2008), NOAA Screening Quick Reference Tables (SQuiRT) Freshwater Threshold Effects Concentration (TEC) and Probable Effects Concentration (PEC) sediment screening values (Buchman, 2008) and a calculated barium soil screening value. These screening values are protective of mammals, birds, invertebrates, and plants. Although sediments have not been observed on site, sediment screening values have been included in the assessment to account for the possibility that sediments could be present in the future. It should be noted that screening values are used to ensure that risk is not overlooked and that all potential constituents that may contribute to risk are evaluated.

5.1.1.4 Potential Receptors and Routes of Exposure

The receptors selected to represent communities or populations on the site are ones that represent the species that are present or could potentially be present in the habitat of interest. The representative receptors and routes of exposure used to estimate risk are ones for which there is sufficient ecotoxicity information available. Exposure is assessed via ingestion of COPECs through exposure to soil/sediment and diet. This exposure pathway (soil/sediment) and exposure route (ingestion) is supported as appropriate for ERA per USEPA guidance (1997). The receptors used in this risk assessment are described in the following sections.

5.1.1.5 Wildlife (Vertebrates)

Wildlife includes four classes of vertebrates in their natural habitats: amphibians, reptiles, birds and mammals. Because these vertebrates are not domesticated, they are included in the general category of wildlife.

Vertebrate wildlife are consumers that can be assessed through estimates of COPEC doses in their diets. Wildlife are exposed to COPECs via ingestion of other organisms, soil/sediment, or water. Other pathways of wildlife COPEC exposure include dermal and inhalation. Generally, wildlife is protected by their fur or feathers from excessive dermal exposure to COPECs, therefore the dermal pathway is not included in the risk assessment. The inhalation pathway is also not included in the risk assessment, as no volatile compounds were analyzed in soils 0-3' bgs, and volatile compounds are unlikely to be present due to weathering, and if present, are expected to rapidly dissipate in ambient conditions. Therefore, this risk assessment is focused on the ingestion pathway, per USEPA guidance (1997).

Specific wildlife species, based on their feeding behaviors have been selected to be evaluated as representatives of larger wildlife communities. Mammals and birds are used as the representative wildlife species, because more toxicity data is available for these vertebrates, as compared to reptiles, fish, and amphibians.

This BERA is focused on birds and mammals associated with a terrestrial (soil-based) food web.

5.1.1.6 Invertebrates

The invertebrate population exists in and on soils and sediments. Invertebrate populations include organisms such as worms, crustaceans, gastropods, arthropods, and mollusks. These organisms function in the ecosystem to digest and degrade other biologic matter and to provide a diet for larger invertebrates and vertebrates. Because they are in direct contact with soils and sediments due to their lifestyles, they are dietary sources of COPECs to higher vertebrates. The BERA is focused on invertebrates associated with soils.

5.1.1.7 Nektonic Aquatic Species

Nektonic aquatic species are larger swimming vertebrates such as fish, alligators, and snakes. These categories of nektonic species are assessed qualitatively in the ERA by direct and indirect field observations. For example, direct observations include observations of the American alligator (*Alligator mississippiensis*), cottonmouth (*Agkistrodon piscivorus*), and least killifish (*Heterandria formosa*) at the site. Examples of indirect observations of nektonic aquatic species include observations of predators, such as fish-eating birds on the site indicate that surface water features on the site provides fish as diet. Examples of fish-eating birds seen on the site include the Great Egret (*Ardea alba*), Little Blue Heron (*Egretta caerulea*), and Belted Kingfisher (*Magaceryle alcyon*). Similarly, the presence of birds on the site that eat aquatic invertebrates indicates that the surface water is of sufficient quality to provide diet to these birds. Examples of invertebrate-eating birds seen on the site include White Ibis (*Eudocimus albus*), Greater Yellowlegs (*Tringa melanoleuca*), King Rail (*Rallus elegans*), and Wilson's Snipe (*Gallinago delicate*).

Site soil constituents did not exceed sediment ecological screening values. Therefore, site soil concentrations are considered protective of nektonic species and their wildlife predators, and further evaluation is not necessary.

5.1.1.8 Plants

Plant communities hosting a variety graminoids (grasses), forbs, herbs, vines, shrubs, and trees are present in great diversity on the site. The plants are primary producers and form the base of the food chain by converting the sun's energy to the carbohydrate energy that other invertebrates and vertebrates use. In this risk assessment, the plant population has been assessed through a vegetation survey at locations of maximum constituent concentrations in site soils and adjacent areas throughout the site (Section 4.1).

5.1.1.9 Exposure Pathways and Conceptual Site Model

A Conceptual Site Model (CSM) has been developed to evaluate potential ecological exposure pathways at the site (Figure 13). A CSM (USEPA, 1997) addresses: (1) the environmental setting and COPECs at the site; (2) COPEC fate and transport mechanisms; (3) mechanisms of ecotoxicity and likely categories of ecological receptors; (4) complete exposure pathways; and (5) selection of endpoints to screen for ecological risk.

The potentially complete exposure pathways at the site are through shallow surface soil. The biologically active zone of soils at the site are from ground surface to three feet deep (LDEQ, 2003). To be inclusive of 0-3' data, soil samples collected in the 0-2' and 2-4' depth intervals were included in the evaluation. The depth of 0-3' includes the effective root zone of trees on the site of up to 10 inches (Holloway and Ritchie, 2022) and the recommended sampling depth biologically active zone for terrestrial species of 25-30 cm (USEPA, 2015).

5.1.2 Effects Evaluation

Following the screening level problem formulation is a preliminary evaluation of ecological effects. Ecological effects are estimated using thresholds values for soil and sediment that are referred to as ESVs. ESVs are COPEC concentrations that are estimated to pose no risk of adverse effects to exposed wildlife. The screening level values are not used as predictors of the occurrence of ecotoxicity, but rather to protectively include all potential COPECs in the risk assessment.

The ESVs used in the SLERA are based on peer reviewed publications of field studies or laboratory studies in which no adverse effects were observed. The ESV is therefore based on the highest observed exposure concentration that does not produce adverse effects. This "no observed adverse effect level" is referred to as the NOAEL. ESVs can also be based on a LOAEL, which is the lowest observed adverse effect level shown to produce adverse effects (reduced growth, impaired reproduction, increased mortality) in a receptor species. Therefore, the ESV is a dose or a concentration at or below which risk is not expected to occur.

The fact that an ESV is exceeded does not indicate the need for remediation or that there is ecological risk. ESVs are not site-specific and are intended to be overly protective. When ESVs are exceeded, a more specific ecological risk analysis can be performed. A concentration that exceeds a soil screening level (SSL) does not identify that there is risk or that there are soil concentrations that require remediation. Screening is the process of identifying and defining areas, contaminants, and conditions that do not require further attention. When COPEC concentrations fall below screening values, no further action is needed. When COPEC concentrations exceed ESVs, further evaluation is valuable, but the need for remediation is not assumed.

For the initial screening assessment in this ERA, conservative (protective) screening thresholds for soils such as USEPA SSLs (USEPA, 2005a, 2005b, 2005c, 2005d, 2005e, 2006, 2007b, 2007c, 2008; USEPA Eco-SSLs) for COPECs present in soil are used. The USEPA Eco-SSL for barium is based on bioavailable forms of barium, and not a low bioavailability form such as barium sulfate, which is the form of barium typically present at legacy oil and gas E&P sites and confirmed to be the form present at this site (see Section 5.2.3.1). A more appropriate barium soil screening value was calculated for the site using barium sulfate data (see Section 5.1.2.1 below). Additionally, NOAA freshwater sediment TECs and PECs (Buchman, 2008) were used to screen COPECs in soil due to the presence of hydrophytic vegetation and episodic standing water at the Site. The limitations of the use of screening values has been discussed by the National Research Council (2003). The screening values used for this ERA are based on ecotoxicity studies of plants, birds, invertebrates, and mammals (Inset Table 5-1).

Table 5-1: Ecological Screening Values

Constituent	Eco-SSL Avian USEPA	Eco-SSL Mammal USEPA	Eco-SSL Invertebrate USEPA	Eco-SSL Plant USEPA	Calculated Soil Screening Value	TEC NOAA	PEC NOAA
Arsenic	43	46	N/S	18	N/S	9.79	33
Barium	N/S	2000	330	N/S	2424	N/S	N/S
Cadmium	0.77	0.36	140	32	N/S	0.99	4.98
Chromium	26	34	N/S	N/S	N/S	43.4	111
Lead	11	56	1700	120	N/S	35.8	128
Mercury	N/S	N/S	N/S	N/S	N/S	0.18	1.06
Selenium	1.2	0.63	4.1	0.52	N/S	N/S	N/S
Silver	4.2	14	N/S	560	N/S	N/S	N/S
Strontium	N/S	N/S	N/S	N/S	N/S	N/S	N/S
Zinc	46	79	120	160	N/S	121	459

Notes:
Concentrations are in mg/kg-dry.
The Soil ESV is the lowest of the Eco-SSLs. For barium, the Soil ESV is the calculated soil screening value.
The Sediment ESVs are freshwater sediment TEC and PEC.

5.1.3 Calculated Barium Soil Screening Value

The form (compound) of barium in site soils is barium sulfate. X-ray diffraction analyses (XRD) demonstrate that barium sulfate is the only form of barium in site soils (Appendix J, ERM Expert Report, 2022). Barium sulfate is of very low toxicity in aquatic and terrestrial soils and sediments.

I have calculated a barium sulfate soil screening value for delineating AOIs at this site, because screening values for barium sulfate are not available from USEPA, LDEQ, and LDNR. The screening value calculated for the site is based on toxicity to invertebrates and plants, which are the ecological receptors that are primarily in direct contact with soils. There is sufficient information in the scientific literature to calculate an invertebrate and plant screening value based on barium sulfate and direct contact with soil, whereas the information in the scientific literature for mammals and birds and this pathway of exposure is limited. Barium sulfate risk to mammals and birds is calculated based on ingestion (including soil ingestion) as the primary route of exposure (USEPA, 1997). Barium soil screening value data and calculations are shown in Appendix F.

5.1.3.1 Literature Review

To calculate the screening value, I performed a literature review and identified seven scientific studies that report invertebrate and/or plant effects associated with barium sulfate in soil. These scientific studies are specific to barium sulfate, rather than other more soluble forms of barium that have different toxicities. The studies identified are shown in Appendix F (Lamb et al., 2103; ESG, 2003; Simini et al., 2002; Kuperman et al., 2007; Kuperman et al., 2002; Honarvar, 1975; and Miller et al., 1980).

In the seven barium sulfate studies (literature review), there are 19 no observed effects concentrations (NOEC) and 7 lowest observed effects concentrations (LOEC) reported that I used to develop the soil screening value. A NOEC is defined as the highest tested concentration in a laboratory or field toxicity test at which no statistically or biologically significant adverse effects are observed. A LOEC is the lowest value at which an adverse effect is observed. NOECs and LOECs for the health effects of reproduction, growth, and survival in plants and invertebrates were included in developing the screening value (USEPA, 1997). The seven studies also report effects concentrations (NOECs and LOECs) that were not used in developing the screening value, however the 19 NOECs and 7 LOECs are the highest or the lowest, respectively, for each health effect studied, making these NOECs and LOECs the most conservative choices for developing the screening value. Both NOECs and LOECs are reported in ecological risk assessment (USEPA, 1997). The use of a NOEC as a screening value, at the screening level of ecological risk assessment (AOI delineation) is appropriate.

5.1.3.2 Barium Analytical Methods

The studies we evaluated to develop the barium site soil screening value include three types of barium concentrations: 1) "nominal" barium sulfate concentrations, which are the result of intentionally mixing known amounts of barium sulfate and soil in the lab, in order to achieve a specific soil concentration for toxicity testing, 2) "total barium" concentrations, which result from analyzing the amount of barium that can be extracted from a sample using concentrated and heated acid, or from analyzing a sample using a mineralogic analysis, such as XRF, and 3) "barium" concentrations that are the result of acid extraction and analysis similar to the USEPA method 3050/6010 used in LDEQ investigations. Generally, "nominal" or "total barium" are larger concentrations than "barium" concentrations, however, the differences in reported concentrations from these methods are related to the analytical method, rather than the amount of barium in the sample. For the calculation of this soil screening value, "barium" concentrations are used. "Barium" concentration data (as defined here) are the type of data previously used by ERM to develop a sediment barium screening value (ERM, 2019) and are the type of data used by LDEQ (RECAP, 2003). There are sufficient "barium" NOECs and LOECs to calculate a soil barium screening value. All NOEC and LOEC data in the literature review, including all data from "total barium" and "nominal" studies, support that barium sulfate in soil is of very low toxicity to soil invertebrates and to plants.

5.1.3.3 "Nominal" Data: Barium Sulfate Toxicity

To understand the very low toxicity of barium sulfate to soil invertebrates and plants, all NOECs and LOECs ("nominal", "total barium", and "barium") from the literature search were evaluated. In the three studies that report "nominal" barium sulfate concentrations (ESG, 2003; Honavar, 1975; Miller et al., 1980), barium sulfate is shown to be of extremely low toxicity to soil invertebrates, such as insects and earthworms, and the reported no effect to survival (NOEC) value is 1,000,000 mg/kg dw barium sulfate (no effect due to exposure to 100% barium sulfate). For plants, such as clovers, grasses, green beans, and corn, the no effects to growth and survival (NOEC) value is an average of 297,777 mg/kg dw barium sulfate. This represents no effect to plants at higher concentrations than are encountered at the site, or at legacy sites, generally. In summary, invertebrates and plants exposed to large amounts of nominally measured barium sulfate in soil, in a laboratory setting, are not predicted to have adverse effects to growth and survival. "Nominally" measured barium sulfate toxicity data are shown in Tables F-3 and F-4, Appendix F.

5.1.3.4 "Total Barium" Data: Barium Sulfate Toxicity

NOECs and LOECs based on "total barium" concentrations from the literature review demonstrate no effects to growth, reproduction, and survival (invertebrates) in "total barium" concentrations up to 29,200 mg/kg dw barium in soil. The "total barium" no effects average is 10,900 mg/kg dw barium in soil for worms and insects, however this is likely a low estimate for no effects. That is, higher concentrations likely would also cause no effects. For most of these studies, the highest concentrations tested in each experiment (e.g., 10,000 – 29,200 mg/kg dw) did not cause adverse effects. The actual no effects value may be higher, if higher concentrations had been tested.

In some instances, there are "total barium" LOEC values that are lower than NOEC values (Simini et al., 2002; Kuperman et al., 2007). This is due to there being multiple types of tests performed and species used, which results in some variation, but this is not a source of concern. The authors of these specific studies (Simini et al., 2002; Kuperman et al., 2007) reported in their paper that they found barium sulfate to be so non-toxic, including in the LOECs mentioned here, that they elected to shift their study to soluble forms of barium, rather than barium sulfate, and calculated a USEPA toxicity value for soluble barium (which is not the form of barium at the site). In summary, barium sulfate, measured as "total barium" is of very low toxicity, and is supportive of the ultimate barium soil screening value calculated using "barium" NOECs and LOECs. "Total barium" toxicity data are shown in Tables F-5 and F-6, Appendix F.

5.1.3.5 "Barium" Data: Barium Sulfate Toxicity

The barium soil screening value developed for the site was calculated using "barium" NOEC data for invertebrates (earthworms) and plants (ryegrass). These "barium" data used are the result of the same type of analytical methods that we have used previously to develop a barium sediment screening value (2197 mg/kg dw barium in sediment, ERM, 2019). That is, the sediment barium screening value of 2,197 mg/kg dw and the calculated soil screening value (2,424 mg/kg dw) developed for this site are both based on barium data that are the result of similar barium extraction and analysis laboratory methodology.

As explained, barium analytical results vary widely, depending on the extraction method and analytical equipment used, therefore, it is important that the analytical methods used to develop a screening value are similar to the analytical methods used to analyze barium in site soils. For this reason, the "barium" NOECs are used to calculate the site soil screening value, because the "barium" NOEC studies use similar acid digestion and inductively coupled plasma (ICP) analysis (Lamb et al., 2013; ESG, 2003), as used by ERM (3050/6010) to analyze site data, in accordance with RECAP requirements. Therefore, the "barium" NOECs are the most appropriate data for calculating a barium soil screening value.

5.1.3.6 Barium Soil Screening Value: Calculation

There are 3 "barium" invertebrate NOECs and one "barium" plant NOEC identified in the literature review of barium sulfate toxicity in soil. The four NOEC values are similar, which lends confidence to the results: 2033, 3377, 2080, 1910 (all mg/kg dw barium in soil). The three invertebrate NOECs of 2033, 3377, 2080 (mg/kg dw) are for no adverse effects to earthworm growth and survival (Lamb et al., 2013; ESG, 2003), and the plant NOEC of 1,910 mg/kg dw is for no adverse effect to ryegrass growth (ESG, 2003). There is a plant LOEC from Lamb et al. (2013) that is a lower value than the plant NOEC, but it is not included, as this plant study uniformly produced effects at all concentrations, other than the control, indicating interference from other factors. The authors (Lamb et al., 2013) identified that their results are not in agreement with other barium plant studies.

To calculate the barium soil screening value for the site, the three invertebrate NOECs (2033 mg/kg dw, 3377 mg/kg dw, 2080 mg/kg dw) were used to calculate an average (2,493 mg/kg dw), a geometric mean (2,424 mg/kg dw) and a median (2,080 mg/kg dw). These three values were compared to the plant NOEC of 1,910 mg/kg dw, and the invertebrate values were selected for use, based on being similar to the plant value, and based on having more data to support them. The geometric mean value of 2,424 mg/kg dw was selected as the soil screening value, as this represents the most commonly used measure of central tendency for toxicity values (USEPA, 2005a). See Inset Table 5-2 below for calculations.

The value of 2,424 mg/kg dw barium in soil has been used in this ecological risk assessment to delineate preliminary AOIs. Values above 2,424 mg/kg dw do not represent toxicity, but are further evaluated in the ERA.

Data for the barium screening value of 2,424 mg/kg dw are shown on Tables F-1 and F-2 in Appendix F.

Table 5-2: Development of Barium Soil Screening Value

Barium Sulfate Invertebrate NOEC	Reference		Barium Sulfate Plant NOEC	Reference
2,033	Lamb et al., 2013		1,910	ESG International, 2003
3,377	Lamb et al., 2013			
2,080	ESG International, 2003			
2,424	**Geometric Mean Invertebrate NOEC**			
2,493	Average Invertebrate NOEC			
2,080	Median Invertebrate NOEC			

5.2 ERA Step 2

5.2.1 Screening Level Exposure Estimates

The exposure assumptions used in the SLERA are intentionally overprotective. In the SLERA, receptors are assumed to be exposed to the maximum COPEC concentrations detected in soil samples and that the home range of ecological receptors is 100% on the site, rather than elsewhere. All COPECs are assumed to be 100% bioavailable to receptors. The receptor diets are assumed to be 100% comprised of the most contaminated food source. By making these overly protective assumptions, the exposure estimates are skewed towards over-predicting risk in the SLERA. The SLERA evaluation identifies COPECs that require no further investigation and identifies COPECs that should be carried forward into the BERA.

Soil concentrations are reported to depths 78 feet below ground surface (bgs). Per LDEQ RECAP (2003), soil results (0-3 feet bgs) are included in the ERA. For this ERA, maximum soil COPEC concentrations from the 0-4 feet bgs for each area (1, 2, 4, 5, 6, and 8) have been used (Inset Table 5-3), in order to be inclusive of the 0-3' depth. Areas 3, 7, and 9 do not include former Chevron operations and are not assessed in this report. Soil concentrations for all areas (1 through 9) are summarized on Table 4 and are shown on Figures 14 through 31 for reference. See Section 5.1.1.9 for discussion of sampling depth.

Detected soil metal concentrations on site are generally within the range of typical soil concentrations in Louisiana in unimpacted soils (USGS, Smith et al., 2013; Appendix G and Table 4) or are of low solubility and low bioavailability.

Maximum soil concentrations were compared to soil ESVs and background (Inset Table 5-4). The following constituents exceeded soil comparison values:

- Area 2: barium;
- Area 4: barium, lead, and mercury. Maximum lead concentration of 54.5 mg/kg-dry at H-16 (0-2) was not confirmed by the split sample result of 11.2 mg/kg-dry. Maximum mercury concentration of 0.157 mg/kg-dry at H-16 (0-2) is marginally greater than the background comparison value of 0.11 mg/kg-dry. Both lead and mercury are within the range of Louisiana background concentrations (Smith et al., 2013; USGS);

- Area 5: barium;
- Area 6: barium, lead, and mercury. Split sample results of lead and mercury at locations of maximum concentrations did not confirm the concentrations, lead at H-28 (0-2) of 14.5 mg/kg-dry (ERM) and 54.2 mg/kg-dry (ICON), and mercury at H-24 (0-2) of 0.32 mg/kg-dry (ERM) and <0.101 mg/kg-dry (ICON). Both lead and mercury are within the range of Louisiana background concentrations (Smith et al., 2013; USGS); and
- Area 8: barium.

Maximum soil concentrations were also compared to sediment TECs and PECs (Inset Table 5-5). Site soil concentrations were below both TEC and PEC, indicating that site soil concentrations are protective of aquatic life and their wildlife predators.

Table 5-3: Maximum Reported Concentrations

Constituent	Maximum Reported Concentration (mg/kg-dry)	Location (Depth feet bgs)	Sample Date
Area 1			
Arsenic	3.58	H-25 (0-2)	4/7/2021
Barium	389	H-26 (0-2)	4/8/2021
Cadmium	ND	-	-
Chromium	9.63	H-26 (0-2)	4/8/2021
Lead	12.6	H-25 (0-2)	4/7/2021
Mercury	ND	-	-
Selenium	ND	-	-
Silver	ND	-	-
Strontium	21.9	H-26 (0-2)	4/8/2021
Zinc	13.3	H-26 (0-2)	4/8/2021
Area 2			
Arsenic	5.89	H-11 (0-2)	11/12/2019
Barium	2740	H-11 (0-2)	11/12/2019
Cadmium	ND	-	-
Chromium	10.1	H-12 (0-2)	11/13/2019
Lead	32.4	H-11 (0-2)	11/12/2019
Mercury	ND	-	-
Selenium	ND	-	-
Silver	ND	-	-
Strontium	110	H-11 (0-2)	11/12/2019
Zinc	121	H-11 (0-2)	11/12/2019
Area 4			
Arsenic	9.46	H-8 (0-2)	11/5/2019
Barium	7000	H-8 (0-2)	11/5/2019
Cadmium	ND	-	-
Chromium	19.7	H-16 (0-2)	11/20/2019
Lead	54.5	H-16 (0-2)	11/20/2019

Constituent	Maximum Reported Concentration (mg/kg-dry)	Location (Depth feet bgs)	Sample Date
Mercury	0.157	H-16 (0-2)	11/20/2019
Selenium	ND	-	-
Silver	ND	-	-
Strontium	148	H-16 (0-2)	11/20/2019
Zinc	98.6	H-16 (0-2)	11/20/2019
Area 5			
Arsenic	7.33	H-18 (0-4)	11/21/2019
Barium	6390	H-18 (0-4)	11/21/2019
Cadmium	ND	-	-
Chromium	24.8	H-18 (0-4)	11/21/2019
Lead	34	H-19 (0-2)	11/22/2019
Mercury	ND	-	-
Selenium	ND	-	-
Silver	ND	-	-
Strontium	124	H-18 (0-4)	11/21/2019
Zinc	30.2	H-18 (0-4)	11/21/2019
Area 6			
Arsenic	3.81	H-28 (0-2)	4/12/2021
Barium	7410	H-24NE (0-2)	1/11/2022
Cadmium	0.538	H-28 (0-2)	4/12/2021
Chromium	63.4	H-28 (0-2)	4/12/2021
Lead	54.2	H-28 (0-2)	4/12/2021
Mercury	0.32	H-24 (0-2)	4/6/2021
Selenium	ND	-	-
Silver	ND	-	-
Strontium	278	H-28 (0-2)	4/12/2021
Zinc	67.4	H-28 (0-2)	4/12/2021
Area 8			
Arsenic	7.65	H-4 (0-2)	11/4/2019
Barium	7290	H-4E2 (0-2)	1/10/2022
Cadmium	ND	-	-
Chromium	12	H-3 (0-2)	10/31/2019
Lead	14.6	H-3 (0-2)	10/31/2019
Mercury	ND	-	-
Selenium	ND	-	-
Silver	ND	-	-
Strontium	39.2	H-4 (0-2)	11/4/2019
Zinc	19.1	H-3 (0-2)	10/31/2019

Table 5-4: Soil Screening Values for Estimation of Potential Ecological Risks

Constituent	Soil Ecological Screening Value	Background USGS	Screening Comparison	
			Soil Concentration [Maximum Value]	Soil Screening Exceedance [Y/N]
Area 1				
Arsenic	18	12[a]	3.58	N
Barium	2424	775	389	N
Cadmium	0.36	0.8	ND	N
Chromium	26	84	9.63	N
Lead	11	44	12.6	N
Mercury	N/S	0.11	ND	N
Selenium	0.52	1.0	ND	N
Silver	4.2	ND	ND	N
Strontium	N/S	203	21.9	N
Zinc	46	140	13.3	N
Area 2				
Arsenic	18	12[a]	5.89	N
Barium	2424	775	2740	Y
Cadmium	0.36	0.8	ND	N
Chromium	26	84	10.1	N
Lead	11	44	32.4	N
Mercury	N/S	0.11	ND	N
Selenium	0.52	1.0	ND	N
Silver	4.2	ND	ND	N
Strontium	N/S	203	110	N
Zinc	46	140	121	N
Area 4				
Arsenic	18	12[a]	9.46	N
Barium	2424	775	7000	Y
Cadmium	0.36	0.8	ND	N
Chromium	26	84	19.7	N
Lead	11	44	54.5	Y
Mercury	N/S	0.11	0.157	Y
Selenium	0.52	1.0	ND	N
Silver	4.2	ND	ND	N
Strontium	N/S	203	148	N
Zinc	46	140	98.6	N
Area 5				
Arsenic	18	12[a]	7.33	N
Barium	2424	775	6390	Y
Cadmium	0.36	0.8	ND	N

Constituent	Soil Ecological Screening Value	Background USGS	Screening Comparison	
			Soil Concentration [Maximum Value]	Soil Screening Exceedance [Y/N]
Chromium	26	84	24.8	N
Lead	11	44	34	N
Mercury	N/S	0.11	ND	N
Selenium	0.52	1.0	ND	N
Silver	4.2	ND	ND	N
Strontium	N/S	203	124	N
Zinc	46	140	30.2	N
Area 6				
Arsenic	18	12[a]	3.81	N
Barium	2424	775	7410	Y
Cadmium	0.36	0.8	0.538	N
Chromium	26	84	63.4	N
Lead	11	44	54.2	Y
Mercury	N/S	0.11	0.32	Y
Selenium	0.52	1.0	ND	N
Silver	4.2	ND	ND	N
Strontium	N/S	203	278	Y
Zinc	46	140	67.4	N
Area 8				
Arsenic	18	12[a]	7.65	N
Barium	2424	775	7290	Y
Cadmium	0.36	0.8	ND	N
Chromium	26	84	12	N
Lead	11	44	14.6	N
Mercury	N/S	0.11	ND	N
Selenium	0.52	1.0	ND	N
Silver	4.2	ND	ND	N
Strontium	N/S	203	39.2	N
Zinc	46	140	19.1	N

Notes:

Concentrations are in mg/kg-dry.

Soil Ecological Screening Value is the lowest of the USEPA Eco-SSLs.

Background, USGS: Background Data for Louisiana, 95% Upper Tolerance Limit, United States Geological Survey.

There are no Eco-SSLs or other reliable ecological screening values for strontium, and strontium is not further assessed.

[a] *Arsenic value is LDEQ-approved background for Louisiana.*

Table 5-5: Sediment Screening Values for Estimation of Potential Ecological Risks

Constituent	NOAA TEC	NOAA PEC	Screening Comparison	
			Soil Concentration [Maximum Value]	Soil Screening Exceedance [Y/N]
Area 1				
Arsenic	9.79	33	3.58	N
Barium	N/S	N/S	389	N
Cadmium	0.99	4.98	ND	N
Chromium	43.4	111	9.63	N
Lead	35.8	128	12.6	N
Mercury	0.18	1.06	ND	N
Selenium	N/S	N/S	ND	N
Silver	N/S	N/S	ND	N
Strontium	N/S	N/S	21.9	N
Zinc	121	459	13.3	N
Area 2				
Arsenic	9.79	33	5.89	N
Barium	N/S	N/S	2740	N
Cadmium	0.99	4.98	ND	N
Chromium	43.4	111	10.1	N
Lead	35.8	128	32.4	N
Mercury	0.18	1.06	ND	N
Selenium	N/S	N/S	ND	N
Silver	N/S	N/S	ND	N
Strontium	N/S	N/S	110	N
Zinc	121	459	121	N
Area 4				
Arsenic	9.79	33	9.46	N
Barium	N/S	N/S	7000	N
Cadmium	0.99	4.98	ND	N
Chromium	43.4	111	19.7	N
Lead	35.8	128	54.5	N
Mercury	0.18	1.06	0.157	N
Selenium	N/S	N/S	ND	N
Silver	N/S	N/S	ND	N
Strontium	N/S	N/S	148	N
Zinc	121	459	98.6	N
Area 5				
Arsenic	9.79	33	7.33	N
Barium	N/S	N/S	6390	N
Cadmium	0.99	4.98	ND	N
Chromium	43.4	111	24.8	N

Constituent	NOAA TEC	NOAA PEC	Screening Comparison	
			Soil Concentration [Maximum Value]	Soil Screening Exceedance [Y/N]
Lead	35.8	128	34	N
Mercury	0.18	1.06	ND	N
Selenium	N/S	N/S	ND	N
Silver	N/S	N/S	ND	N
Strontium	N/S	N/S	124	N
Zinc	121	459	30.2	N
Area 6				
Arsenic	9.79	33	3.81	N
Barium	N/S	N/S	7410	N
Cadmium	0.99	4.98	0.538	N
Chromium	43.4	111	63.4	N
Lead	35.8	128	54.2	N
Mercury	0.18	1.06	0.32	N
Selenium	N/S	N/S	ND	N
Silver	N/S	N/S	ND	N
Strontium	N/S	N/S	278	N
Zinc	121	459	67.4	N
Area 8				
Arsenic	9.79	33	7.65	N
Barium	N/S	N/S	7290	N
Cadmium	0.99	4.98	ND	N
Chromium	43.4	111	12	N
Lead	35.8	128	14.6	N
Mercury	0.18	1.06	ND	N
Selenium	N/S	N/S	ND	N
Silver	N/S	N/S	ND	N
Strontium	N/S	N/S	39.2	N
Zinc	121	459	19.1	N

Notes:
Concentrations are in mg/kg-dry.
Sediment Ecological Screening Values are the NOAA TEC and NOAA PEC.

5.2.2 Screening Level Risk Calculations

The HQ is used to estimate risk in the SLERA (USEPA, 1997). The HQ is estimated by comparing ESVs to exposure concentrations. The HQ is defined as the estimated environmental concentration (EEC) divided by the ESV:

$$HQ = EEC / ESV$$

The EEC is the maximum dry weight concentration detected in soil in mg COPEC/kg soil. The ESV represents the concentration below which no risk is predicted. For HQ values that exceed 1.0, the potential for adverse effects to a receptor cannot immediately be ruled out. For HQs equal to or less than 1.0, the potential for risks due to that COPEC can be considered minor and are dropped from further consideration. An HQ >1.0 does not mean that unacceptable ecological risks exist or that any remediation is needed, only that further analyses, such as a site-specific BERA, are needed.

The screening level HQs calculated by comparison of maximum soil concentrations to screening values are presented in Inset Table 5-6. At this level of the screening assessment, 3 metals in soil have HQ values greater than 1.0, and are carried forward into the BERA: barium, lead, and mercury.

Table 5-6: COPEC Screening Hazard Quotients using Maximum Soil Concentrations

Constituent	Soil Concentration [Maximum Value] (mg/kg dry)	Location (depth feet bgs)	Lowest Ecological Screening Value (mg/kg dry)	Screening Hazard Quotient (HQ) [Based on Lowest ESV]
Area 2				
Barium	2740	H-11 (0-2)	2424	1.1
Area 4				
Barium	7000	H-8 (0-2)	2424	2.9
Lead	54.5	H-16 (0-2)	11	5
Mercury	0.157	H-16 (0-2)	NA	NA
Area 5				
Barium	6390	H-18 (0-4)	2424	2.6
Area 6				
Barium	7410	H-24NE (0-2)	2424	3.1
Lead	54.2	H-28 (0-2)	11	4.9
Mercury	0.32	H-24 (0-2)	NA	NA
Area 8				
Barium	7290	H-4E2 (0-2)	2424	3.0

Note:

Mercury is retained for BERA due to exceedance of Louisiana soil background (0.11 mg/kg, USGS).

5.2.3 Risk Characterization

Risk characterization combines data for exposures and effects into a statement about risk. If screening values are not exceeded, no risk exists due to COPEC exposures on the site, and if screening values are exceeded, a more detailed and focused site-specific ecological risk analysis can be initiated. The term site-specific refers to data that is collected from the site to characterize the environmental conditions present. Examples of site-specific data collected by ERM for this ERA include soil chemical concentration data, barium speciation data, site vegetation species counts, root zone studies, ecosystem services assessments, and recorded observations of site wildlife. These site-specific data support the conclusions made in the BERA.

An important part of risk characterization is based on COPEC bioavailability. Factors controlling bioavailability of COPECs in soils are discussed in the following sections.

5.2.3.1 Metals

Uptake of metals from soils to plants and animals is limited by natural soil components that bind metals and limit metal solubility and availability. Metal bioavailability at the site is limited because metals preferentially remain adsorbed to the organic carbon and iron and manganese oxides that are naturally present in silt and loam soils of the region. Metals that are bound to soils are unavailable for uptake and absorption by plants and animals, and are therefore of limited toxicity (Langmuir, 1997; Lytle, 1968; Stumm, 1996; USDA, 1988; USDA, 2003; Zhong, 2014; USEPA, 2007a; USDOD, 2003).

Lead and mercury in site soils have been measured by SPLP analysis to be very low concentrations (Table 4), which is an important line of evidence for low toxicity of site soils. SPLP analysis was performed on the soil resample at the highest lead concentration (H-16, 0-2') and highest mercury concentration (H-24, 0-2') to determine if lead and mercury compounds present are available for uptake. SPLP analysis involves mixing and agitating site soil with water over an 18-hour period. After 18 hours, the water will contain any metals that can solubilize from the soil. The SPLP analysis resulted in a very low lead concentration of 0.0147 mg/L (resample of H-16 (0-2')) and no detected concentration of mercury (resample of H-24 (0-2')). Because only the soluble metals in soils are assumed to be available to ecological species, the low and non-detect SPLP metal results support the lack of bioavailability and toxicity of site metals in soils.

A discussion of metals bioavailability for arsenic, barium, lead, and mercury (metals in the BERA) follows in the next few paragraphs.

Barium

Barium concentrations measured in site soils are 36.6 - 7,410 mg/kg-dry, 0-3'. A discussion of barium in soils and ecotoxicity is presented in this section.

Barium speciation in other areas of E&P activities throughout Louisiana has demonstrated that the soil barium compound associated with oil and gas E&P operations is barium sulfate (barite), which is of low toxicity and of low bioavailability. Based on this experience, and laboratory analysis of barium compounds in site soils at resample locations of H-8 (H-8R 0-2') and H-28 (H-28R 0-2') by X-Ray Diffraction (XRD) and energy dispersive x-ray spectrometry (EDX) performed by Core Mineralogy, Inc. (see Appendix J of the ERM Expert Report (2022; Angle/Levert/Purdom)), barium in site soils is documented to be barium sulfate (barite), and is evaluated in this ERA based on the toxicity of barite.

The presence of elevated barium sulfate/barite in soils in locations of E&P operations is due to the fact that barium sulfate/barite can be a product of produced waters and/or a component of the drilling muds that are used in E&P operations. Barite is very poorly soluble in water and is of very low toxicity to mammals, birds, soil invertebrates, aquatic invertebrates, and plants (Khangarot and Das, 2009; Boyd and Abel, 1966; Brown and Brown, 2014; Silverman and Tell, 2010; Kubiak and Forbes, 2012). Barium sulfate is of low bioavailability in soil (Engdahl et al., 2008; Cappuyns, 2018; USGS, 2002; Environment International Ltd., 2010; Kuperman et al., 2006). LDEQ (2003) recognizes the differences in toxicity between barium sulfate and other forms of barium (RECAP, pg. 82). Therefore, analysis beyond the screening level in this ERA incorporates the laboratory demonstration that barium is in a form of limited toxicity (barium sulfate).

Areas on site with elevated barium were selected for vegetation observations, as a "worst case" scenario investigation, in order to assess if there are impacts due to barium. The 7 vegetation and wildlife survey locations on site, with elevated barium concentrations (area of former operations), are supporting expected vegetation and are providing habitat for wildlife, per our observations (see Table 5-7 below and Figure 5A). These areas where barium was measured include various habitats such as fallow rice fields, swamps, and other treed and wetland areas. Barium is the primary COPEC in these areas, and other site

COPECs are similar in concentration to unimpacted soils throughout Louisiana. Therefore, as barium is the primary COPEC of concern in locations of elevated barium, it is apparent that barium has not adversely affected vegetative diversity and composition. The barium concentrations in the vegetation survey locations range from 1270 – 7080 mg/kg dw barium.

The vegetative species counts at site survey locations (13-38) are similar to those documented at Bayou Lacassine (an area of no E&P operations) just east of the site (30 species). Vegetative species counts are not related to barium concentrations (see Table 5-7 below), and elevated barium is not correlated to reduced vegetative diversity or affected community structure. For example, trees make up 12 – 20% of the vegetative communities at site locations with elevated barium, which is similar to reference locations at Lacassine Bayou and the NWR (10 – 31% trees). There is no reduction in plant species diversity at locations of maximum barium concentration. For example, at location H-28 (barium concentration of 7, 080 mg/kg dw) there are 25 vegetative species, of which 20% are trees, which compares favorably to reference areas with 30-56 species, 10-31% trees. The NWR reference locations have higher vegetation species counts (39-56) than site locations, as they were not assessed as 30' radius circle areas, as the site locations were, but as observations made over a linear distance of more than a mile.

Evidence of wildlife at site locations with elevated barium also supports the lack of impact due to barium. Birds of prey such as the Red-shouldered Hawk (*Buteo lineatus*), American Kestrel (*Falco sparverius*), Peregrine Falcon (*Falco peregrinus*), and Red-tailed Hawk (*Buteo jamaicensis*), were observed at 6 of the 7 site locations of maximum barium concentration (1,270 – 7,080 mg/kg dw barium), which indicates that small animals, mammals, and other birds are available for these avian predators with high calorie diets, and barium is not inhibiting the presence and survival of avian predators and prey.

In summary, there is no evidence that barium is impacting vegetation or wildlife at the site, even in areas of elevated concentrations. Table 5-7 below presents soil barium concentrations and associated biota data.

Table 5-7: Biota at Locations of Maximum Soil Barium

Vegetation Sample Location[1,2]	Maximum Barium Concentration (mg/kg dw)	Habitat Type	Species Count	% Trees	Birds of Prey Observed
Bayou Lacassine	NA	Bayou/BLH	30	31%	Red-shouldered Hawk (*Buteo lineatus*) Peregrine Falcon (*Falco peregrinus*)
Unit A	NA	Moist soil*	39	10%	
Unit B	NA	Moist soil*, cropland, emergent marsh	56	18%	*Red-tailed Hawk (Buteo jamaicensis)*
H-15 (7-L)	1,270	Scrub-shrub	13	15%	*Red-tailed Hawk (Buteo jamaicensis)*
H-11 (12-A)	2,740	Emergent wetland	36	14%	Red-shouldered Hawk (*Buteo lineatus)*
H-24 (5-B)	4,180	Scrub-shrub	37	14%	
H-16 (7-A)	4,390	Scrub-shrub	15	13%	Red-shouldered Hawk (*Buteo lineatus*) Red-tailed Hawk *(Buteo jamaicensis)*
H-4 (1-A)	4,540	Fallow rice field	38	0%	American Kestrel (*Falco sparverius*) Peregrine Falcon (*Falco peregrinus*),
H-8	7,000	Scrub-shrub	17	12%	Red-shouldered Hawk (*Buteo lineatus*)
H-28 (5-A)	7,080	Forested wetland**	25	20%	Red-shouldered Hawk (*Buteo lineatus*)

Notes:
1. The vegetation at the Bayou Lacassine, H-15, H-11, H-24, H-16, H-4, H-8, H-28was documented for each location within a circle of 30' radius (see Figure 5A).
2. The vegetation in Unit A and Unit B was documented along a linear distance of approximately one mile (see Figure 5B) at Lacassine National Wildlife Refuge.
**Vegetation is managed to encourage annual plant production (USFWS, 2011).*
***Chinese tallow swamp.*
BLH = Bottomland hardwood forest; forested wetland

Lead

Lead concentrations in site soils (6.86 – 54.5 mg/kg-dry) are similar to soils throughout Louisiana in unimpacted soils (5-91 mg/kg-dry, Smith et al., 2013). SPLP analysis in sample H-16R 0-2 (resample of the maximum lead concentration) demonstrates that lead compounds are very poorly soluble, as total lead was detected in the SPLP leachate water at low concentration (0.0147 mg/L). Therefore, due to demonstrated low solubility and low bioavailability, lead is not predicted to be a source of ecotoxicity at the site.

Mercury

Mercury in site soils are low in concentration or non-detect (ND-0.32 mg/kg-dry), which is similar to unimpacted soils throughout Louisiana (ND-6.24 mg/kg-dry, Smith et al., 2013). Mercury was not detected in the SPLP analysis (Hg SPLP < 0.0002) at location H-24R (0-2'), which is a resample of the location of maximum mercury measured in soil at 0.32 mg/kg-dry. Therefore, due to demonstrated low solubility and low bioavailability, mercury is not predicted to be a source of ecotoxicity at the site.

5.2.3.2 Total Petroleum Hydrocarbons

TPH concentrations in site soils are below levels of ecological concern, per review of the scientific literature, and do not present ecological risk at the site. TPH concentrations are not further evaluated beyond the screening level. A discussion of TPH in site soil follows.

Only three soil samples (0-2') were analyzed for TPH fractions, located in Area 5 (Table 4, Figure 32). No samples were analyzed for TPH mixtures (TPH-O or TPH-D) in any of the areas for the 0-3' interval range. Of these three samples, total TPH fractions were non-detect in one sample (H-1R 0-2') and less than 5 mg/kg-dry (sum of aliphatic and aromatic fractions) in the other two samples (H-1E of 4.34 mg/kg-dry and H-1SE of 2.99 mg-kg-dry). Measured site TPH of less than 5 mg/kg-dry is similar to hydrocarbon concentrations in unimpacted soils.

Per literature review, weathered TPH in soils are of low toxicity and have been shown to be non-toxic to birds, mammals, and invertebrates in soil concentrations ranging from 3,000 – 16,000 mg/kg (Pattee and Franson, 1982; Zhou et al., 2019; and Berger et al., 2016). Measured hydrocarbons in surface soils in Area 5 (ND – 4.34 mg/kg-dry) are weathered and degraded and are well below ecological levels of concern for weathered TPH in soil. Additionally, TPH do not have detectable concentrations of aromatic hydrocarbons in the 0-3' interval, which also supports a weathered and non-toxic characterization of site hydrocarbons. The measured concentrations of TPH in site soils are below levels of ecological concern and are not presenting ecological risk to the site ecosystem.

In addition to the measured TPH soil concentrations being below levels of concern, the field evidence of thriving vegetation in the location where TPH was measured supports the absence of adverse effects due to TPH. At location H-1, 38 grasses, forbs, vines, shrubs, and herbaceous species of vegetation were observed, with no denuded areas or vegetation that was not thriving. Wildlife taxa, including ten bird species, were observed. The line of evidence of healthy vegetation in the area where TPH was measured, supports the conclusion of no effects to the ecosystem due to TPH in soil.

Based on low TPH soil concentrations that are below literature values of concern for weathered TPH, as well as thriving vegetation growing throughout the site, TPH are not affecting the ecology of the site and are not further assessed beyond the screening level of assessment.

6. BASELINE ECOLOGICAL RISK ASSESSMENT (BERA)

6.1 ERA Step 3

Based on the results from Step 2 of the USEPA (1997) ERA process, the following COPECs on the site exceed conservative screening values and are further investigated in the BERA: barium, lead, and mercury.

At the conclusion of Step 2, a Scientific Management Decision is made to either proceed to a site-specific BERA or to end the risk assessment at the screening level (USEPA, 1997). Based on the screening results, the Scientific Management Decision at the conclusion of Step 2 is to proceed to a site-specific BERA.

The BERA is a site-specific ecological evaluation based on the chemical forms of constituents present, the concentrations of COPECs, the ecotoxicity of chemical species, and complete exposure pathways. The BERA assesses potential toxicological impacts to ecological populations using indicator or surrogate species.

In the BERA, site-specific data is evaluated. The bioavailability of COPECs is evaluated along with fate and transport, potential for bioconcentration, bioaccumulation, and biomagnification in the food chain. Indicator species are selected to assess ecotoxicity of COPECs. To select appropriate indicator species, trophic level relationships and the physical structure of the habitat are considered. The toxicity endpoints used in this stage of the risk assessment are values based on mortality, reproduction, or growth.

In order to assess toxicity via ingestion exposure in a variety of animal populations, several indicator species are required. The following factors are considered in the species selection process: 1) ecological relevance to site, 2) vulnerability to exposures, 3) sensitivity to toxic effects of COPECs, 4) social and economic importance, 5) protected species status, and 6) availability of species-specific toxicological information.

The following avian and mammalian indicator species were selected for the site-specific BERA: 1) Mourning Dove, 2) Red-winged Blackbird, 3) Common Yellowthroat, 3) Red-tailed Hawk, 4) Swamp Rabbit, 6) Raccoon and 7) Coyote. The following sections discuss the lifestyle of these species.

6.1.1 Mourning Dove (Zenaida macroura)

The Mourning Dove is a widespread partially migratory bird species that is endemic from the Southern Provinces of Canada in North America all the way to southern Central America. However, it is primarily a residential bird species in the lower latitudes of North America and can be found in rural, suburban, and urban landscapes. The Mourning Dove prefers open habitats such as open woodlands and edges between forest and prairie and not deep forested areas.

The Mourning Dove has a typically grayish-blue to grayish-brown body with black-bordered white tips on its wing and tail feathers. Black spots are present on the wing and back feathers with one black spot or streak behind and below the eye. Additionally, the bill of a Mourning Dove is black and their legs and feet are a dull red color. Males (26.5-34 centimeters and 96-170 grams) are larger and slightly more colorful than females (22.5-31 centimeters and 86-156 grams), having a more bluish crown and nape as well as a paler rosier breast.

The Mourning Dove diet consists of 99% seeds from cultivated plants such as sunflowers, corn, wheat, grain sorghum, various millets, buckwheat, barley, and peanuts and wild plants such as grasses, spurges, crotons, goosefoots, saltbushes, ragweeds, pokeweeds, poppies, amaranths, smartweeds, hemp, purslanes, and pines. The Mourning Dove forages almost exclusively on the ground, using its beak to expose seeds found under litter. During the breeding and nesting season, the Mourning Dove will feed in pairs while late summer through autumn they will feed in larger flocks. The Mourning Dove's home range is extensive between their feeding sites and their nesting sites which can be as much as 1 to 8 kilometers apart.

Due to their adaptability, Mourning Dove nests on the ground, shrubs, trees, and ledges. The average clutch size for a Mourning Dove is two eggs with the fledging season occurring primarily in summer from May through August, although in the southern latitudes can occur year-round. The Mourning Dove's expected lifespan is about 1 year for adult birds (The Cornell Lab of Ornithology, 2020).

The Mourning Dove was observed at the site.

6.1.2 Red-winged Blackbird (*Agelaius phoeniceus*)

The Red-winged Blackbird is a widespread species that is observed from southern Alaska and Central Canada down to Costa Rica in Central America. The majority of the United States, including Louisiana, and Central America have year-round residents as well as migratory visitors from northern populations. The predominant habitats of the Red-winged Blackbird include large freshwater marshes and prairies. The Red-winged Blackbird prefers to breed in open wetland (freshwater marsh, saltwater marsh, and rice paddies) and upland (sedge meadows, alfalfa fields and old fields) environments. In contrast, the Red-winged Blackbird prefers to roost in the denser cover of those habitats as well as deciduous thickets, coniferous stands, cane brakes, and sugarcane fields. Often, the Red-winged Blackbird will flock and roost amongst other bird species during the non-breeding season.

The Red-winged Blackbird is sexually dimorphic with the males exhibiting glossy black with red and yellow at the shoulders while the females are brown with dark stripes on undersides. Although similar in size (15-25 centimeters), the male Red-winged Blackbird (45-75 grams) is approximately 50% larger than the female (30-50 grams) with more elaborate plumage for attracting mates.

Red-winged Blackbirds are generalized feeders, consuming a higher proportion of animal matter during breeding season and plants during non-breeding season. Preferred diet items include seeds, corn, rice, dragonflies, damselflies, butterflies, moths, and true flies. However, the red-winged blackbird consumes almost any plant matter and a variety of animal matter such as arachnids, snails, frogs, fledging birds, eggs, carrion, and worms. The primary methods of feeding for the Red-winged Blackbird include foraging on difference substrates such as vegetation, bare ground, floating mats of vegetation, logs and tree trunks as well as gaping to expose insects hiding in vegetation or under rocks. The Red-winged Blackbird will feed during the day and roost at night which can range between 14-80 kilometers between roost site and feeding site.

Breeding season is from early spring to mid-summer. Male Red-winged Blackbirds are territorial and establish defined boundaries that range from 1,625 square meters in marshes and 2,895 square meters in uplands. The majority of foraging and breeding occur within their territories; however, they will forage in loose aggregations outside their territories during the breeding season. The Red-winged Blackbird is polygamous with up to 15 females breeding with one male. Nests are woven using plants materials and located in or near marshland or moist, grassy areas above water level. Average lifespan is 2.14 years in the wild (The Cornell Lab of Ornithology, 2020).

The red-winged blackbird was observed at the site.

6.1.3 Common Yellowthroat (*Geothlypis trichas*)

The Common Yellowthroat is a widespread migratory warbler songbird species that is endemic to all of North America including Canada as well as Central America. In the lower latitudes of the United States and Mexico, the Common Yellowthroat is a year-round resident. Common Yellowthroat habitats include wetlands, marshes, prairies, and thickets, with a preference for denser and shrubbier environments.

The Common Yellowthroat has an olive head, wings, and tail with a bright yellow chin, throat, and upper-belly and whitish under-belly. Males will have a black mask on their face that usually begins on the forehead then extends past the eyes to continue partly down the neck. Males and females' length and mass are similar (11-13 centimeters and approximately 10 grams) with the males only being slightly heavier and longer in length.

A Common Yellowthroat's diet consists primarily of spiders and insects such as flies, beetles, ants, termites, bees, wasps, grasshoppers, and various larvae that are present on the ground or in the lower-height vegetation.

Common Yellowthroats exhibit territoriality with territory sizes ranging from 0.2-2.9 hectares, however; this behavior is relaxed during nesting, and fledgling season. During mating season, the Common Yellowthroat are a monogamous species with courtship behavior initiated once the female arrives in the male territory. The average clutch size for a Common Yellowthroat is four to six with up to two broods. There is little data on expected life span for the Common Yellowthroat. The oldest recorded banded bird was approximately 11.5 years old (The Cornell Lab of Ornithology, 2020).

The Common Yellowthroat was observed at the site.

6.1.4 Red-tailed Hawk (Buteo jamaicensis)

The Red-tailed Hawk is a widespread soaring-hawk species that is endemic in the Southern Provinces of Canada and the United States, and year-round residents in southern latitudes of the United States. The primary habitats of the Red-tailed Hawk include woodlands, wetlands, pastures, prairies, and some deserts. The Red-tailed Hawk is able to adapt to rural, suburban, and urban landscapes.

The physical appearance of a Red-tailed Hawk can vary across North America but typically has the brick-red color on its tail feathers with variations of brown on its wings, neck, and head, pale underbelly, and yellow legs and feet. Males (46 cm and 1 kilograms) are approximately 20% larger than females.

The Red-tailed Hawk is carnivorous and will hunt for small- to medium-sized prey in open fields, forest edges, and most open areas. The preferred hunting method of a Red-tailed Hawk is to start from an elevated perch location usually near woodland edges to pursue prey such as mice, shrews, voles, rabbits, squirrels as well as birds, lizards, snakes, and large insects.

Breeding hawks select wooded or semi-wooded areas where they can build their nests close to tree tops or, if trees are scarce, then high up on rock pinnacles, ledges or even man-made structures. The Red-tailed Hawk is territorial year-round where its home range can be few hundred to 1,500 hectares. Red-tailed Hawks breed once per year during mid-February to mid-May with a clutch size of one to three eggs. The Red-tailed Hawk reaches sexual maturity at two years of age and has a life span up to 18 years (USEPA, 1993).

The Red-Tailed Hawk was observed at the site.

6.1.5 Swamp Rabbit (Sylvilagus aquaticus)

Swamp rabbits, also known as cane-cutters, are found in marshy lowlands along the Gulf coast from South Carolina to Texas.

Swamp rabbits often feed at dusk, eating emergent aquatic vegetation and succulent herbaceous vegetation, such as grasses, sedges, and cane. Swamp rabbits breed year round on the Gulf coast and nests are often constructed underneath brush or fences (Wilson and Ruff, 1999).

Swamp rabbits are hunted in Louisiana. Specific population surveys are not conducted for either rabbit species native to Louisiana; however, the Louisiana Department of Wildlife's Louisiana Big and Small Game Harvest Survey for 2019-2020 reported that 12,300 rabbit hunters harvested 71,800 rabbits (LDWF, 2020b).

The Swamp Rabbit was observed at the site.

6.1.6 Raccoon (Procyon lotor)

Raccoons are nocturnal omnivores found throughout North America. They have a black mask appearance across their eyes, a pointed snout, and a bushy ringed tail. Raccoons can be grey, reddish brown, or beige. Their front paws look like human hands and they are dexterous in using their paws to collect and manipulate food. Raccoons can eat insects, eggs, small mammals, fruit, berries, seeds, frogs, crayfish, fish, and mollusks. However, they adapt to the available diet. Raccoons often rinse their food in water prior to eating.

Raccoons weigh about six to seven kilograms (about 6-15 pounds) depending on food availability, with males being generally larger than females. Raccoon body length ranges from ~600 to 950 mm (two to three feet, including tail). Their front legs are shorter than their hind legs, producing a hunched appearance when walking or running. Raccoons can swim and climb. They prefer forested habitat near water, but adapt to many habitats. The lifespan of raccoons in the wild is approximately two to five years (Chow et al., 2005; Goldman, 1950; Hamilton, 1936; Schuttler et al., 2015).

The Raccoon was observed at the site.

6.1.7 Coyote (Canis latrans)

The Coyote is a widespread and extremely adaptable species that is found as far north as Canada, the entire United States, and as far south as Panama in Central America. The primary habitats of the Coyote include forests, grasslands, deserts, and swamps as well as able to adapt to agricultural, suburban, and urban landscapes.

The Coyote has a grayish brown to a yellowish gray upper coat and a whitish under-belly and throat with reddish brown forelegs, muzzle, and feet. Coyotes usually have black-tipped guard hairs on its back, a black nose, and a bottle-shaped tail with a black tip. Males are larger than females with an average mass of 7-21 kilograms and 75-100 centimeters long.

A Coyote's diet mainly consists of small mammals such as rabbits, squirrels, and mice. Additionally, their versatility enables them to feed on birds, snakes, large insects, and carrion as well. During the fall and winter months, the Coyote is known to get a significant portion of its diet from fruits and vegetables such as leaves of balsam fir and white cedar, sarsaparilla, strawberry, and apple. Coyotes are nocturnal predators that can hunt individually or form hunting partnerships to hunt prey such as deer and can travel as much as 4 kilometers during a night's hunt.

Coyotes breed typically once a year from January to March with gestation lasting 60 to 63 days. Litter size ranges from 1 to 19 pups (average is 6 pups). Pups are born and remain in a den until approximately 28 days after birth for protection from predators and competitors. Coyotes will often enlarge burrows from other animals to make their den. The adults will hunt and defend their territory up to 19 kilometers in diameter along fixed routes and trails. Coyotes become adults and sexually mature at 12 months of age with an average lifespan in the wild of 14.5 years.

The Coyote was observed at the site.

6.2 ERA Step 4

6.2.1 Work Plan and Sampling Plan

For assessing wildlife receptor exposures, available soil concentration data and vegetation and wildlife survey data (ERM, 2021, 2022; ICON, 2019, 2021, 2022) for the site were used. Chemical exposure point concentrations were estimated; chemical environmental fate and transport mechanisms were determined; potentially exposed populations were identified; and ingestion exposure routes were identified.

Under RECAP, an area of investigation (AOI) can be used to evaluate exposure to ecological species in the exposure assessment. Preliminary AOIs for ERA purposes were developed to accurately estimate and evaluate ecological exposures (e.g. through concentration averaging) across a distinct relevant exposure area having similar habitat. Barium is the most widely distributed COPEC at the Site. As such, preliminary AOIs for Areas 4, 5, 6, and 8 were developed and delineated based on the barium screening value of 2424 mg/kg dry weight. Figures 33 through 37 show the preliminary AOIs and delineation boundaries for Areas 2, 4, 5, 6, and 8. There are 2 preliminary AOIs each for Areas 2 and 4, and one preliminary AOI each for Areas 5, 6, and 8.

Preliminary AOIs were not developed for Areas 1, 2, 7, and 9. Concentrations in Areas 1 and 2 are less than ecological screening values and soil background, and not evaluated further. Areas 7 and 9 do not include former Chevron operations, and therefore are not assessed in this report.

For a site-specific BERA, exposure estimates can be based on the 95% UCL of the arithmetic mean of concentrations or average concentrations (USEPA 1997; LDEQ 2003). For this BERA, the 95% UCL of the arithmetic mean was used to estimate the exposure concentration for each COPEC (where sufficient data points are available), and the average concentration was also calculated for comparison and reference (Appendix H). Exposure estimates used in the site-specific BERA are presented below and the maximum value is also shown for each COPEC for comparison (Inset Table 6-1).

Table 6-1: Soil Exposure Point Concentrations for Preliminary Ecological AOI

Prelim AOI	Constituent	95% Upper Confidence Limit (UCL) Concentration	Average Concentration	Maximum Concentration
Area 2 | 1	Barium	NA	NA	2740
Area 2 | 2	Barium	NA	1493	2670
Area 4 | 1	Barium	3437	2537	7000
	Lead	NA	27.2	54.5
	Mercury	NA	0.12	0.157
Area 4 | 2	Barium	NA	2176	3130
Area 5	Barium	4425	3084	6390
Area 6	Barium	4597	3785	7410
	Lead	NA	29.4	54.2
	Mercury	NA	0.123	0.32
Area 8	Barium	4699	3767	7290

Note:

Concentrations are in mg/kg-dry.

6.2.2 Measurement Endpoints

Measurement endpoints for the BERA are Toxicity Reference Values (TRVs). TRVs are estimated to be safe doses for the wildlife being assessed. TRVs are generally based on studies that use the most toxic form of the element being assessed. Therefore, the BERA is a conservative evaluation, due to the fact that the metal compounds present in high moisture, high organic south Louisiana settings are generally less toxic than the metal compounds that the TRVs are based on (Table 5). TRVs are based are mortality, growth, and reproduction effects (USEPA, 2007a).

6.2.3 Study Design

The BERA uses more realistic input values and assumptions than are used in the SLERA. The following sections describe some of the assumptions used in the BERA, as compared to the SLERA.

Bioavailability and Bioaccumulation: Bioavailability of soil contaminants is assumed to be 100 percent in the SLERA. In the BERA, more accurate bioavailability has been estimated from a review of the scientific literature (Table 6 and Table 7).

Dietary composition: In the SLERA, the assumption is made that a species' diet is entirely comprised of the most contaminated food type available. In the BERA, the diet composition of the receptor is based on scientific research and specifically, the diet composition of animals native to Louisiana is used when that information is available (Table 8).

Area-use factor: The assumption used for home range in the SLERA is that an animal's home range is only in the area of contaminated soil and that the animal spends 100 percent of its time in the contaminated area. The area use factor in the BERA more accurately represents the actual percentage of an animal's home range that may be affected and the percentage of time that the receptor would spend in the contaminated area, by incorporating home range and time estimates in the calculations (Table 9).

Life stage: The SLERA uses toxicity data from the most sensitive life stage of the receptor population. For example, if an animal is the most sensitive to a toxin in its juvenile stage of life, then data from the juvenile life stage is used for the SLERA. In the BERA, data from an average receptor age is used to estimate risk. It is an overestimation of risk to assume that the entire population at the site is at the most sensitive life stage.

Body weight and food ingestion rates: The BERA uses the body weights and food ingestion rates from the primary scientific literature to accurately estimate risk at the site. Body weights from studies of Louisiana animals are used when available (Table 8).

Toxicity Values: For the SLERA, toxicity is estimated for entire classifications of receptors (example: vertebrates, invertebrates) by comparing soil concentrations to screening values that are calculated to be over-inclusive. The screening values are designed to "not miss" the possibility of risk being present. For the BERA, TRVs are used for calculating risk. TRVs are species specific, and are used to calculate a more accurate risk estimate for a representative receptor population.

6.2.4 Data Quality Objectives

Data Quality Objectives are important to the acquisition of reliable data for quantitative risk assessment. Risk-based decisions must be based on data of known quality which meet LDEQ RECAP and USEPA requirements. The data for this risk assessment were determined to be usable for risk assessment.

The soil data collected and discussed in this report were collected by ERM (2021, 2022), and ICON (2019, 2021, 2022). The chemical analyses of metals, and TPH fractions in soil were performed by Element Materials Technology Lafayette (Element) in Lafayette, Louisiana, Pace Analytical Gulf Coast (Pace) in Baton Rouge, Louisiana, and Waypoint Analytical Louisiana, Inc. (Waypoint) in Marrero, Louisiana. Element, Pace, and Waypoint are LDEQ LELAP certified laboratories. All qualified data have been included in this risk assessment. The metals data were generated using USEPA SW-846 methods, while TPH fraction data were generated using TPH MADEP VPH and TPH MADEP EPH methods. ERM's metals and TPH fraction data meet the definition of definitive data per RECAP guidelines. Samples were appropriately collected and identified in the field by sample identification number, and date and time of collection. Sample quantitation limits were reviewed and found to be acceptable for ERA.

6.3 ERA Step 5

6.3.1 Field Sampling Plan Verification

In Step 5, efforts are made to determine that the field sampling plan is appropriate for site conditions. That is, the sampling methods and equipment planned should be effective for the media and populations on the site. Past experience with working in similar Louisiana habitats was used to determine the sampling efforts needed.

6.4 ERA Step 6

6.4.1 Analysis of Ecological Exposures and Effects

A review of the available sampling data (ERM, 2021, 2022; ICON, 2019, 2021, 2022) identified that sufficient data are available to estimate ecological risk at the site. Site-specific data from this step replace assumptions made during the screening-level analysis in Steps 1 and 2.

6.5 ERA Step 7

6.5.1 Risk Estimation and Characterization

Risk Characterization includes two major steps: risk estimation and risk description. In the risk estimation step of the BERA, risk is estimated and the uncertainties associated with risk assessment methods are evaluated. All input assumptions to the risk estimate are documented.

Potential exposures and ecological effects were evaluated for COPECs and receptors at the site. The equation used for calculating potential risk (HQs) for COPECs in the site-specific BERA for the site is as follows (USEPA 2005a):

$$\frac{\left(\left[\mathbf{Soil\ x\ Ps\ x\ FIR\ x\ AFas}\right] + \left[\sum_{\mathbf{i}}^{\mathbf{N}} \mathbf{Bi\ \ x\ Pi\ x\ FIR\ x\ AFai}\right]\right)\mathbf{\ x\ AUF}}{\mathbf{TRV}} = \mathbf{HQ}$$

HQ	=	Hazard Quotient for analyte/COPEC (unitless)
Soil	=	Concentration of analyte/COPEC in soil (mg/kg dry weight)
N	=	Number of different biota types in diet (food types)
B_i	=	Analyte/COPEC in biota type (i) (mg/kg dry weight)
P_i	=	Proportion of biota type (i) in diet
FIR	=	Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai}	=	Absorbed fraction of analyte/COPEC from biota type (i)
AF_{as}	=	Absorbed fraction of analyte/COPEC from soil (s)
TRV	=	Toxicity Reference Value, based on estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s	=	Soil ingestion as a proportion of diet
AUF	=	Area use factor (spatial factor, SF x temporal factor, TF)

Appendices I and J include all of the HQ calculations, analyses, and input values used to calculate risk estimates.

A summary of the results of the risk assessment and a discussion of uncertainties is included in Sections 5.6 and 5.7.

6.6 ERA Step 8

6.6.1 Risk Management Decision

Results of the BERA are provided in summary form for the ecological preliminary AOIs (Inset Table 6-2). The results of this BERA can be used to support decisions regarding any remediation needed for the ecological preliminary AOIs. The damage caused by any remedy must be considered and weighed against the need for that remedy (USEPA, 1997).

Table 6-2: Results (Hazard Quotients) for Preliminary Ecological AOI

Soil Hazard Quotients (HQs)								
Prelim AOI	COPEC	Avian Receptor Species				Mammalian Receptor Species		
		Mourning Dove	Red-winged Blackbird	Common Yellowthroat	Red-tailed Hawk	Swamp Rabbit	Raccoon	Coyote
95% UCL as Exposure Concentration								
Area 4 | 1	Barium	0.0000000488	0.0117	0.0122	0.00000394	0.0000171	0.000000457	0.00000000464
Area 5	Barium	0.0000000630	0.0150	0.0157	0.00000510	0.0000220	0.000000586	0.00000000598
Area 6	Barium	0.0000000654	0.0156	0.0163	0.00000527	0.0000228	0.000000610	0.00000000621
Area 8	Barium	0.000000228	0.0159	0.0321	0.0000186	0.0000809	0.00000208	0.0000000220
Average Concentration as Exposure Concentration								
Area 2 | 2	Barium	0.00000000179	0.00101	0.000439	0.000000142	0.000000643	0.0000000162	0.000000000166
Area 4 | 1	Barium	0.000000036	0.00861	0.00900	0.00000291	0.0000126	0.000000336	0.00000000343
Area 4 | 1	Lead	0.00000123	0.116	0.105	0.0000237	0.00134	0.0000152	0.0000000818
Area 4 | 1	Mercury	0.0000000184	0.00165	0.00146	0.0000000296	0.000188	0.00000172	0.00000000127
Area 4 | 2	Barium	0.00000000260	0.00147	0.000639	0.000000207	0.000000936	0.0000000236	0.000000000242
Area 5	Barium	0.0000000440	0.0105	0.0109	0.00000354	0.0000153	0.000000409	0.00000000417
Area 6	Barium	0.0000000539	0.0129	0.0134	0.00000434	0.0000188	0.000000502	0.00000000512
Area 6	Lead	0.00000133	0.125	0.112	0.0000256	0.00145	0.0000164	0.0000000885
Area 6	Mercury	0.0000000189	0.00168	0.00150	0.0000000303	0.000192	0.00000176	0.00000000131
Area 8	Barium	0.000000183	0.0128	0.0257	0.0000149	0.0000648	0.00000167	0.0000000177
Maximum Concentration as Exposure Concentration								
Area 2 | 1	Barium	0.00000000327	0.00186	0.000804	0.000000260	0.00000118	0.0000000297	0.000000000305
Area 2 | 2	Barium	0.00000000319	0.00181	0.000783	0.000000254	0.00000115	0.0000000290	0.000000000297
Area 4 | 1	Barium	0.0000000996	0.0238	0.0249	0.00000804	0.0000348	0.000000927	0.00000000945
Area 4 | 1	Lead	0.00000246	0.232	0.208	0.0000475	0.00269	0.0000304	0.000000164
Area 4 | 1	Mercury	0.0000000241	0.00216	0.00192	0.0000000387	0.000246	0.00000224	0.000000002
Area 4 | 2	Barium	0.00000000375	0.00213	0.000918	0.000000298	0.00000135	0.0000000340	0.000000000348
Area 5	Barium	0.0000000910	0.0217	0.0227	0.00000733	0.0000317	0.000000848	0.00000000863
Area 6	Barium	0.000000105	0.0251	0.0263	0.00000850	0.0000368	0.000000983	0.0000000100
Area 6	Lead	0.00000245	0.230	0.207	0.0000472	0.00267	0.0000303	0.000000163
Area 6	Mercury	0.0000000491	0.00439	0.00390	0.0000000788	0.000499	0.00000457	0.00000000340
Area 8	Barium	0.000000353	0.0248	0.0498	0.0000289	0.000126	0.00000323	0.0000000342

Note:

The appropriate exposure concentration for a BERA is the 95% UCL of the arithmetic mean of concentrations or average concentrations (USEPA 1997; LDEQ 2003). The maximum concentration is a hypothetical exposure concentration and shown for completeness.

The calculated HQs, based on 95% UCL and average exposure concentrations in soil, are low for all receptors, and all HQs are less than 1.0. Therefore, based on the multiple lines of field evidence demonstrating expected biological diversity for the region, and low HQ values, there is currently no risk identified and no potential for risk to the ecological receptors on the site. There is no need for remediation or for further investigation. See Appendix J for HQ calculations using 95% UCL and average exposure concentrations.

In addition to all calculated risk for all receptors being below the benchmark of 1.0, based on 95% UCL and average soil concentrations, all calculated risk values for maximum concentrations in all soils are also below the benchmark of 1.0 (see Appendix J).

No adverse effects to receptors in soil (0-3') are predicted for the site.

6.6.2 Future Land Use

6.6.2.1 Soil

Site soil concentrations are acceptable for future agricultural use, including plant-based farming. Soil concentrations (average and 95% UCL, 0-3') are protective of crop growth, as they do not exceed screening values for plant health (Eco-SSLs), or are of low toxicity to plants (see Appendix F).

The average concentrations of COPECs in soil within the root depth of crops (< 10 inches, Holloway and Ritchie, 2022) are within the range of Louisiana background soil concentrations (Smith et al., 2013), or are of low bioavailability to crops (see Appendix I, Table 1). Therefore, these soils are not associated with adverse effects to humans consuming crops.

Site soils are acceptable for the potential future use of crawfish production. Soil concentrations measured within the typical depth of crawfish ponds (0-3' bgs or less) are not associated with adverse health effects to shellfish such as crawfish or to humans who consume shellfish (Finerty et al., 1990, ERM, 2019).

6.6.2.2 Groundwater

The 31 monitoring wells on Site are installed in the shallow water-bearing zone, classified as Class 3A groundwater based on analysis of slug test results. Monitoring wells were screened in a discontinuous confining unit zone, and multiple wells (MW-7, MW-9, MW-9D, MW-11, H-25, H-26, and H-27) went dry during purging and sampling. The zone is not a viable or desirable water supply for irrigation or other purposes (ERM (Angle/Levert/Purdom), 2022). Deeper groundwater for irrigation is available from the Chicot Aquifer (ERM (Angle/Levert/Purdom), 2022). Therefore, groundwater in the shallow water-bearing zone was not evaluated for hypothetical future use for crop, crawfish, or livestock irrigation.

There are no existing registered drinking or irrigation wells screened in the shallow water-bearing unit on site (ERM (Angle/Levert/Purdom), 2022).

6.7 Uncertainty Evaluation

The uncertainty evaluation is an assessment of the qualitative and quantitative methods used in ERA and the measure of confidence in the risk estimates produced from the ERA. The uncertainty analysis is a required portion of USEPA ecological risk assessment. There are three basic categories of uncertainty: 1) conceptual model uncertainty; 2) natural variation and parameter error; and 3) model error.

Parameter error in general is unavoidable, because all members of a population, all soil present, all habitat features cannot be sampled. If all members of a population could be sampled, the true parameter distribution could be known. However, only a few members of the population can be sampled, leaving uncertainty concerning the true parameter value distribution. We have reduced this uncertainty for soil concentrations by sampling the E&P operational areas, biasing the results towards over estimation of risk.

The uncertainty associated with the conceptual model is related to potentially underestimating the number of routes of exposure. This is counterbalanced by using very conservative screening values to estimate the toxicity of the routes of exposure that are assessed, so this is judged to be a small source of uncertainty.

The initial constituent list is a source of uncertainty. All chemicals present cannot be measured and analyzed. We have addressed this uncertainty by measuring and analyzing the chemicals that have historically been associated with oil and gas production sites and that are required by the LDNR and LDEQ for E&P sites. Uncertainty can arise from making estimates of toxicity based on limited data. We have limited this uncertainty by using conservative estimates of toxicity from the primary scientific literature. There is uncertainty in chemical monitoring data and in dose models. We have addressed this uncertainty by analyzing data at qualified labs, certified to do the analyses. The uncertainty in the dose model is based on limiting the model to ingestion. There are other forms of exposure, but they are minor compared to ingestion, so this portion of uncertainty is judged to be low.

The uncertainty due to environmental variability, which arises from true heterogeneity in the environment and receptors, will be inherent in any calculation. There is uncertainty that could potentially be reduced by additional study, but in the instance of this assessment, there is no indication, based on the collected data and multiple lines of evidence, that further assessment is required. For this reason, that portion of uncertainty is judged to be low.

The effect of the uncertainties in the BERA results in overestimation of risk.

6.8 Summary and Conclusions

The BERA developed for the site was conducted in accordance with LDEQ (LDEQ 2003) and USEPA (USEPA 1997 and 1998) guidance. ERAs evaluate ecological effects caused by human activities or stressors. The term “stressor” is used here to describe any chemical, physical, or biological entity that can induce adverse effects on individuals, populations, communities, or ecosystems. Thus, the ERA process must be flexible while providing a logical and scientific structure to accommodate a broad array of stressors (USEPA, 1998).

USEPA guidance uses a tiered approach (Figure 6) to determine if site COPECs present an unacceptable risk to ecological receptors. The SLERA focused on potential chemical stressors associated with the site (i.e. in surface soils). The SLERA for the site conservatively estimated potential risks by comparing maximum detected COPEC concentrations to conservatively-derived ecotoxicity screening values. Per USEPA guidance, site-specific information can be developed and used to accomplish more accurate risk assessment. For the site, this was accomplished by proceeding with Steps 3-8 of the USEPA ERA process and production of a BERA that is specific for this site.

The conclusions presented in this ERA are based on: 1) data from investigations conducted in 2021 and 2022 of the wildlife and vegetation, and measurements of COPECs in soils in 2019, 2020, and 2021; 2) site inspections; 3) a SLERA; and 4) a site-specific BERA. The multiple lines of evidence including expected biodiversity in plant and avian populations, functioning terrestrial food chains, hazard quotients below the benchmark of 1.0, and no evidence of damage to wildlife or habitats, demonstrate that there are no unacceptable risks to ecological receptors at the site

The data, analyses, and lines of evidence presented in the site-specific BERA demonstrate that there are no actual or potential ecological risks for the biological populations at the site.

7. RESPONSE TO PLAINTIFFS' CLAIMS OF ECOLOGICAL RISK AND ASSESSMENT OF NEED FOR REMEDIATION

Miller, Gregory W. and W. Prejean. 2021. Expert Report and Restoration Plan for the Landowners, Henning Management, LLC v Chevron USA, Inc et al; Docket No. 73318; 31st JDC; Division "C", Jefferson Davis Parish, LA, Hayes Oil Field, Calcasieu and Jefferson Davis Parish, LA (September 30, 2021).

The ICON report (Miller and Prejean 2020) contains a proposal by Mr. Miller and Mr. Prejean to restore soil to "baseline soil remediation goals", also referred to as "background". Mr. Miller and Mr. Prejean did not perform an ecological risk assessment.

Mr. Miller and Mr. Prejean's proposal to remediate soil based on a potential exceedance of a calculated background value using data from three soil borings is not supported by any data that remediation would benefit ecological species that are currently using the habitat. The calculated background values presented by Mr. Miller and Mr. Prejean are not related to ecological risk and have not been demonstrated to be more protective of ecological populations than the existing soils that are currently on site and supporting wildlife and vegetation. A decision to remediate, following exceedance of a background value, is not part of the USEPA (1997) ecological risk assessment process. If screening levels are exceeded in steps 1 and 2 of an ERA, the decision can be made to further investigate, but the EPA process does not prescribe remediation without risk assessment.

Mr. Miller and Mr. Prejean propose restoration of soil to a maximum depth of approximately 16 feet below ground surface. Removing soils in depths up to 16 feet is not beneficial in a setting that is currently supporting 193 vegetative taxa, 62 non-avian taxa, and 70 species of birds, including 10 birds listed by LDWF as Species of Greatest Conservation Need. The Miller/Prejean planned removal would destroy approximately 16.4 acres of forest, grassland, scrub-shrub habitat, and croplands that currently serve as habitat for birds, mammals, reptiles, fish, invertebrates, and other plants. The Miller/Prejean plan would not protect habitats and biodiversity. The habitats on site are functioning and the removal of 16.4 acres, for no improvement to the setting, is wasteful and imprudent from an ecological perspective.

Mr. Miller and Mr. Prejean suggest residual salt-related impact to plants from the 1941 blowout event, such as killing of crops and vegetation [p.8], and scarring by SN 25340 [p.9] and #2 tank battery and pit north of #6 well, north of #7 well pad [p.9], and on the levee by #2 well [p.10]. These observations are based on case history for Watkins v Gulf Refining Co. (*20 So. 2d 273 La. 1944*), and review of aerial photographs from 1981 and earlier (over 40 years ago). Based on the site inspection performed in January 2022 by myself and analysis of soil and vegetation data collected by ERM and others, vegetation and crops in the vicinity of Chevron former operational areas are not adversely impacted by salt. Salt-scarring and denuded areas were not observed in Chevron former operational areas during my site inspection. To the contrary, vegetation was dense, or in the case of the sampling area 8, as expected based on a fallow rice field. Soil EC in the area of the 1941 event (sampling area 2, 0-4', vicinity of SN 25340) ranges from 0.27 to 1.51 mmhos/cm, with one unconfirmed result of 2.33 mmhos/cm at H-12 0-2' (11/13/2019, ICON). EC in the resample of H-12 within that depth interval were 0.60 and 0.76 mmhos/cm (H-12R, 0-1', 1-2', 11/17/2021, ICON). Soil EC (0-4') in other Chevron former operational areas range from 2 to 2.54 mmhos/cm (Area 1), 0.36 to 2.06 mmhos/cm (Area 4), 0.45 to 2.99 mmhos/cm (Area 5), 0.31 to 1.25 mmhos/cm (Area 6), 0.35 to 0.77 mmhos/cm (Area 8). These EC values are less than 29-B standards for upland (4 mmhos/cm) and wetland (8 mmhos/com) soil and do not indicate evidence of salts in the surface soils.

Based on our site inspection and ERA, the opinions provided by the plaintiffs' experts regarding exposures from legacy operations as well as impacts to the flora and fauna in Chevron former operational areas on the subject site are not supported by site-specific data. There is no evidence that habitat for populations of any species has been limited on the site by Chevron legacy oil and gas operations.

Walker, Wilson. 2021. Assessment of the Environmental State of Sites Associated with Oil and Gas Activities on the Henning Management, LLC Site, Thornwell Field, Jefferson Davis and Calcasieu Parishes, Louisiana, Henning Management, LLC v Chevron USA, Inc., et al. Docket No. C-733-18, 31st JDC, Jefferson Davis Parish, LA (June 3, 2021).

The Wilson (2021) report includes an inventory of flora and fauna observed during his March 2021 site investigations as well as conclusions regarding the ecological condition of the site. Wilson alleges that oil and gas production activities have impacted and continue to impact the flora and fauna at the site (pg.25, Wilson, 2021). However, the Wilson report does not claim that there are impacts to flora and fauna that are the result of oil and gas operations. Wilson alleges on page 25 of his report that agriculture as a cause of disturbance to the site, limits the ability to associate ecological impacts to E&P operations.

The following discussions address Wilson's claims of impact.

Evaluation of Site Avian Diversity

The Wilson (2021) report concludes that the bird species observed at the site represent a modest portion of the species expected for the region. However, the Wilson evaluation of site bird diversity is not based on an appropriate comparison population.

Wilson compares the list of birds he observed on site from March 24-26, 2021, to birds historically documented in Jefferson Davis Parish and Calcasieu Parish, as provided by the Bird Study Group, an organization of birders based in Shreveport, Louisiana (Bird Study Group, 2021). The parish reference list of birds (Bird Study Group) is not an appropriate comparison as it includes: 1) parish-wide records of bird species that utilize habitats that do not occur on the site, 2) species that occur in different times of the year, and 3) rare species with geographic ranges outside of Louisiana (e.g., not expected to occur), such as the Northern Wheatear (*Oenanthe oenanthe*) (Audubon, 2022b). Therefore, the comparison made of the site to the parish list is not an appropriate reference.

A total of 70 species of birds were observed at the site during ERM (March 2021, January 2022) and CEI (March, 2021) site investigations. In our evaluation of site bird populations, we compare the list of 70 site birds to more accurate representative populations in Management Units A and B of Lacassine NWR. Management Units A and B of the refuge contain habitat that is similar to the site (emergent marsh, croplands, and early successional communities), and therefore more likely to host species similar to the site. Our evaluation of agency lists for Units A and B (USFWS, 2011) and reference area survey data from Units A and B (Mr. Jody Shugart, February 24, 2022) provide a more appropriate reference for birds expected in the region.

Of the 76 bird species associated with croplands, moist soil areas, and unimpounded marsh habitats at the reference area, 33 (42%) were also observed on site (Appendix E-3). Given that bird abundance at these properties is highly dependent on migratory birds (i.e., species richness fluxes throughout the year), and recreational hunting was observed on site during the January 2022 surveys, this is a favorable comparison of species richness. The data support that the birds observed on site represent a significant portion of those expected in similar habitat types in the region.

Evaluation of Site Plant Diversity

The Wilson (2021) report also concludes that the site lacks vegetative diversity. In his report, Wilson states that the low numbers of native plant species are to be expected because most of the subject site was in agricultural production, including fallow fields, during site visits. Wilson's conclusions are based on his inventory of plants recorded during his March 2021 site investigation, and a comparison of site plant diversity from Noss (2012): "grasslands in the southern U.S. host up to 60 species per square meter" (Wilson Report, page 22). This description of species richness appears to be from Table 3.2 (Noss (2012), with 63 species reported in a square meter in a wooded meadow in Estonia. The geography and habitat in Estonia are not appropriate references for the site.

By contrast, the finding in our study is that plant species diversity at the site is exceptional. When the Wilson plant inventory is combined with ERM's survey data from March 2021 and January 2022, and all species recorded in the Holloway and Ritchie (2022) report, the plant list for the site totals 193 species. This total includes both hydrophytic and non-hydrophytic species from a range of vegetative communities, including freshwater marsh, ponds, bayous, and canals, bottomland forest, croplands, and early successional grassland and scrub-shrub communities. The species observed on site include the majority of species associated with Louisiana Freshwater Marsh and Sweetgum-Water Oak Bottomland Forest Natural communities (LDWF, 2010), and compares favorably to the vegetation data collected at Units A and B of Lacassine NWR by measures of species richness (79% species in common), proportion of hydrophytic and non-hydrophytic species, and vegetative community structure.

Given the mixed land use of the site (e.g., unmanaged successional growth, agriculture, hunting activities), the presence of natural community plant associates, and the similarity of the site vegetation to the Lacassine NWR reference area, the site has exceptional plant diversity by comparison to expected diversity in the region.

8. REFERENCES

Adair, B.M., Reynolds, K.D., McMurray, S.T., and G.P. Cobb. 2003. Mercury Occurrence in Prothonotary Warblers (Protonotaria citrea) Inhabiting a National Priorities List Site and Reference Areas in Southern Alabama. Archives of Environmental Contamination and Toxicology 44: 265–271.

Adamcik, R.S., Tood, A.W. and L.B. Keith. 1979. Demographic and dietary responses of red-tailed hawks during a snowshoe hare fluctuation. Can. Field-Nat. 93: 16-27.

Aldrich, J.W. and A.J. Duvall. 1958. Distribution and migration of races of the mourning dove. Condor. Patuxent Wildlife Research Center. Volume 60. Issue 2: 108-128.

Andersen, D.E. and O.J. Rongstad. 1989. Home-range estimates of red-tailed hawks based on random and systematic relocations. J. Wildl. Manage. 53: 802-807.

Angle, D.G., Levert, A., and M.T. Purdom. 2022. Expert Report of David G. Angle, P.G., CGWP, Angela Levert, and Michael T. Purdom, P.G. in the matter: Henning Management LLC v. Chevron USA, Inc. et al. Docket No. 73318 (Div. C) 31st Judicial District Court, Parish of Jefferson Davis, State of Louisiana. Prepared by: Environmental Resources Management, 3838 N. Causeway Blvd. Suite 3000 Metairie, LA 70002. March 4, 2022.

Audubon. 2022a. Important Bird Areas: Coastal Prairie, Louisiana. Available: https://www.audubon.org/important-bird-areas/coastal-prairie. Accessed March 2022.

Audubon. 2022b. Guide to North American Birds: Northern Wheatear *Oenanthe*. Available: https://www.audubon.org/field-guide/bird/northern-wheatear. Accessed March 2022.

Barbier, E.B. 2013.Valuing ecosystem services for coastal wetland protection and restoration: Progress and challenges. Resources 2: 213-230.

Bechtel-Jacobs Company. 1998a. Empirical models for the uptake of inorganic chemicals from soil by plants. BJC/OR-133. U.S. Department of Energy, Oak Ridge, TN.

Bechtel-Jacobs Company. 1998b. Biota-sediment accumulation factors for invertebrates: review and recommendations for the Oak Ridge Reservation. BJC/OR-112. Oak Ridge National Laboratory, Oak Ridge, TN.

Berger, R.G., Aslund, M.W., Sanders, G., Charlebois, M., Knopper, L.D., and K.E. Bresee. 2016. A multiple lines of evidence approach for the ecological risk assessment of an accidental bitumen release from a steam assisted gravity drainage (SAGD) well in the Athabasca oil sands region. Science of the Total Environment 542: 495-504.

Beyer, W.N., Connor, E.E., and S. Gerould. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management 58(2): 375-382.

Beyer, W.N., Pattee, O.H., Sileo, S., Hoffman, D.J., and B.M. Mulhern. 1985. Metal contamination in wildlife living near two zinc smelters. Environmental Pollution (Series A) 38: 63-86.

Bird Study Group. 2021. Louisiana Birds: Bird Checklists for All 64 LA Parishes. Available: http://www.birdstudygroup.org/pdfs/LA%20Combined%20Parish%20Checklists.pdf. Accessed March 2022.

BirdLife International. 2022. Central Americas Flyway. Available: http://datazone.birdlife.org/userfiles/file/sowb/flyways/2_Central_Americas_Factsheet.pdf. Accessed March 2022.

Bond, B.T., Bowman, J.L., Leopold, B.D., Burger, Jr., L.W., Godwin, K.D., and C.M. Class. 2006. Swamp rabbit (Sylvilagus aquaticus) demographics, morphometrics, and reproductive characteristics in Mississippi. Journal of the Mississippi Academy of Sciences 51(2): 123-128.

Boyd and Abel. 1966. Canad. Med. Ass. J., The Acute Toxicity of Barium Sulfate Administered Intragastrically, Canad. Med. Ass. J.

Brown, M. and L. Brown. 2014. Lavin's Radiography for Veterinary Technicians – E-book, 5th Edition. ISBN 978-1-4557-2280-8.

Buchman, M.F. 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration. 34 pp.

Byrne, M. and M. Chamberlain. 2011. Seasonal Space Use and Habitat Selection of Adult Raccoons (Procyon lotor) in a Louisiana Bottomland Hardwood Forest. Am. Midl. Nat. 166:426-434. School of Renewable Natural Resources, Louisiana State University Agricultural Center, Baton Rouge, Louisiana.

Cappuyns, V. 2018. Barium (Ba) leaching from soils and certified reference materials. Applied Geochemistry 88: 68-84.

Carls, M.G. and S.D. Rice. 1984. Toxic Contributions of Specific Drilling Mud Components to Larval Shrimp and Crabs. Marine Environmental Research 12, 45-62.

Chalmers, A. et al. 2013. Characterization of Mercury Contamination in the Androscoggin River, Coos County, New Hampshire, USGS, USEPA, USDOI

Chibunda, R.T. 2009. Chronic Toxicity of Mercury (HgCl2) to the Benthic Midge Chironomus riparius. Int. J. Environ. Res., 3(3):455-462

Chow, T.E., Gaines, K.F., Hodgson, M.E., and M.D. Wilson. 2005. Habitat and exposure modeling for ecological risk assessment: A case study for the raccoon at the Savannah River Site. Ecological Modeling 189: 151 – 167.

Coastal Environments, Inc. (CEI). 2021. Assessment of the Environmental State of Sites Associated with Oil and Gas Activities on the Henning Management, LLC Site, Thornwell Field, Jefferson Davis and Calcasieu Parishes, Louisiana in the matter of: Henning Management, LLC v Chevron USA, Inc et al; Docket No. 73318; 31st JDC; Division "C", Jefferson Davis Parish, LA, Hayes Oil Field, Calcasieu and Jefferson Davis Parish, LA. Walker B. Wilson. June 3, 2021.

Craighead, J.J. and F.C. Craighead. 1956. Hawks, owls and wildlife. Harrisburg, PA: The Stackpole Co. and Washington, DC: Wildl. Manage. Inst.

Czech, H.A. and K.C. Parsons. 2002. Agricultural wetlands and waterbirds: A review. Waterbirds: International Journal of Waterbird Biology 25: 56-65.

Daigle, J.J., Griffith, G.E., Omernik, J.M., Faulkner, P.L., McCulloh, R.P., Handley, L.R., Smith, L.M., and Chapman, S.S. 2006. Ecoregions of Louisiana. U.S. Geological Survey.

Davis, A., Sellstone, C., Clough, S., Barrick, R. and B. Yare. 1996. Bioaccumulation of arsenic, chromium and lead in fish: constraints imposed by sediment geochemistry. Applied Geochemistry 11: 409-423.

Dillon, O.W., Jr. 1958. Food habits of wild ducks in the rice-marsh transition area of Louisiana. Soil Conservation Service, Rosenberg, Texas.

Engdahl, A., Borgiel, M., and L.G. Omberg. 2008. Oskarshamm and Forsmark Site investigation, Chemical composition of suspended material, sediment and pore water in lakes and sea bays, Swedish Nuclear Fuel and Waste Management Co., P-08-81, 80 pp.

Environment International Ltd. 2010. Upper Columbia River in-Situ Porewater Assessment Sampling and Quality Assurance Plan, Washington State Attorney General's Office.

ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Site, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

ESG International Inc. 2003. Ecotoxicity evaluation of reference site soils amended with barium sulphate. Technical Appendices for Barite Soil Remediation Guidelines. Alberta Environment and Canadian Association of Petroleum Producers. 2009. Appendix VI: 287-328.

Falk, M.R. and M.J. Lawrence. 1973. Acute Toxicity of Petrochemical Drilling Fluids Components and Wastes to Fish. Environment Canada, Technical Report Series: CEN T-73-1.

Feijtel, T.C. 1986. Biogeochemical Cycling of Metals in Barataria Basin (Diagenesis, Mass Balance, Transport, Louisiana). LSU Historical Dissertations and Theses. 4183. January 1986.

Fernández-Martínez, R., Larios, R., Gomez-Pinilla, I., Gomez-Mancebo, B., Lopez-Andres, S., Loredo, J., Ordonez, A., and I. Rucandio. 2015. Mercury accumulation and speciation in plants and soils from abandoned cinnabar mines. Geoderma 253–254, 30–38.

Finerty, M.W., Madden, J.D., Feagley, and R.M. Grodner. 1990. Tissues of Wild and Pond-raised Crayfish in Southern Louisiana, Effect of Environs and Seasonality on Metal Residues. Arch. Environ. Contam. Toxicol. 19: 94-100.

Fitch, H.S., Swenson, F., and D.F. Tillotson. 1946. Behavior and food habits of the red-tailed hawk. Condor 48: 205-237.

Foley, C.C. 2015. Wading bird food availability in rice fields and crawfish ponds of the Chenier Plain of southwest Louisiana and southeast Texas. LSU Master’s Thesis. 19. Available: https://digitalcommons.lsu.edu/gradschool_theses/19. Accessed March 2022.

Goldman, E.A. 1950. Raccoons of North and Middle America. Fish and Wildlife Service, U.S. Department of the Interior. North American Fauna 60. 153 pp.

Gosselink, J.G. 1979. An ecological characterization study of the Chenier Plain Coastal Ecosystem of Louisiana and Texas. Volume 1 Narrative Report. U.S. Fish and Wildlife Service. FWS/OBS-78/9

Grantham, C.K. and J.P. Sloan. 1975. Toxicity Study Drilling Fluid Chemicals on Aquatic LifeConf.Proc.on Environ.Aspects of Chemical Use in Well-Drilling Operations, Research Triangle Inst., NC. EPA 560/1-75-004. (from ECOTOX)

Hamilton, Jr., W.J. 1936. The food and breeding habits of the raccoon. The Ohio Journal of Science 36: 131 – 140.

Hamilton, M.A., Rode, P.W., Merchant, M.E., and J. Sneddon. 2008. Determination and comparison of heavy metals in selected seafood, water, vegetation and sediments by inductively coupled plasma-optical emission spectrometry from an industrialized and pristine waterway in Southwest Louisiana. Microchemical Journal 88 (2008) 52–55.

Hamilton, W.J., Jr. 1951. Warm weather foods of the raccoon in New York state. J. Mammal. 32: 341-344.

Harper, C.A. 2007. Strategies for managing early succession habitat for wildlife. Weed Technology 21:932-937.

Hettiarachchi, G.M. and G.M. Pierzynski. 2004. Soil lead bioavailability and in situ remediation of lead-contaminated Soils: A Review. Environmental Progress 23: 78-93.

Holcomb, S.R, Reid, C.S., Seymour, M.A., Lorenz, N.F., Gregory, B.B., Javed, S.M., and K.F. Balkum. 2015. Louisiana Wildlife Action Plan. Louisiana Department of Wildlife and Fisheries. Available: https://www.wlf.louisiana.gov/assets/Resources/Publications/Wildlife_Action_Plans/Wildlife_Action_Plan_2015.pdf. Accessed October 2021.

Holloway, L. and P. Ritchie. 2022. Review of Plant Conditions and Vegetation Root Study on the Henning Management, LLC Site in Jefferson Davis and Calcasieu Parish, Louisiana in the matter: Henning Management LLC v. Chevron USA, Inc. et al. Docket No. 73318 (Div. C) 31st Judicial District Court, Parish of Jefferson Davis, State of Louisiana. Prepared by: Holloway Environmental Services, Inc., 9269 Hwy. 124, Harrisonburg, LA 71340 & Environmental Resources Management, 3838 N. Causeway Blvd. Suite 3000 Metairie, LA 70002. Luther F. Holloway, Ph.D. and Patrick M. Ritchiew, PWS. February 14, 2022.

Honarvar, S. 1975. Effect of drilling fluid components and mixtures on plants and soils. Utah State University. All Graduate Theses and Dissertations. 3497.

Hull, S.D., Shaffer, J.A., and L.D., Igl. 2019. The effects of management practices on grassland birds – Eastern Meadowlark (*Sturnella magna*), chap. MM of Johnson, D.H., Igl, L.D., Shaffer, J.A., and DeLong, J.P., eds. The effects of management practices on grassland birds: U.S. Geographical Survey Professional Paper 1842, 26 p. https://doi.org/10.3133/pp1842MM

Hutcheson, D.P., Gray, D.H., Venugopal, B., and T.D. Luckey. 1975. Studies of Nutritional Safety of Some Heavy Metals in Mice. The Journal of Nutrition, Vol 105, no.6.

ICON. 2021. Expert Report and Restoration Plan for the Landowners Henning Management, LLC v Chevron USA, Inc et al; Docket No. 73318; 31st JDC; Division “C”, Jefferson Davis Parish, LA, Hayes Oil Field, Calcasieu and Jefferson Davis Parish, LA. Gregory W. Miller and Wayne Prejean. September 30, 2021.

Janes, S.W. 1984. Influences of territory composition and interspecific competition on red-tailed hawk reproductive success. Ecology 65: 862-870.

Johnson, A.S. 1970. Biology of the raccoon (Procyon lotor varius Nelson and Goldman) in Alabama. Alabama Cooperative Wildlilfe Research Unit; Auburn Univ. Agric. Exp. Stn. Bull. 402.

Khangarot, B.S. 1991. Toxicity of Metals to a Freshwater Tubificid Worm, Tubifex (Muller). Bull. Environ. Contam. Toxicol.46:906-912. (from ECOTOX)

Khangarot, B.S. and P.K. Ray. 1989. Investigation of Correlation Between Physicochemical Properties of Metals and Their Toxicity to the Water Flea Daphnia magna Straus. Ecotoxicol. Environ. Saf.18(2): 109-121 (from ECOTOX)

Khangarot, B.S. and S. Das. 2009. Acute toxicity of metals and reference toxicants to a freshwater ostracod, Cypris subglobosa Sowerby, 1840 and correlation to EC(50) values of other test models. J Hazard Mater, 172(2-3):641-9.

Kubiak, M. and N.A. Forbes. 2012. Short Communications, Fluoroscopic Evaluation of Gastrointestinal Transit Time in African Grey Parrots. 10.1136/vr.100774, Veterinary Record.

Kuperman, R., Checkai, R., Phillips, C., Simini, M., and J. Speicher. 2002. Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (ECO-SSL) Using Enchytraeid Reproduction Benchmark Values. U.S. Army Soldier and Biological Chemical Command.

Kuperman, R., Checkai, R., Simini, M., Phillips, C., Speicher, J., and D. Barclift. 2006. Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Used Reproduction Endpoints for Folsomia candida, Eisenia fetida, and Enchytraeus crypticus. Environmental Toxicology and Chemistry 25: No. 3: 754-762.

Lamb, D.T., Vitukawalu, P.M., Palanisami, T., Megharaj, M., and R. Naidu. 2013. Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite. Environ. Sci. Technol. 47: 4670-4676.

Langmuir, D. 1997. Aqueous environmental geochemistry. Upper Saddle River, NJ: Prentice-Hall. 600 pp.

LDEQ. 2014. Louisiana Water Quality Ecoregions: For Use in Ecologically-Driven Water Quality Standards.

LDEQ. 2019. Data taken from the LDEQ's Louisiana Environmental Assessment Utility (LEAU) database. https://waterdata.deq.louisiana.gov/

LDWF. 2010a. "Freshwater Marsh." Natural Communities Fact Sheets. Available: https://www.wlf.louisiana.gov/assets/Resources/Publications/Natural_Communities_Fact_Sheets/Freshwater_Marsh.pdf . Accessed March 2022.

LDWF. 2010b. "Bottomland Hardwood Forest." Natural Communities Fact Sheets. Available: https://www.wlf.louisiana.gov/assets/Resources/Publications/Natural_Communities_Fact_Sheets/Bottomland_Hardwood_Forest.pdf . Accessed March 2022.

LDWF. 2010c. "Coastal Prairies." Natural Communities Fact Sheets. Available: https://www.wlf.louisiana.gov/assets/Resources/Publications/Natural_Communities_Fact_Sheets/Coastal_Prairie.pdf . Accessed March 2022.

LDWF. 2020a. "Louisiana's Animal Species of Greatest Conservation Need (SGCN) – Rare, Threatened, and Endangered Animals – 2020." Available: https://www.wlf.louisiana.gov/assets/Conservation/Protecting_Wildlife_Diversity/Files/rare_animals_tracking_list_2020.pdf. Accessed March 2022.

LDWF. 2020b. Louisiana Big and Small Game Harvest Survey for 2019-2020. https://www.wlf.louisiana.gov/assets/Resources/Publications/Hunting/louisiana_big_and_small_game_harvest_survey_2019-2020.pdf . Accessed March 2022.

LDWF. 2021. Rare, Threatened, and Endangered Ranks and Statuses. Available online: https://www.wlf.louisiana.gov/page/rare-threatened-and-endangered-ranks-and-statuses. Accessed March 2022.

Louisiana Department of Environmental Quality (LDEQ) Corrective Action Group. 2003. Risk Evaluation and Corrective Action Program (RECAP). 129 pp.

Louisiana Department of Environmental Quality (LDEQ). 2001. State-specific Background Arsenic Level in Soil: First Accessed online August 2011 via: http://thelensnola.org/wp-content/uploads/2010/02/LDEQ_Arsenic-background-level.pdf

Louisiana Department of Wildlife and Fisheries (LDWF). 2009. The Natural Communities of Louisiana. Louisiana Natural Heritage Program. Available: https://www.wlf.louisiana.gov/assets/Conservation/Protecting_Wildlife_Diversity/Files/natural_communities_of_louisiana.pdf. Accessed March 2022.

Luo, W., Verweij, R.A. and C.A.M. van Gestel. 2014. Contribution of soil properties of shooting fields to lead bioavailability and toxicity to Enchytraeus crypticus. Soil Biology & Biochemistry 76: 235-241.

Lytle, S. 1968. The morphological characteristics and relief relationships of representative soils in Louisiana. LSU AgCenter.

Macdonald J.M., Shields, J.D., and R.K. Zimmer-Faust. 1988. Acute toxicities of eleven metals to early life-history stages of the yellow crab Cancer anthonyi, Marine Biology 98, 201-207.

MacRoberts, M., MacRoberts, B., and Jackson, L. 2003. Louisiana Prairies. Chapter 6. Blackland Prairies of the Guld Coastal Plain, Four Existing Prairies. Edited by Evan Peacock and Timothy Schauwecker. University of Alabama Press.

Menzie, C.A., Southworth, B., Stephenson, G., and N. Feisthauer. 2008. The Importance of Understanding the Chemical Form of a Metal in the Environment: The Case of Barium Sulfate, Human and Ecological Risk Assessment, 14: 974–991.

Miller, R.W., Honarvar, S., and B. Hunsaker. 1980. Effects of drilling fluids on soils and plants: I. Individual fluid components. Journal of Environmental Quality. Volume 9. Issue 4. 547-552.

Molino, D. 2021. Rice farms double as bird habitats. Louisiana Farm Bureau News. Available: https://lafarmbureaunews.com/news/2021/11/3/rice-farms-double-as-bird-habitats. Accessed March 2022.

Nagel, W.O. 1943. How big is a 'coon. Missouri Conservationist 6-7.

Nagy, K.A. 2001. Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews Series B: Livestock Feeds and Feeding. 71(10): 3R-12R.

National Research Council. 2003. Bioavailability of Contaminants in Soils and Sediments, Processes, Tools and Applications. Division on Earth and Life Sciences, Water Science and Technology Board, Committee on Bioavailability of Contaminants in Soils and Sediments., Washington, D.C.

Natural Resources Conservation Service (NRCS). 1999. “Chapter 4: Corridor Benefits.” In Part 614.4 Conservation Corridor Planning at the Landscape Level Managing for Wildlife Habitat. U.S. Department of Agriculture Natural Resources Conservation Service. Part 190 National Biology Handbook. Available: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_014927.pdf. Accessed March 2022.

NatureServe. 2022. NatureServe Explorer. Available: https://explorer.natureserve.org . Accessed March 2022.

Nelson, D.W., Lui, S.L., and L.E. Sommers. 1984. Extractability and Plant Uptake of Trace Elements from Drilling Fluids. Journal of Environmental Quality, Vol. 13, No. 4.

Noss, R.F. 2012. “Species Richness in Southern Grasslands.” Forgotten grasslands of the South: natural history and conservation. Island Press, p 94.

NRCS. 2012. What is early successional habitat? U. S. Department of Agriculture. Available: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1081109.pdf. Accessed March 2022.

Ohio EPA. 1991. Fish Tissue Bottom Sediment Surface Water Organic & Metal Chemical Evaluation, Ottawa River, Ten Mile Creek, Toledo, Ohio, Division Of Water Quality Planning And Assessment. US Geological Survey. Pearl, Mississippi.

Pattee, O. and J.C. Franson. 1982. Short-term effects of oil ingestion on American Kestrals (Falco Sparverius). Journal of Wildlife Diseases, Vol. 18, No.2.

Payne, J.F. et al. 2006. Risks assoc. with drill. fluids at petrol. developm. sites in the offsh.: Eval. of the potent. for an aliph. HC- based drill. fluid to produce sedimen. toxicity and for barite to be acut. toxic to plankton. Can. Tech. Rep. Fish. Aquat. Sci. 2679

Payne, J.F., Andrews, C., Fancey, L., French, B., and K. Lee. 2011. Produced Water: Overview of Composition, Fates, and Effects. Chapter 21 Risks to Fish Associated with Barium in Drilling Fluids and Produced Water: A Chronic Toxicity Study with Cunner (Tautogolabrus adspersus).

Razavi, R. 2013. Ebullition Rates and Mercury Concentrations In St. Lawrence River Sediments And a Benthic Invertebrate. Environmental Toxicology and Chemistry, Vol. 32, No. 4, pp. 857–865.

Remsen, J.V., Swan, M.M., Cardiff, S.W., and Rosenberg, K.V. 1991. J. La. Ornith. 1(2): 35-50.

Ridal, J., Yanch, L.E., Fowlie, A.R., Razavi, N.R., Delongchamp, T.M., Choy, E.S., Fathi, M., Hodson, P.V., Campbell, L.M., Blais, J.M., Hickey, M.B.C., Yumvihoze, E., and D.R.S. Lean. 2010. Potential causes of enhanced transfer of mercury to St. Lawrence River Biota: implications for sediment management strategies at Cornwall, Ontario, Canada. Hydrobiologia 647:81–98.

Rodriguez, L., Rincon, J., Asencio, I., and L. Rodriguez-Castellanos. 2007. Capability of Selected Crop Plants for Shoot Mercury Accumulation from Polluted Soils: Phytoremediation Perspectives. Journal of Phytoremediation, 9:1–13, 2007.

Sample, B.E. and G.W. Suter II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory, Tennessee, U.S. Department of Energy.

Sample, B.E., Suter II, G.W., Beauchamp, J.J., and R.A. Efroymson. 1998a. Literature-derived bioaccumulation models for earthworms: development and validation. Environmental Toxicology and Chemistry 18(9): 2110-2120.

Sample, B.E., Suter II, G.W., Beauchamp, J.J., and R.A. Efroymson. 1998b. Development and validation of bioaccumulation models for small mammals. ES/ER/TM-219. Oak Ridge National Laboratory, Oak Ridge, TN.

Sanderson, G.C. 1984. Cooperative raccoon collections. Ill. Nat. Hist. Survey Div.; Pittman-Robertson Proj. W-49-R-31.

Schuttler, S., Monello, R.J., Ruiz-Lopez, M.J. and L.S. Eggert. 2015. The interplay between clumped resources, social aggregation, and genetic relatedness in the raccoon. Mammal Research 60: 365-373.

Silverman, S. and L.A. Tell. 2010. Radiology of Birds: Atlas of Normal Anatomy and Positioning. First Edition.

Simini, M., Checkai, R., Kuperman, R., Phillips, C., and J. Speicher. 2002. Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (ECO-SSL) Using Earthworm (Eisenia Fetida) Benchmark Values. U.S. Army Soldier and Biological Chemical Command.

Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E. and D.L. Fey. 2013. Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19 p. http://pubs.usgs.gov/ds/801/.

Smith, N.R. 2014. History, nesting population, migration, home range and habitats used by Louisiana bald eagles. LSU Master's Theses. 867.

Spencer, R.K. and J.A. Chapman. 1986. Seasonal feeding habits of New England and eastern cottontails. Proc. Penn. Acad. Sci. 60: 157-160.

Sprague, J.B. and W.J. Logan, 1979, Separate and Joint Toxicity to Rainbow Trout of Substances Used in Drilling Fluids for Oil Exploration, Environ. Pollut. 0013-9327.

Springer, M.A. and D.R. Osborne. 1983. Analysis of growth of the red-tailed hawk (Buteo jamaicensis). Ohio J. Sci 83: 13-19.

Steenhof, K. 1983. Prey weights for computing percent biomass in raptor diets. Raptor Res. 17: 15-27.

Stumm, W. and J.J. Morgan. 1996. Aquatic chemistry: Chemical equilibria and rates in natural waters. In 3rd (Ed.), Scope of aquatic chemistry 1996; 1-15. John Wiley & Sons: New York, NY.

Tabatabai, F.R. and M.L. Kennedy. 1988. Food habits of the raccoon (Procyon lotor) in Tennessee. J. Tenn. Acad. Sci. 63: 89-94.

Teck American, Inc. 2010. Upper Columbia River Screening Level Ecological Risk Assessment (SLERA) Teck American, Inc., Spokane, WA.

The Cornell Lab. 2022a. All About Birds: Bird Guide. Available: https://www.allaboutbirds.org/guide/. Accessed March 2022.

U.S. Department of Agriculture (USDA). 1988. Soil Survey of Calcasieu Parish.

U.S. Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. Volumes I and II. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R- 93/187a, b.

U.S. Fish and Wildlife Service (USFWS). 1994. Accumulation of Mercury in Sediments, Prey, And Shorebirds of Lavaca Bay, Texas, Phase II Report.

U.S. Forest Service (USFS). 2022. Ecosystem Services from National Grasslands. Available: https://www.fs.fed.us/grasslands/ecoservices/index.shtml. Accessed March 2022.

U.S. Geological Survey (USGS). 2002. Vertical Distribution of Trace-Element Concentrations and Occurrence of Metallurgical Slag Particles in Accumulated Bed Sediments of Lake Roosevelt, Washington. Scientific Investigations Report 2004-5090.

United States Department of Defense (USDOD). 2003. Final Guide for Incorporating Bioavailability Adjustments into Human Health and Ecological Risk Assessments at U. S. Department of Defense Facilities, Part 1: Overview of Metals Bioavailability Update Prepared for Tri-Service Ecological Risk Assessment Workgroup, Updated by Rosalind A. Schoof, Ph.D., From January 2000 Navy Edition, Prepared by Battelle and Exponent.

University of Michigan. 2001. Animal Diversity Web. Canis latrans. Tokar, E. https://animaldiversity.org/accounts/Canis_latrans/ . Accessed March 2022.

USDA. 2003. Soil Survey of Jefferson Davis Parish.

USDA. 2012. Wetland Indicator Status." Natural Resources Conservation Service PLANTS Database. Available: https://plants.usda.gov/wetinfo.html. Accessed October 2021.

USDA. 2021. Louisiana Rice Parish Estimates. Available: https://www.nass.usda.gov/Statistics_by_State/Louisiana/Publications/Parish_Estimates/2020/20_LA_rice.pdf. Accessed March 2022.

USDA. 2022. Natural Resources Conservation Service. PLANTS Database. https://plants.sc.egov.usda.gov/java . Accessed March 2022.

USEPA. 1997. Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final, EPA 540-R-97-006.

USEPA. 1998. Guidelines for Ecological Risk Assessment, EPA/630/R-95/002F.

USEPA. 1999. Toxicity Reference Values, Screening Level Ecological Risk Assessment Protocol, Multimedia Planning and Permitting Division Office of Solid Waste, Center for Combustion Science.

USEPA. 2005a. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs). OSWER Directive 92.857-55 and Attachment 1-2 (Assessment of whether to develop ecological soil screening levels for microbes and microbial processes).

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic, Interim Final, OSWER Directive 9285.7-62. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. March 2005.

USEPA. 2005c. Ecological Soil Screening Levels for Barium, Interim Final, OSWER Directive 9285.7-63. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. February 2005.

USEPA. 2005d. Ecological Soil Screening Levels for Cadmium, Interim Final, OSWER Directive 9285.7-65. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. March 2005.

USEPA. 2005e. Ecological Soil Screening Levels for Lead, Interim Final, OSWER Directive 9285.7-70. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. March 2005.

USEPA. 2006. Ecological Soil Screening Levels for Silver, Interim Final, OSWER Directive 9285.7-77. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. September 2006.

USEPA. 2007a. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs). Review of Background Concentrations for Metals (Attachment 4-1). OSWER Directive 92857-55.

USEPA. 2007b. Ecological Soil Screening Levels for Selenium, Interim Final, OSWER Directive 9285.7-72. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. June 2007.

USEPA. 2007c. Ecological Soil Screening Levels for Zinc Interim Final OSWER Directive 9285.7-73. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. June 2007.

USEPA. 2008. Ecological Soil Screening Levels for Chromium, Interim Final, OSWER Directive 9285.7-66. Office of Solid Waste and Emergency Response, 1200 Pennsylvania Avenue, N.W. Washington, DC 20460. April 2008.

USEPA. 2015. Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments EPA/600/R-15/176.

USEPA. 2022a. “Exhibit 1: Ecological hubs and corridors in the contiguous U.S., based on 2001 NLCD.” Ecological Connectivity. Report on the Environment: Explore ROE Indicators. Available: https://cfpub.epa.gov/roe/indicator.cfm?i=80. Accessed March 2022.

USEPA. 2022b. National Ecological Framework. Available: https://cfpub.epa.gov/roe/documents/NEF_brochure.pdf. Accessed March 2022.

USEPA. ProUCL Software, Version 5.1.02. https://www.epa.gov/land-research/proucl-software

USFWS. 2007. Lacassine National Wildlife Refuge Comprehensive Conservation Plan. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region. https://ecos.fws.gov/ServCat/DownloadFile/5799 . Accessed March 2022.

USFWS. 2011. Lacassine National Wildlife Refuge Habitat Management Plan. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region. https://ecos.fws.gov/ServCat/DownloadFile/16127?Reference=16600 . Accessed March 2022.

USFWS. 2021. Migratory Bird Hunting Activity and Harvest Report 2019-20 and 2020-21. https://www.fws.gov/sites/default/files/documents/migratory_bird_hunter_activity_harvest_report_2019-20_and_2020-21.pdf . Accessed March 2022.

Wharton, C.H., Kitchens, W.M., Pendleton, E.C., and T.W. Sipe. 1982. The ecology of bottomland hardwood swamps of the Southeast: a community profile. USFWS. 133 pp.

White, D.H. and E. Cromartie. 1985. Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas. Bulletin of Environmental Contamination and Toxicology 34: 295-300.

Wilson, D.E. and S. Ruff. 1999. The Smithsonian Book of North American Mammals. Smithsonian Institution Press.

Wojtowski, P.A. 2008. Fallow. Advances in Agronomy. Available: https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/fallow. Accessed March 2022.

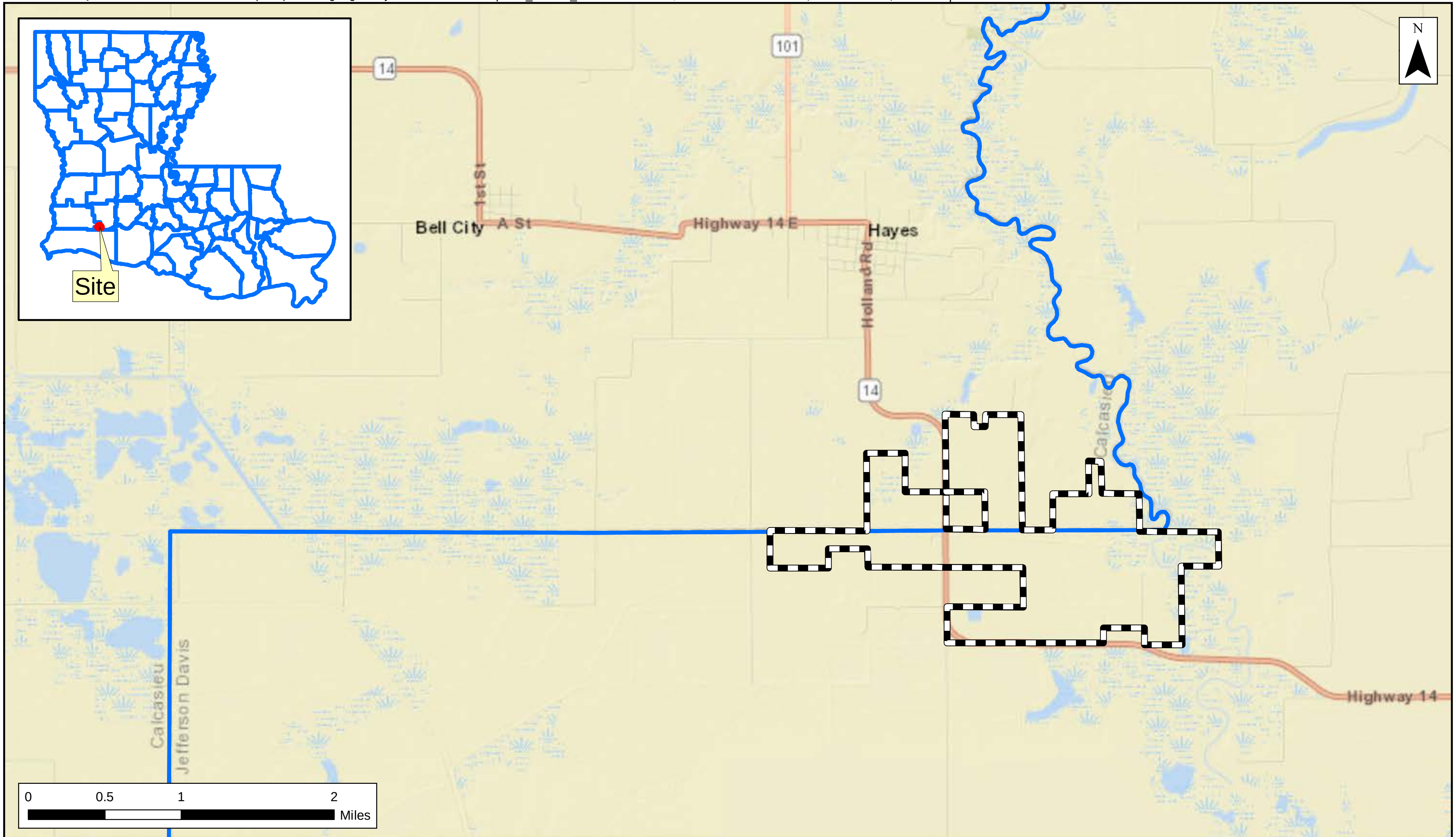
Xu, X., Bryan, A.L., Mills, G.L., and A.M. Korotasz. 2019. Mercury speciation, bioavailability, and biomagnification in contaminated streams on the Savannah River Site (SC, USA), Science of The Total Environment. 668, 261-270.

Zhong, B. and Xu, Yi Jun. 2014. Predicting climate change effects on surface soil organic carbon of Louisiana, USA. Environ Monit Assess 186:6169–6192.

Zhou, W., Liang, J., Pan, H., Liu, J., Liu, Y., and Y. Zhao. 2019. A model of the physiological and biochemical characteristics of earthworms (Eisenia fetida) in petroleum-contaminated soil. Ecotoxicology and Environmental Safety 174: 459-466.

FIGURES

15 March 2022



Property
Parish Boundary

Figure 1
Site Location
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
World Street Basemap via ArcGIS

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Source: Esri - ArcGIS Online; NAD 1983 UTM Zone 15N

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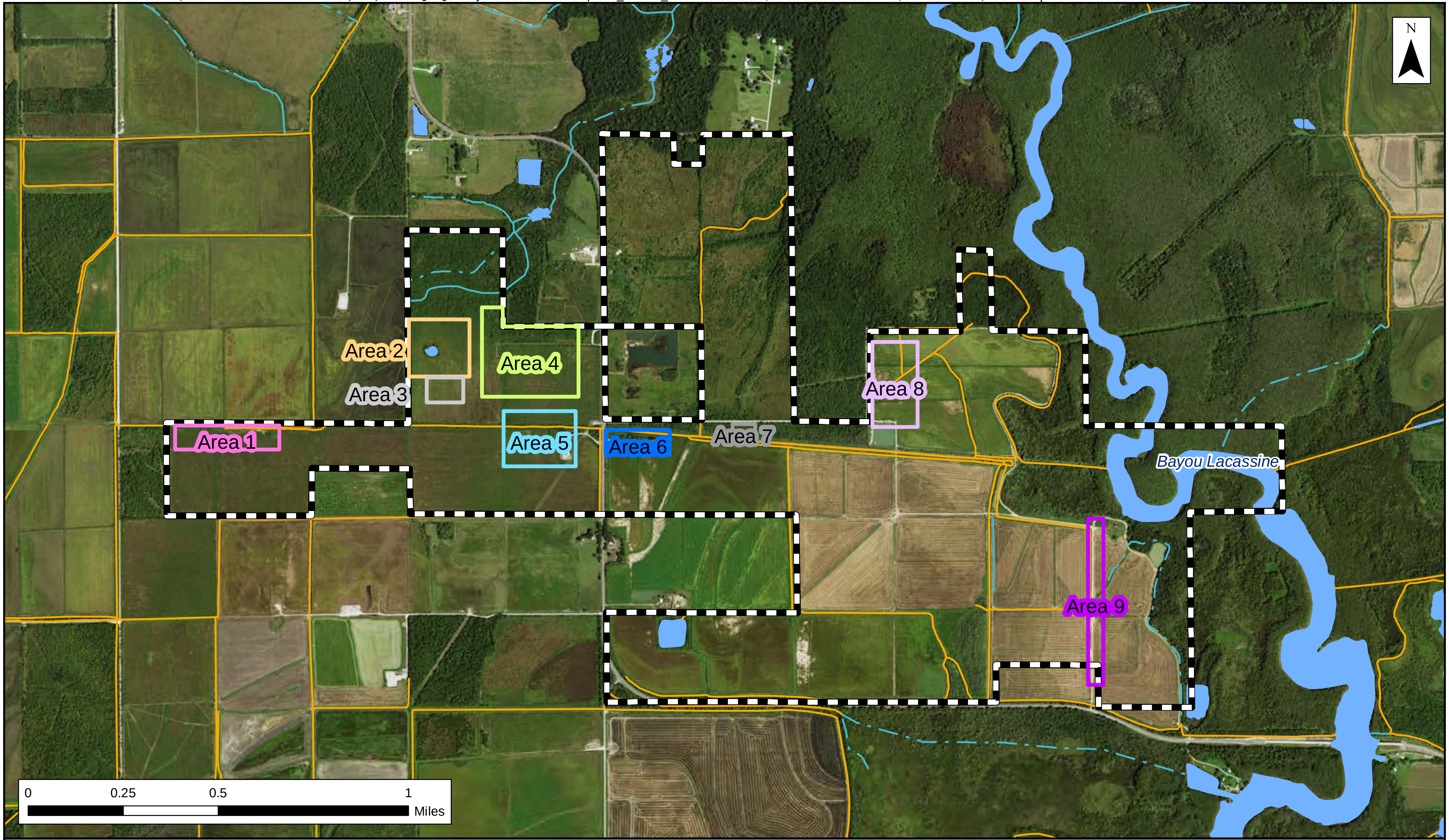

Property
Sampling
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9
Canal/Ditch
Stream/River - Perennial
Stream/River - Intermittent
Stream/River
Lake/Pond

Notes:
1- Hydrography data from the USGS National Map Viewer (https://viewer.nationalmap.gov/advanced-viewer/).
2- Based on Figure 7 of ERM Expert Report (Angle/Levert/Purdom) 2022
3- 2019 Aerial via Earth Explorer

Figure 2
Site Features
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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Source: Esri - ArcGIS Online; NAD 1983 UTM Zone 15N

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Property
Photo Location and Direction
ERM Vegetation Observation Locations
ERM Observation Path with Dr. Helen Connelly
ERM Observation Path

Sampling Areas

Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

Notes:
2019 Aerial via Earth Explorer
A-12 H-11 Vegetation Observation was the perimiter of the water feature.

Figure 3
Site Habitat
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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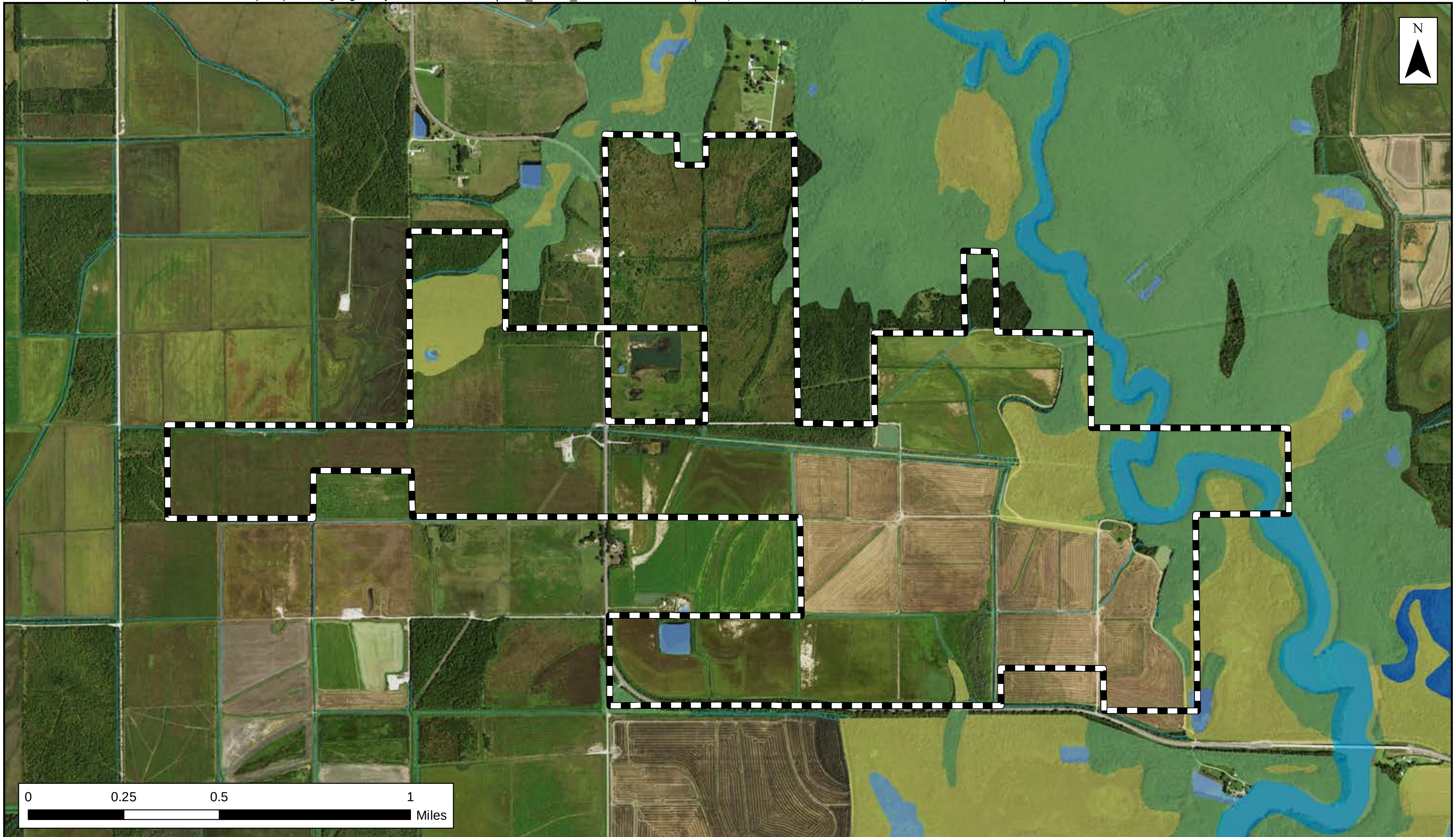

Property
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
River

Notes:
1- Wetland data from US Fish and Wildlife Service (https://www.fws.gov/wetlands/data/mapper.html).
2- 2019 Aerial via Earth Explorer

Figure 4
USFWS Wetlands Map
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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Source: Esri - ArcGIS Online; NAD 1983 UTM Zone 15N

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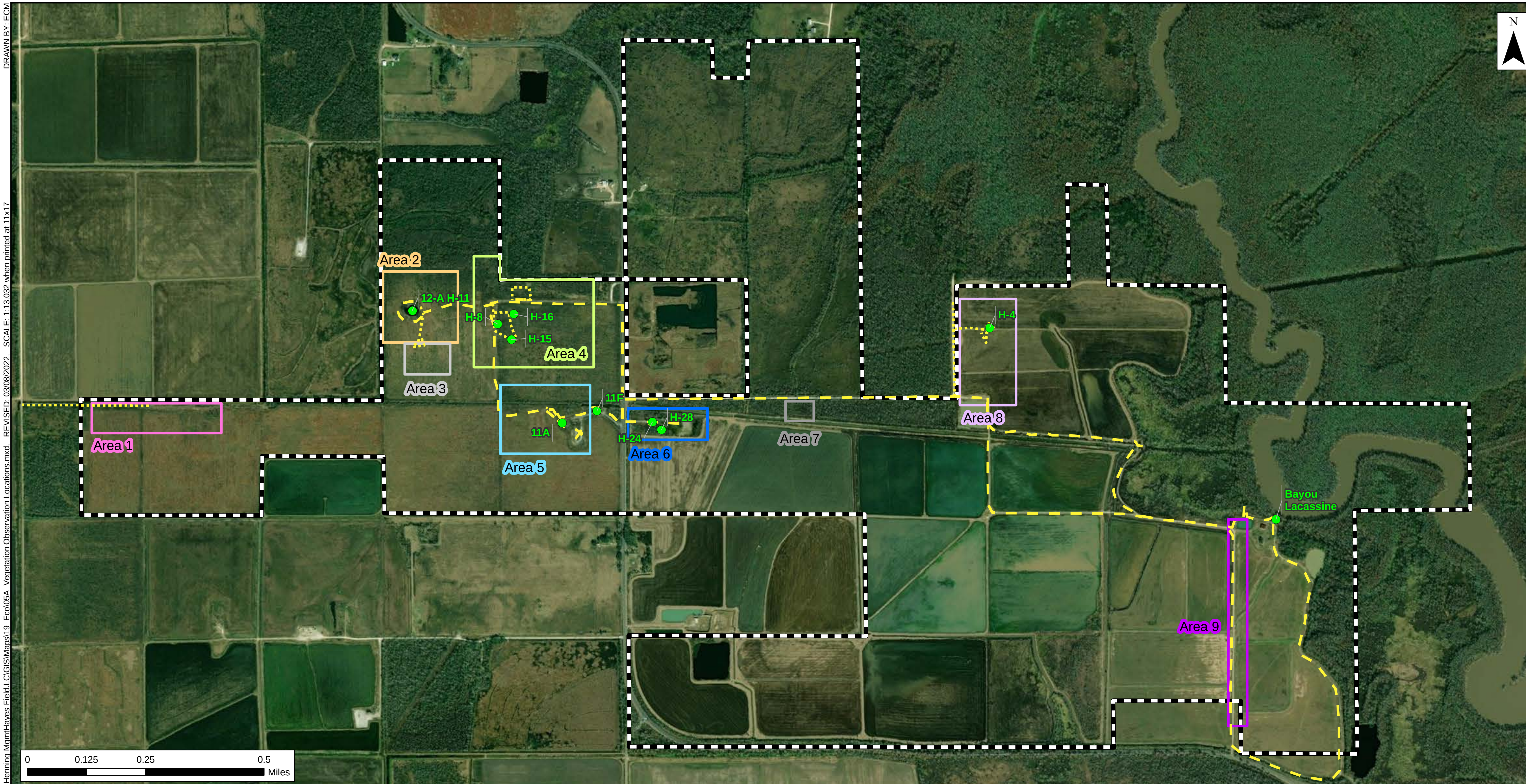

Property
ERM Vegetation Observation Locations
ERM Observation Path with Dr. Helen Connelly
ERM Observation Path

Sampling Areas
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

Notes:
2019 Aerial via Earth Explorer

Figure 5A
Vegetation Observation Locations: Site
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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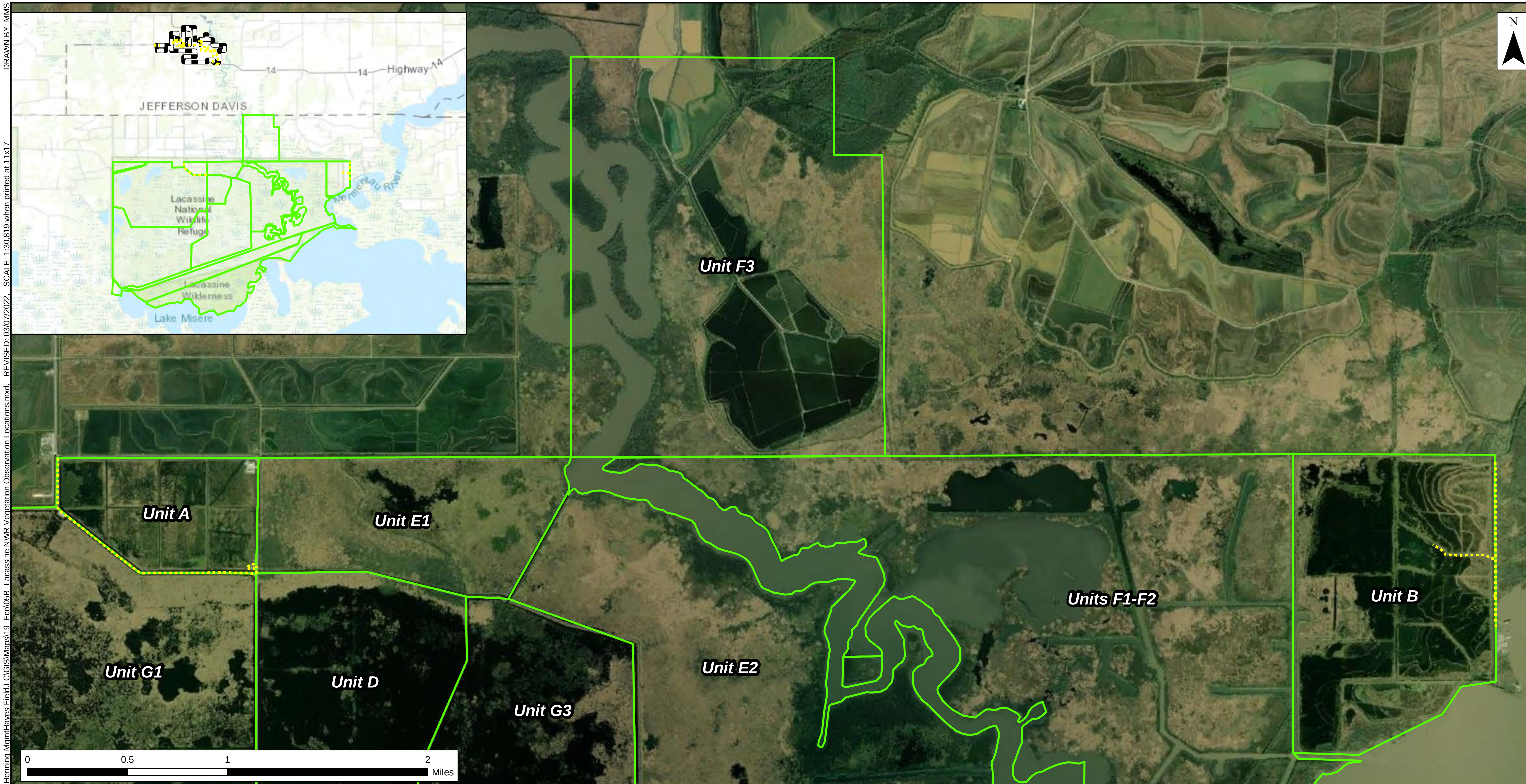

Property
Lacassine NWR Management Units
ERM Observation Path

Figure 5B

Vegetation Observation Locations: Lacassine National Wildlife Refuge

Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
Aerial Imagery Basemap via ESRI

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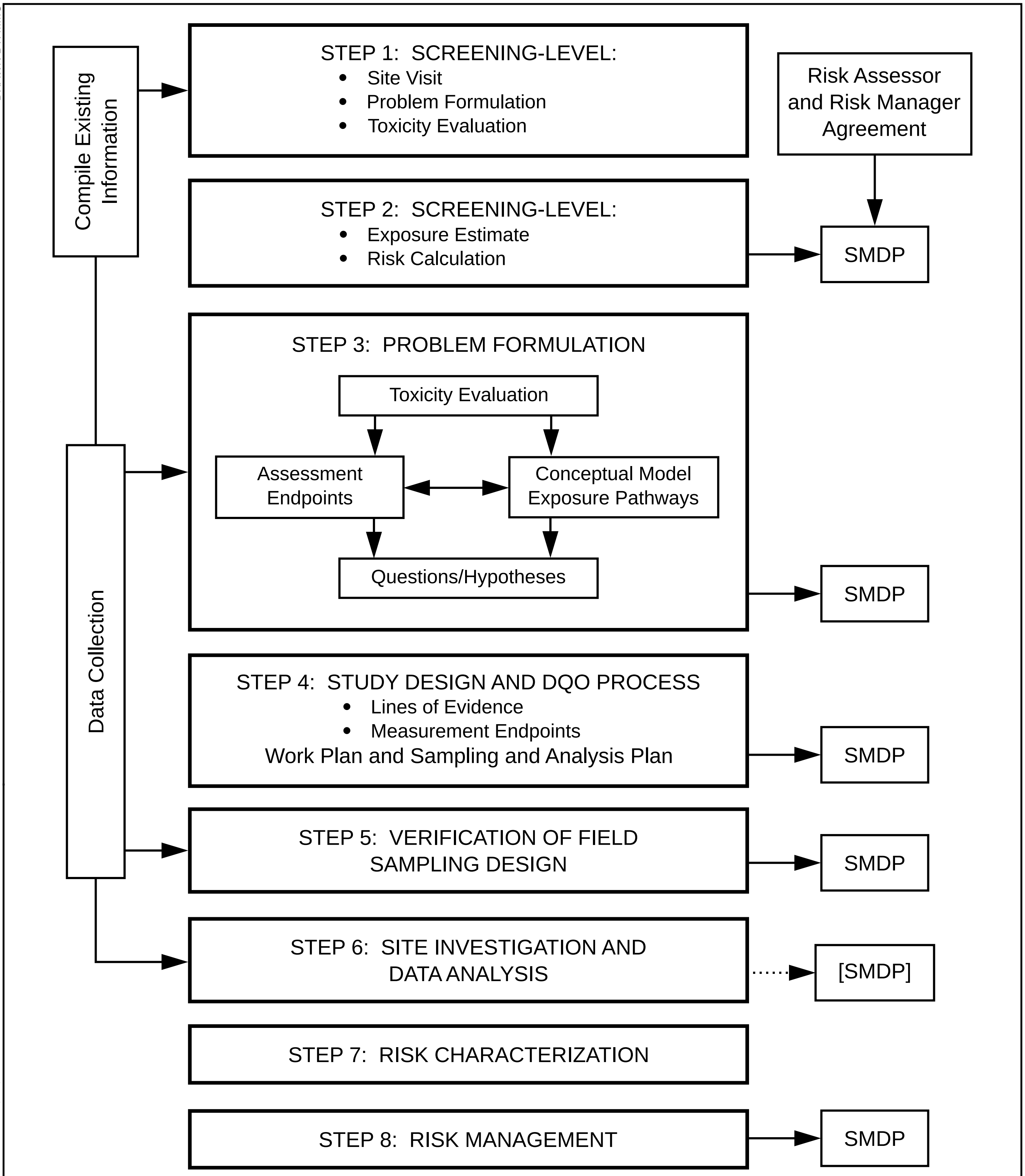

Figure 6
USEPA 8-Step Ecological Risk Assessment Process
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
From EPA "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments" June 1997

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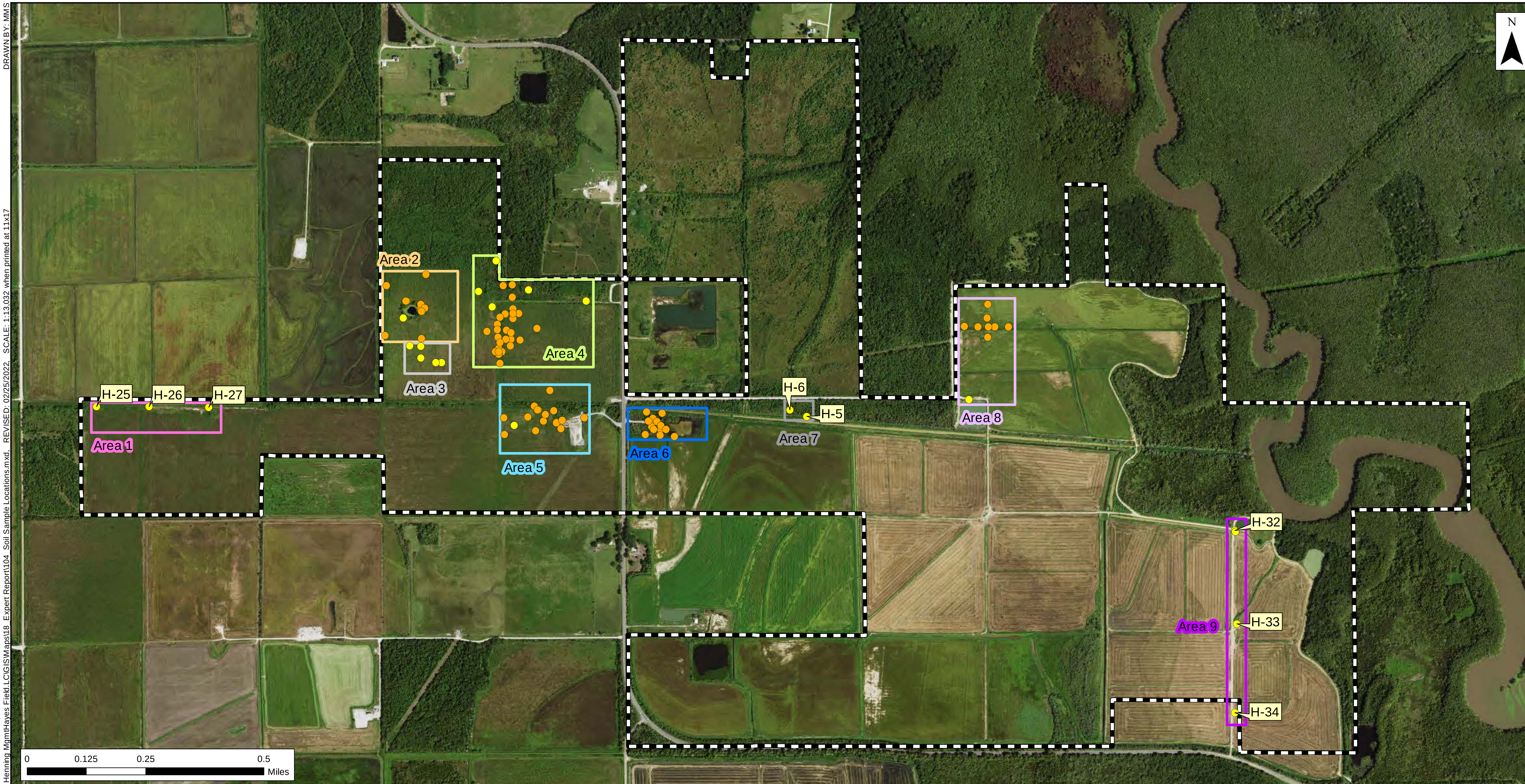

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas

Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

Figure 7
Soil Sample Locations
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
2019 Aerial via Earth Explorer

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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas

Area 2
Area 3
Area 4

Figure 8

Soil Sample Locations - Areas 2 & 3 Zoom

Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
2019 Aerial via Earth Explorer

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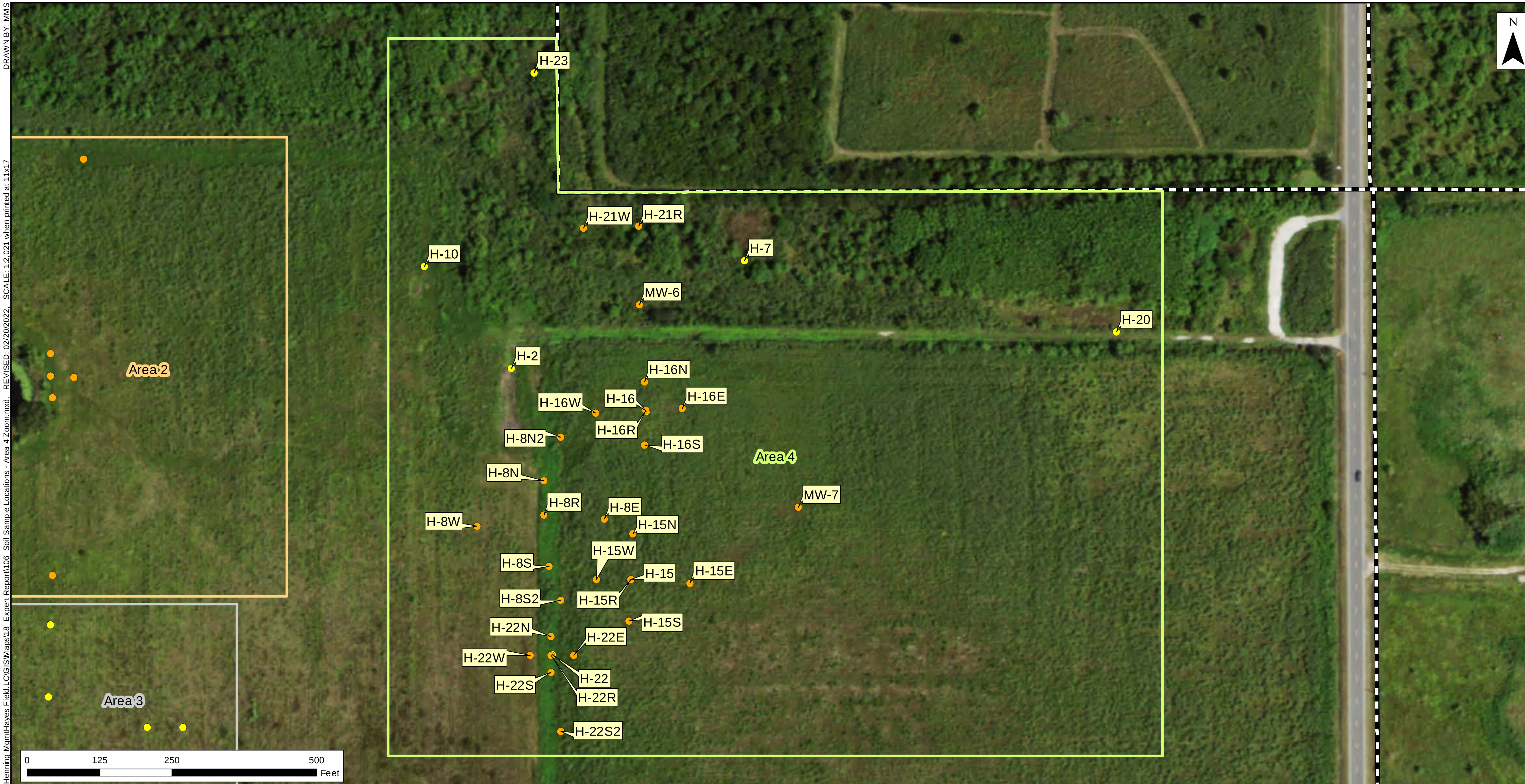

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

Figure 9
Soil Sample Locations - Area 4 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 5

Figure 10
Soil Sample Locations - Area 5 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
2019 Aerial via Earth Explorer

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Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 6

Notes:
2019 Aerial via Earth Explorer

Figure 11
Soil Sample Locations - Area 6 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 8

Figure 12
Soil Sample Locations - Area 8 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
2019 Aerial via Earth Explorer

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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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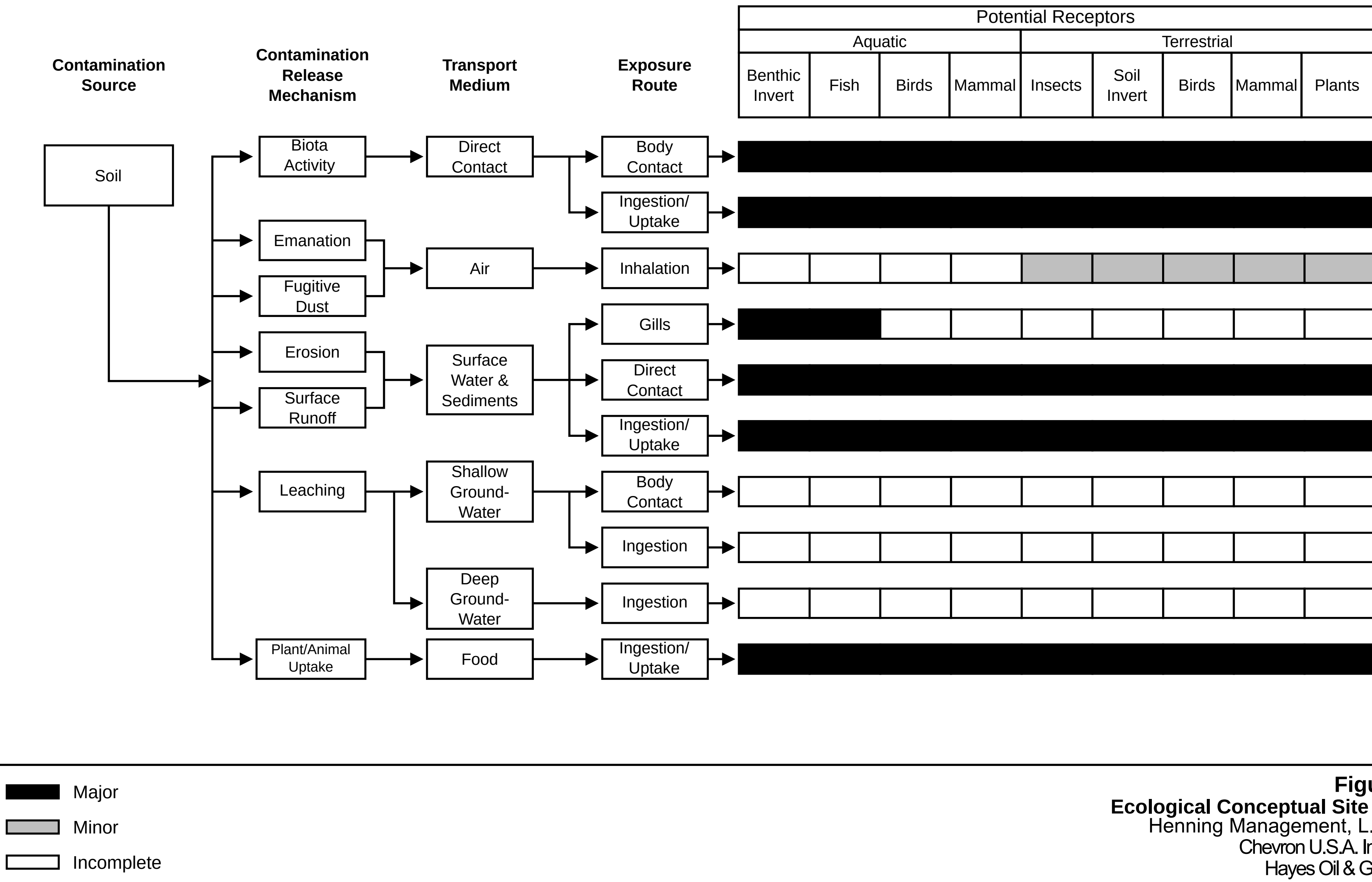

Figure 13
Ecological Conceptual Site Model
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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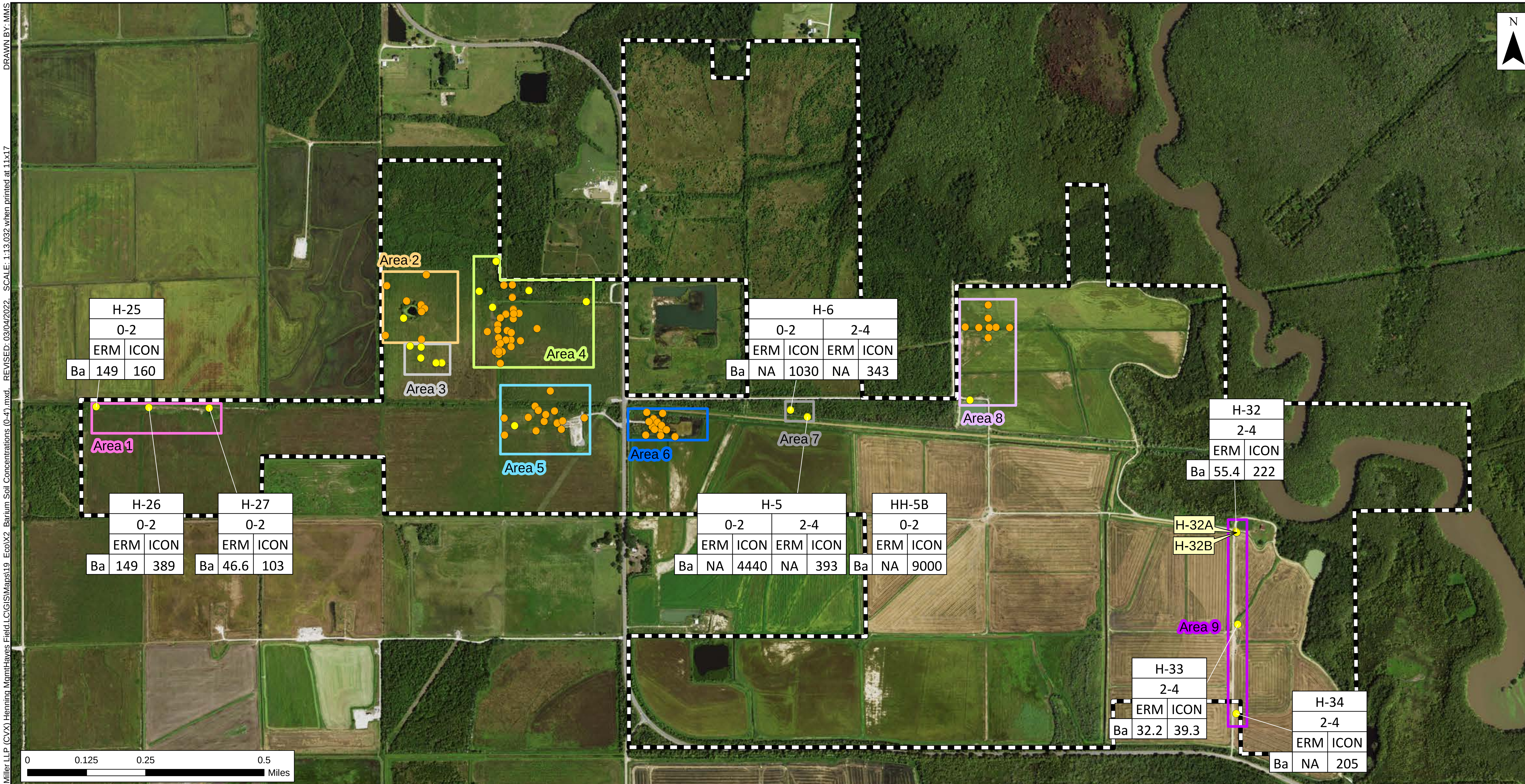

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Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 14
Barium Soil Concentrations (0-4')
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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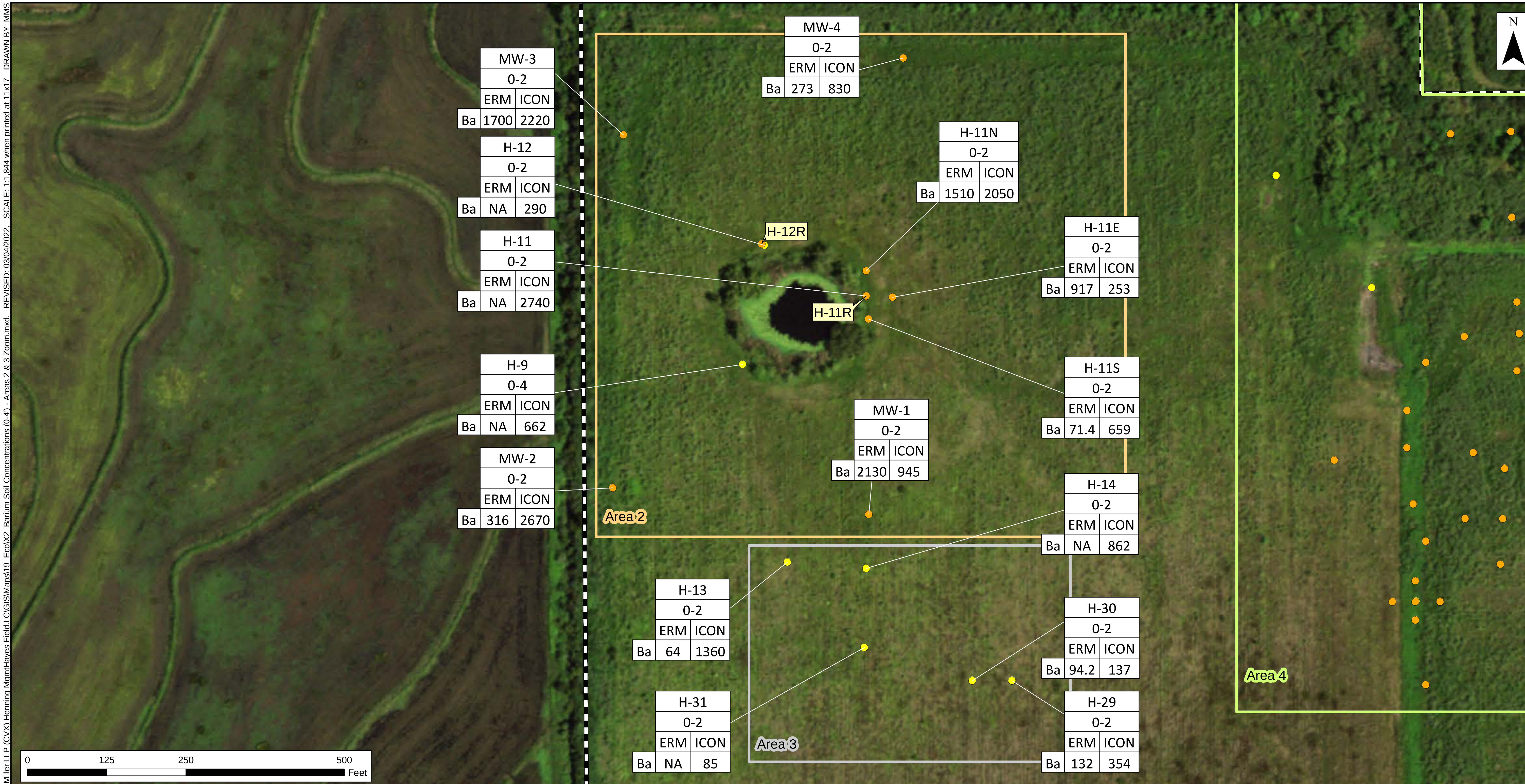

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 15
Barium Soil Concentrations (0-4') - Areas 2 & 3 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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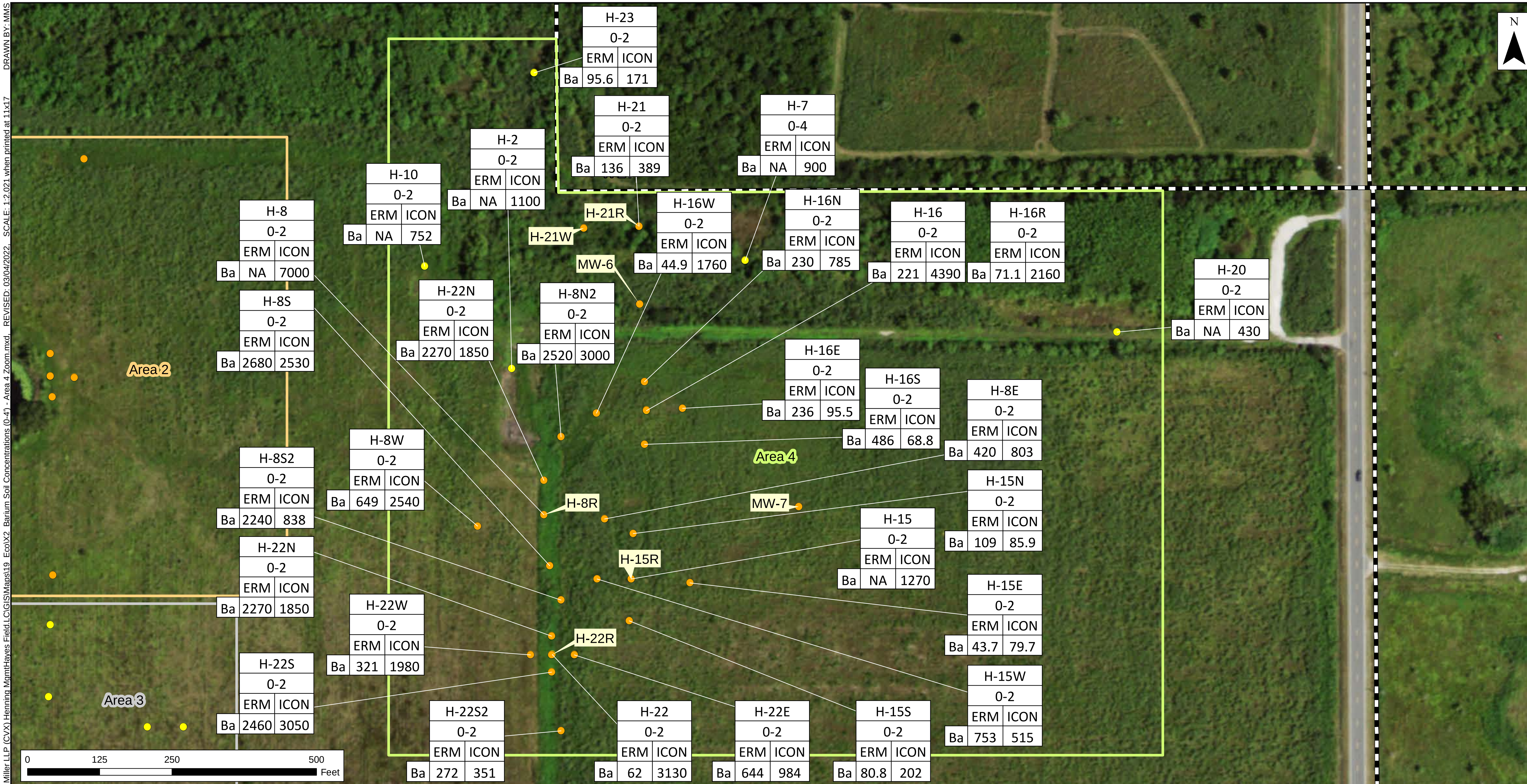

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas

Area 2
Area 3
Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 16
Barium Soil Concentrations (0-4') - Area 4 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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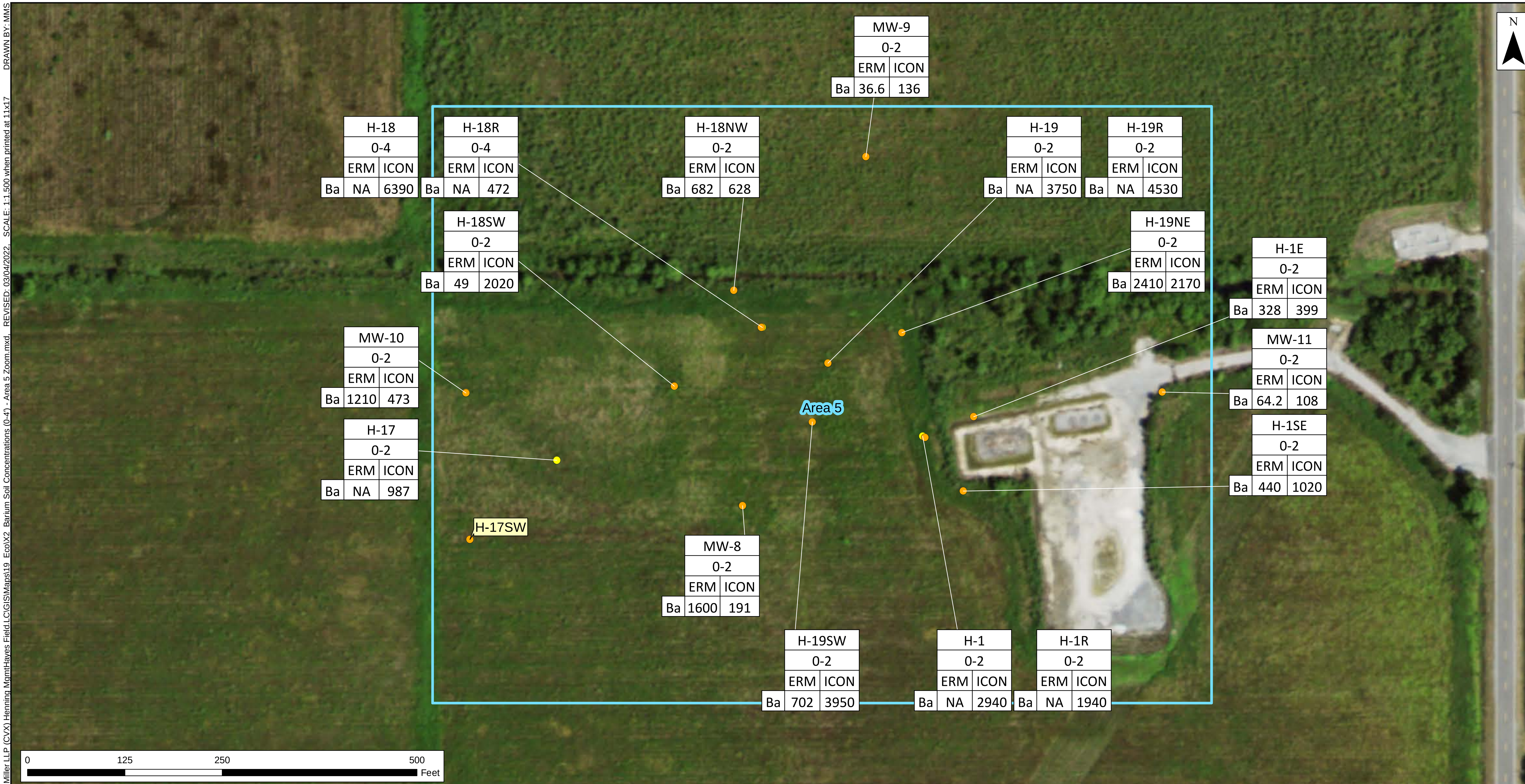

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Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 5

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 17
Barium Soil Concentrations (0-4') - Area 5 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Environmental Resources Management
www.erm.com
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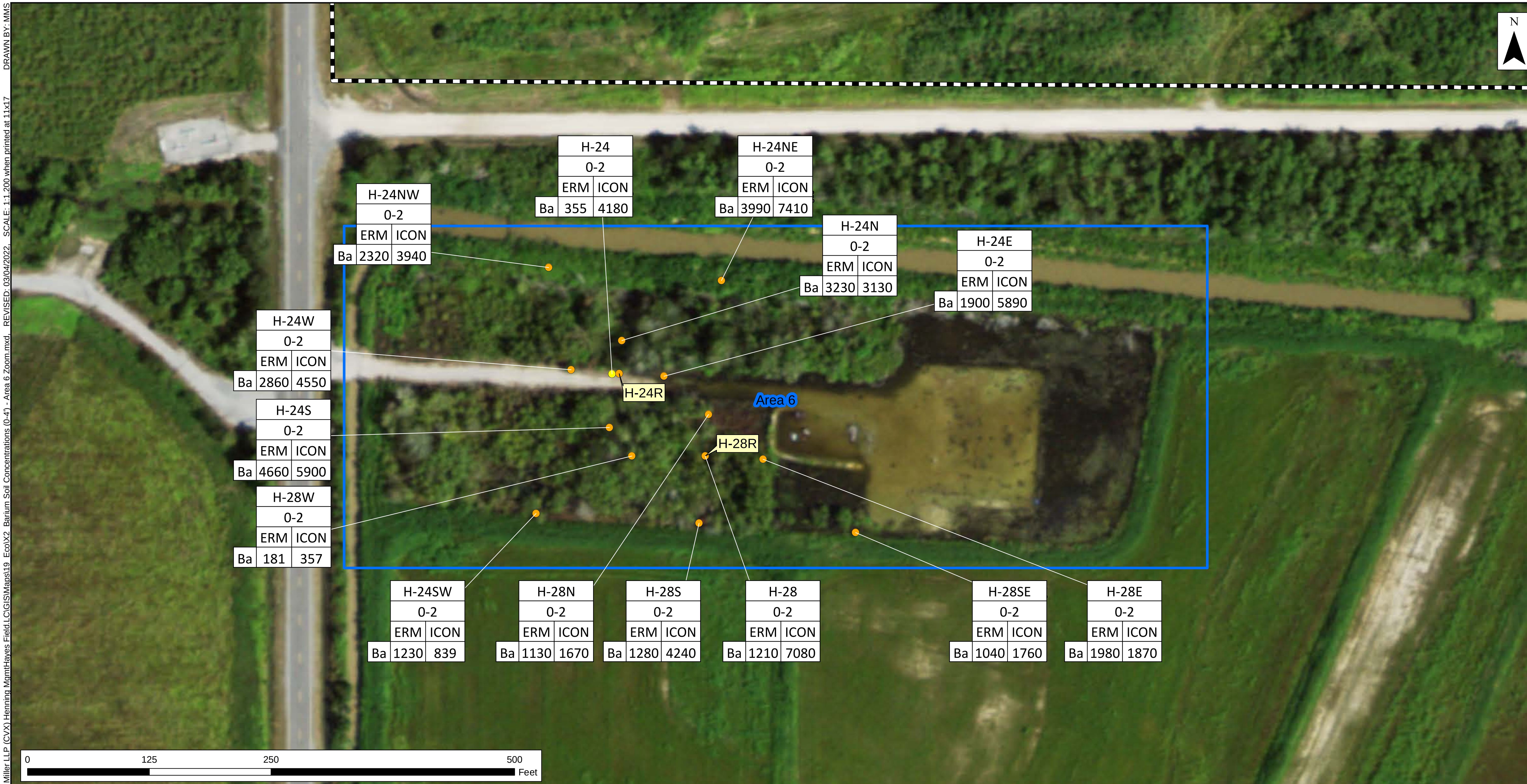
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 6

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 18
Barium Soil Concentrations (0-4') - Area 6 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 8

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 19
Barium Soil Concentrations (0-4') - Area 8 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
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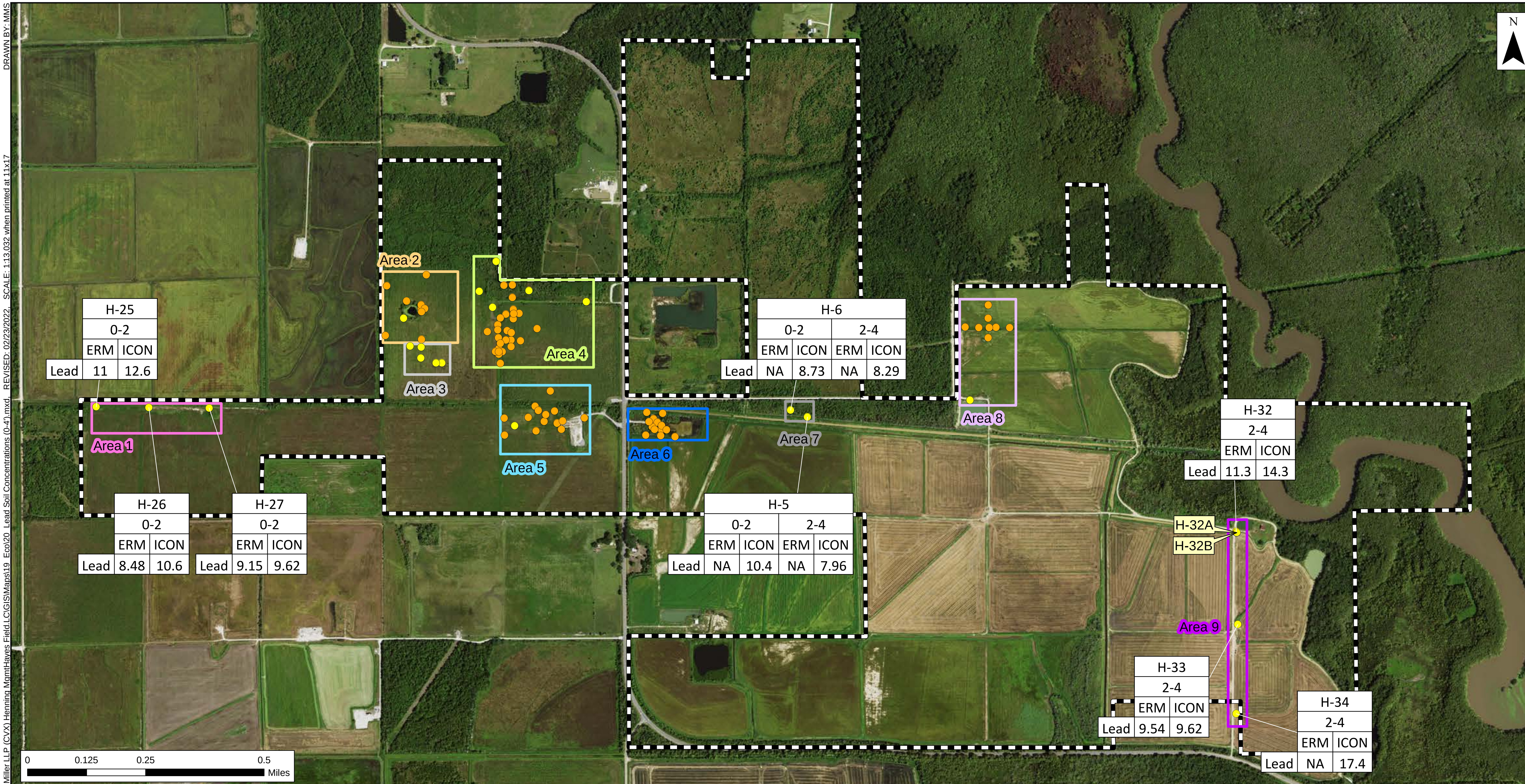
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 20
Lead Soil Concentrations (0-4')
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
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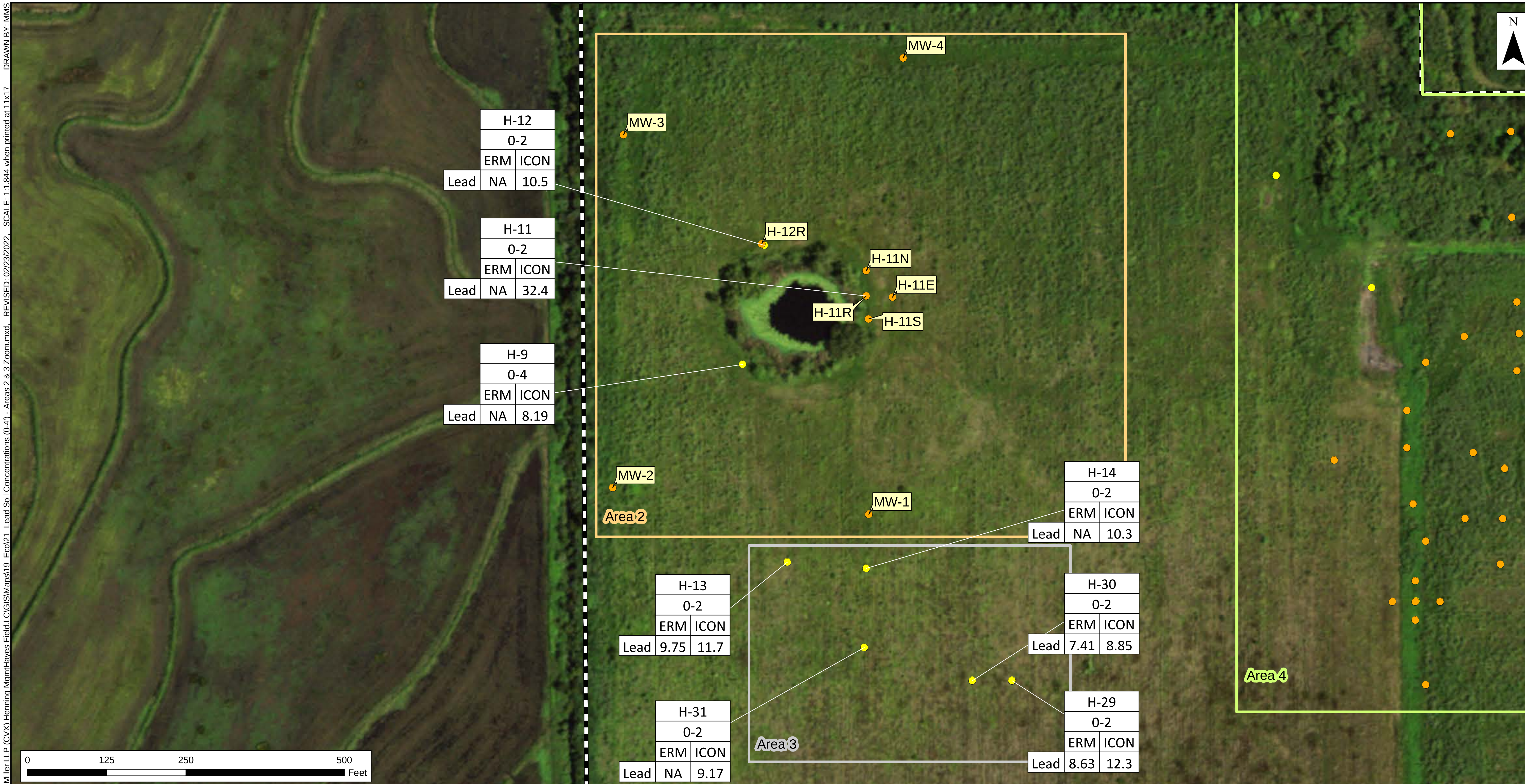
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 21
Lead Soil Concentrations (0-4') - Areas 2 & 3 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
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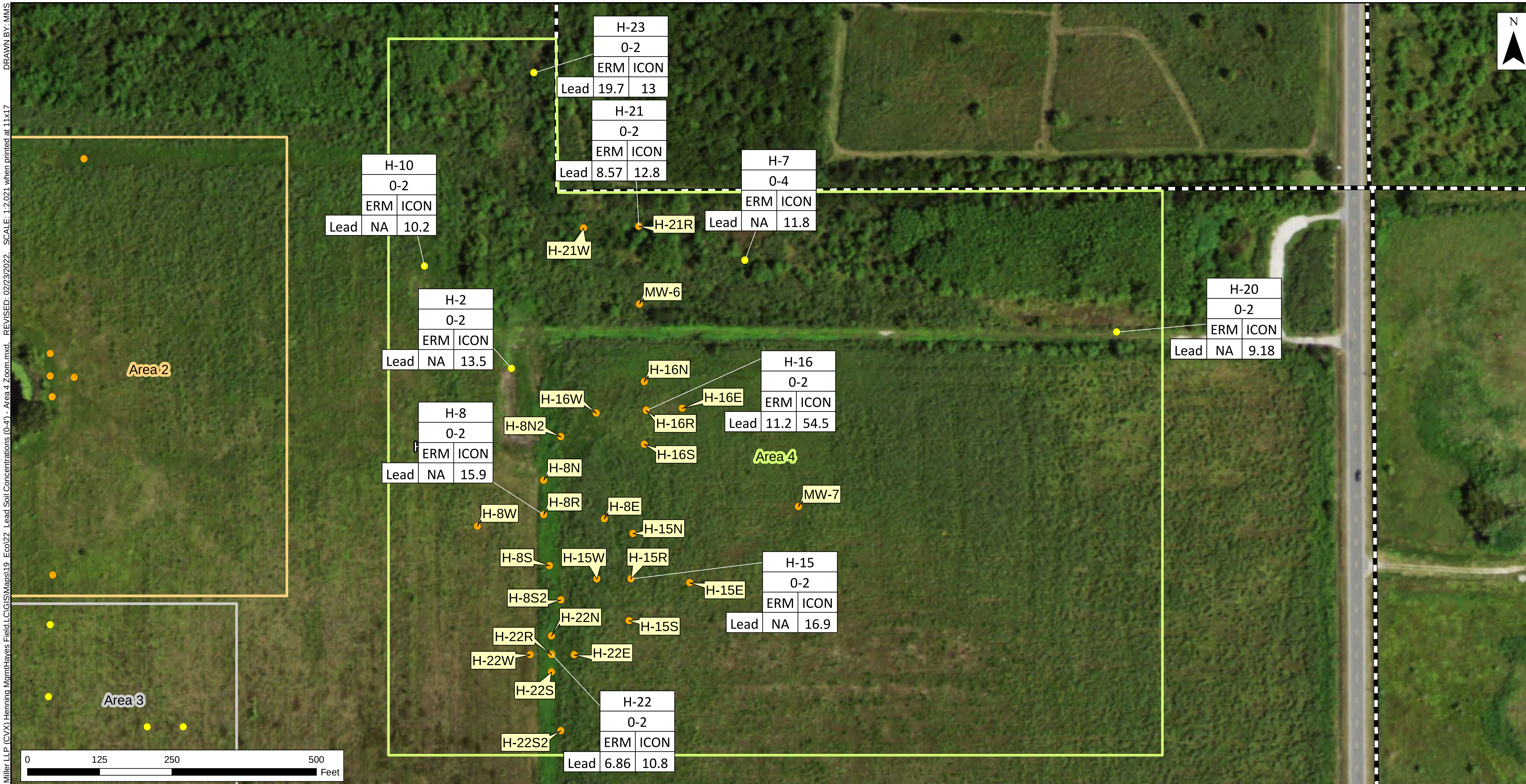
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property

ERM Soil Sample Location

ICON Soil Sample Location

Sampling Areas

Area 2

Area 3

Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 22
Lead Soil Concentrations (0-4') - Area 4 Zoom
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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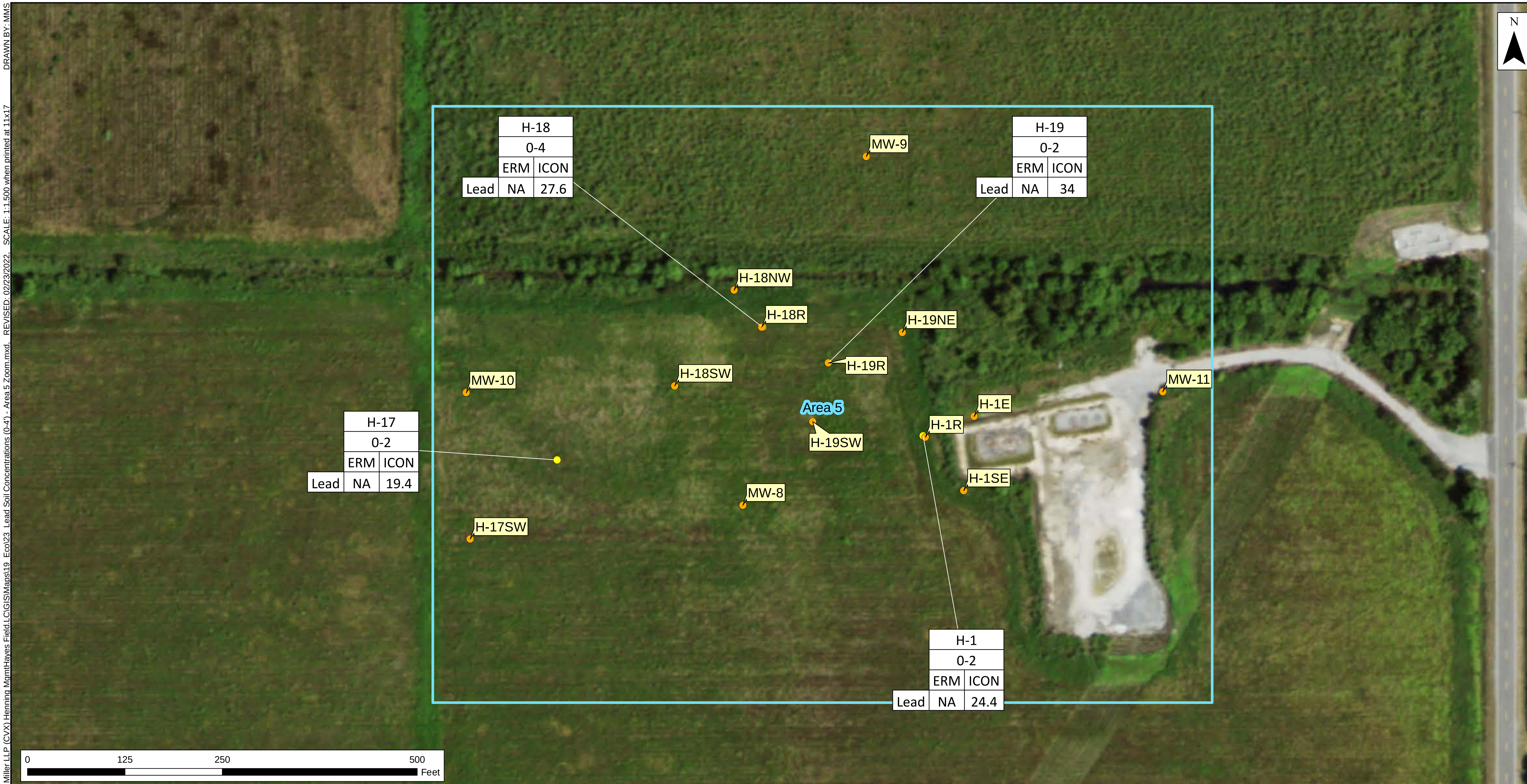

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 5

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 23
Lead Soil Concentrations (0-4') - Area 5 Zoom
Henning Management, L.L.C. v.
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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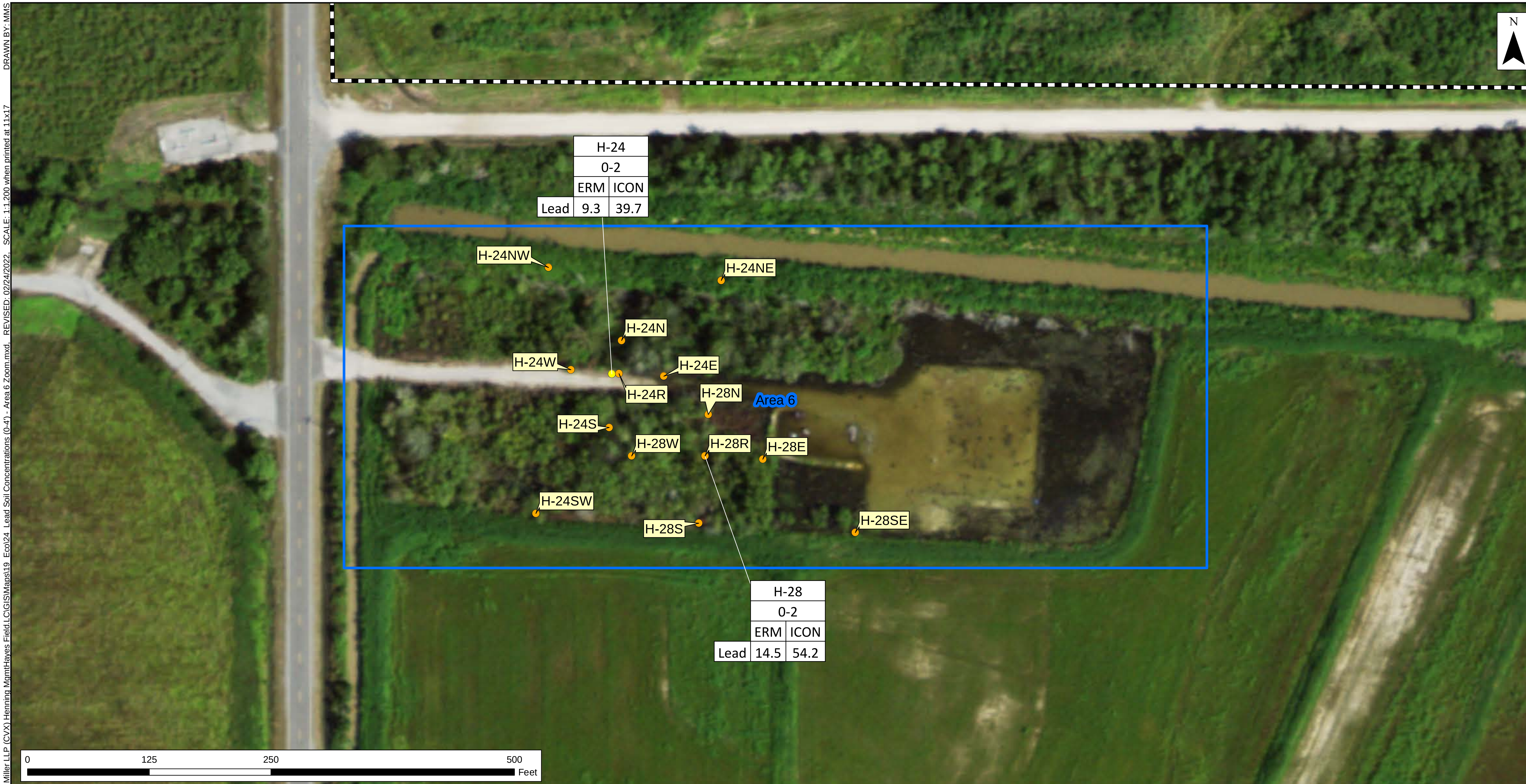

Property

ERM Soil Sample Location

ICON Soil Sample Location

Sampling Areas

Area 6

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 24
Lead Soil Concentrations (0-4') - Area 6 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

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Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 8

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 25
Lead Soil Concentrations (0-4') - Area 8 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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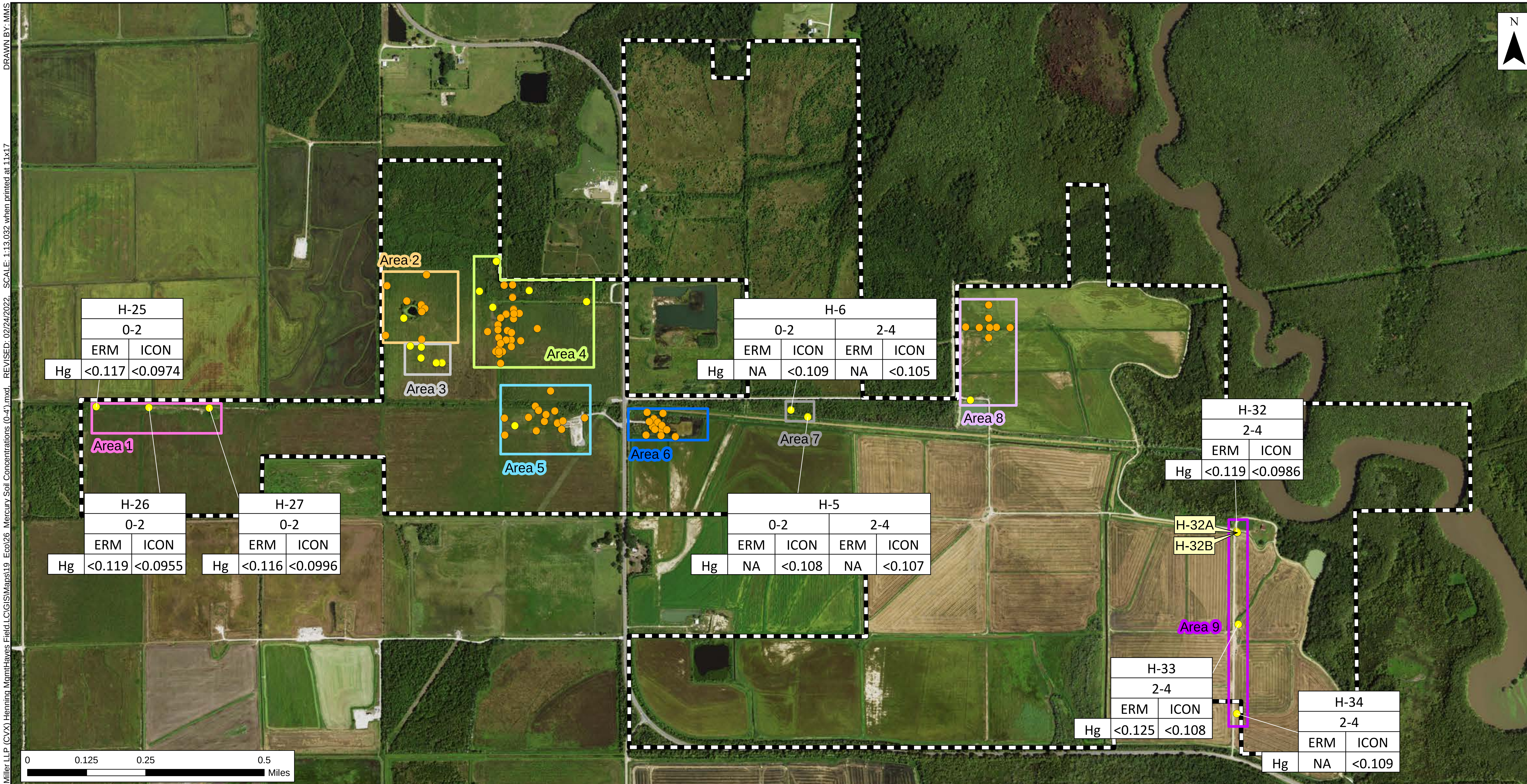
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 26
Mercury Soil Concentrations (0-4')
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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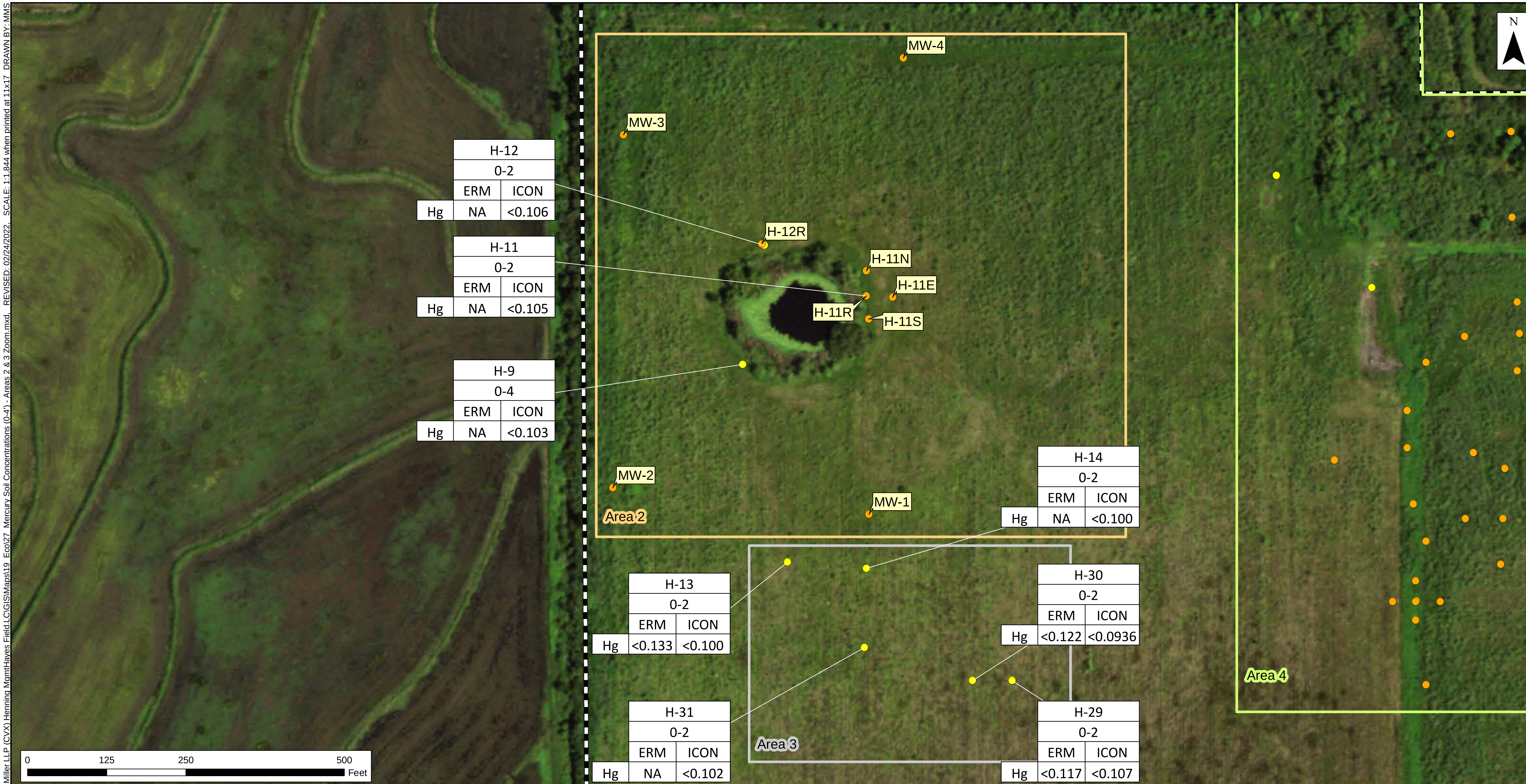

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 27
Mercury Soil Concentrations (0-4') - Areas 2 & 3 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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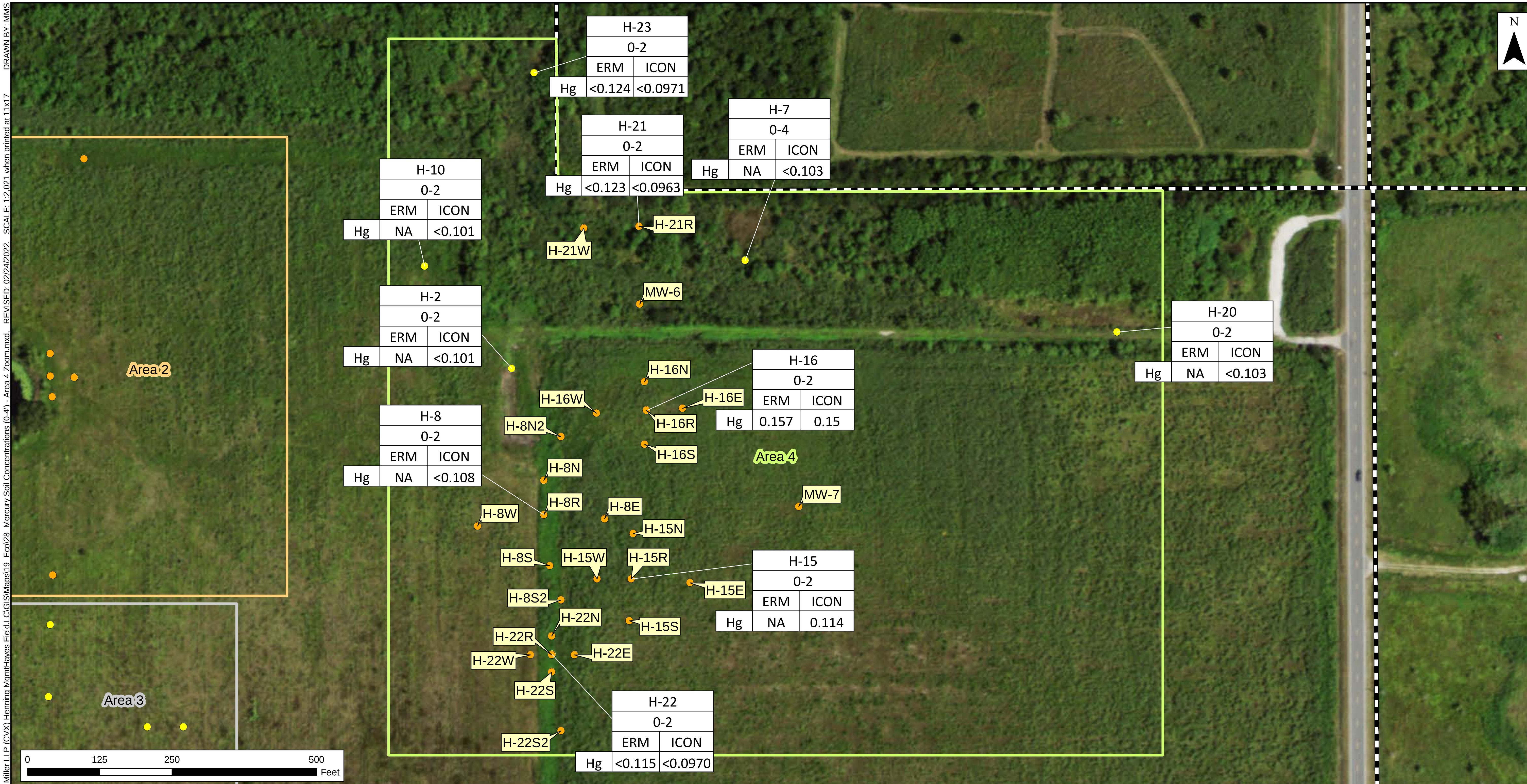
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 28
Mercury Soil Concentrations (0-4') - Area 4 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
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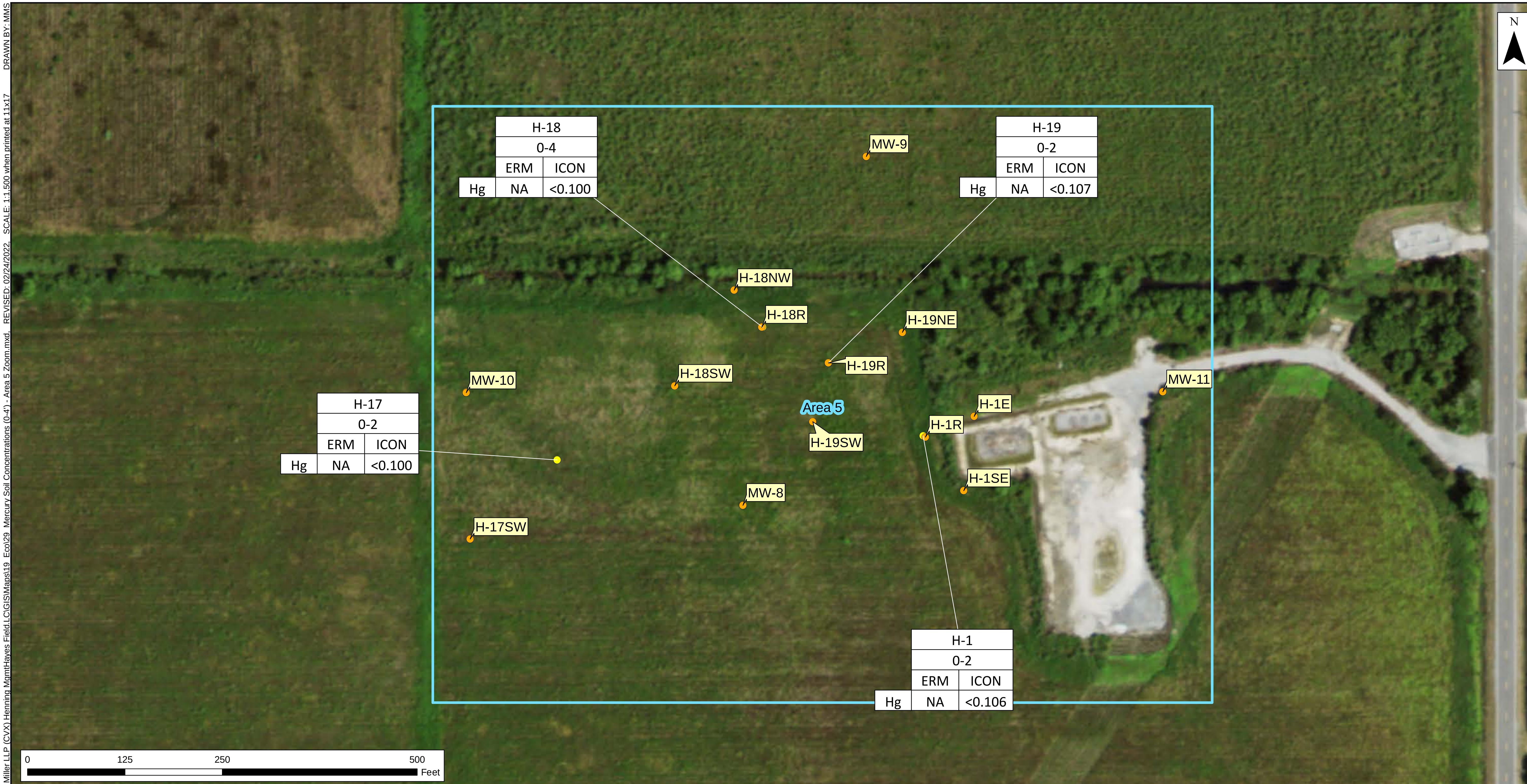

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 5

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 29
Mercury Soil Concentrations (0-4') - Area 5 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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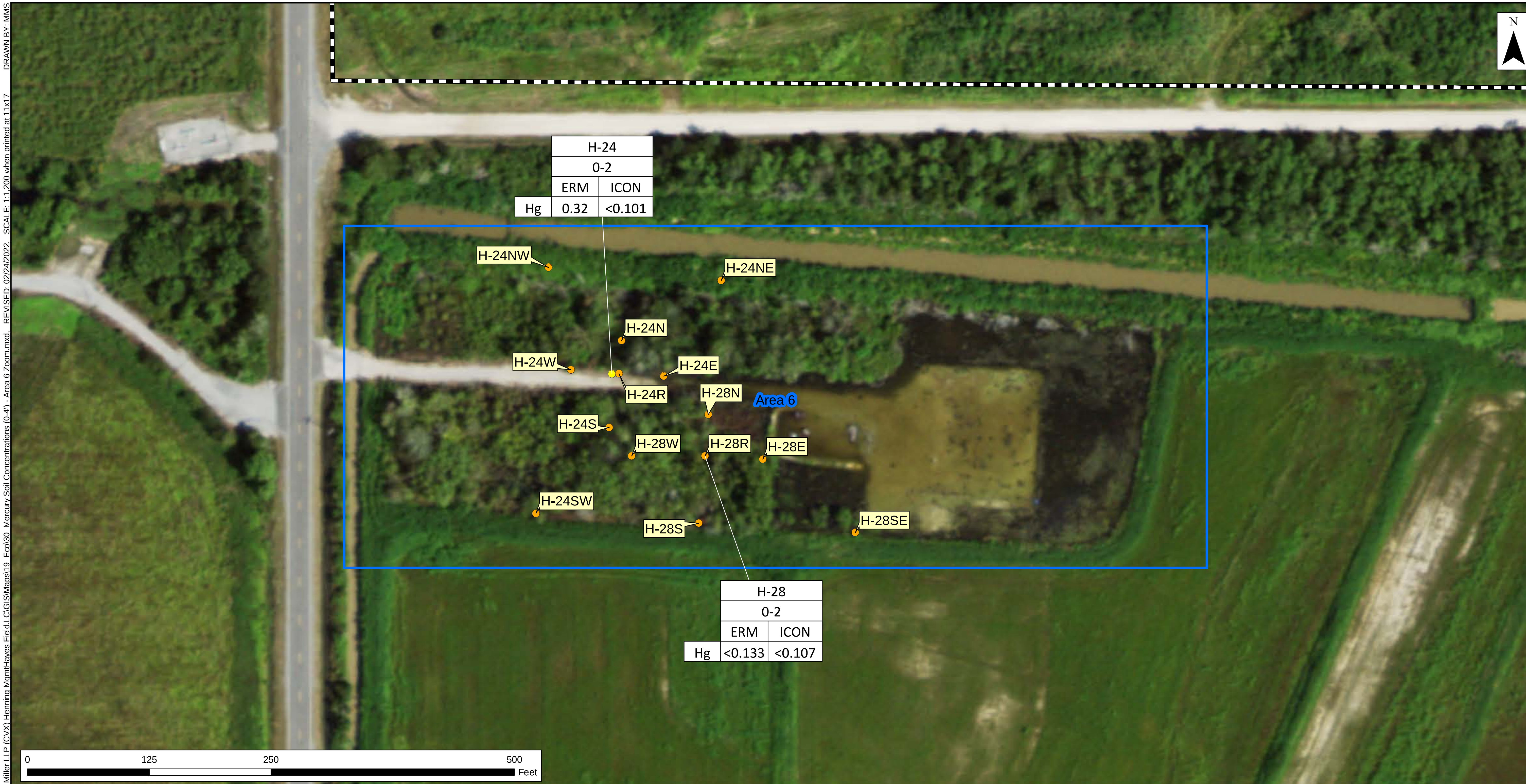

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 6

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 30
Mercury Soil Concentrations (0-4') - Area 6 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 8

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 31
Mercury Soil Concentrations (0-4') - Area 8 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

Property
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 5

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 32
Sum TPH Fractions Soil Concentrations (0-4') - Area 5 Zoom
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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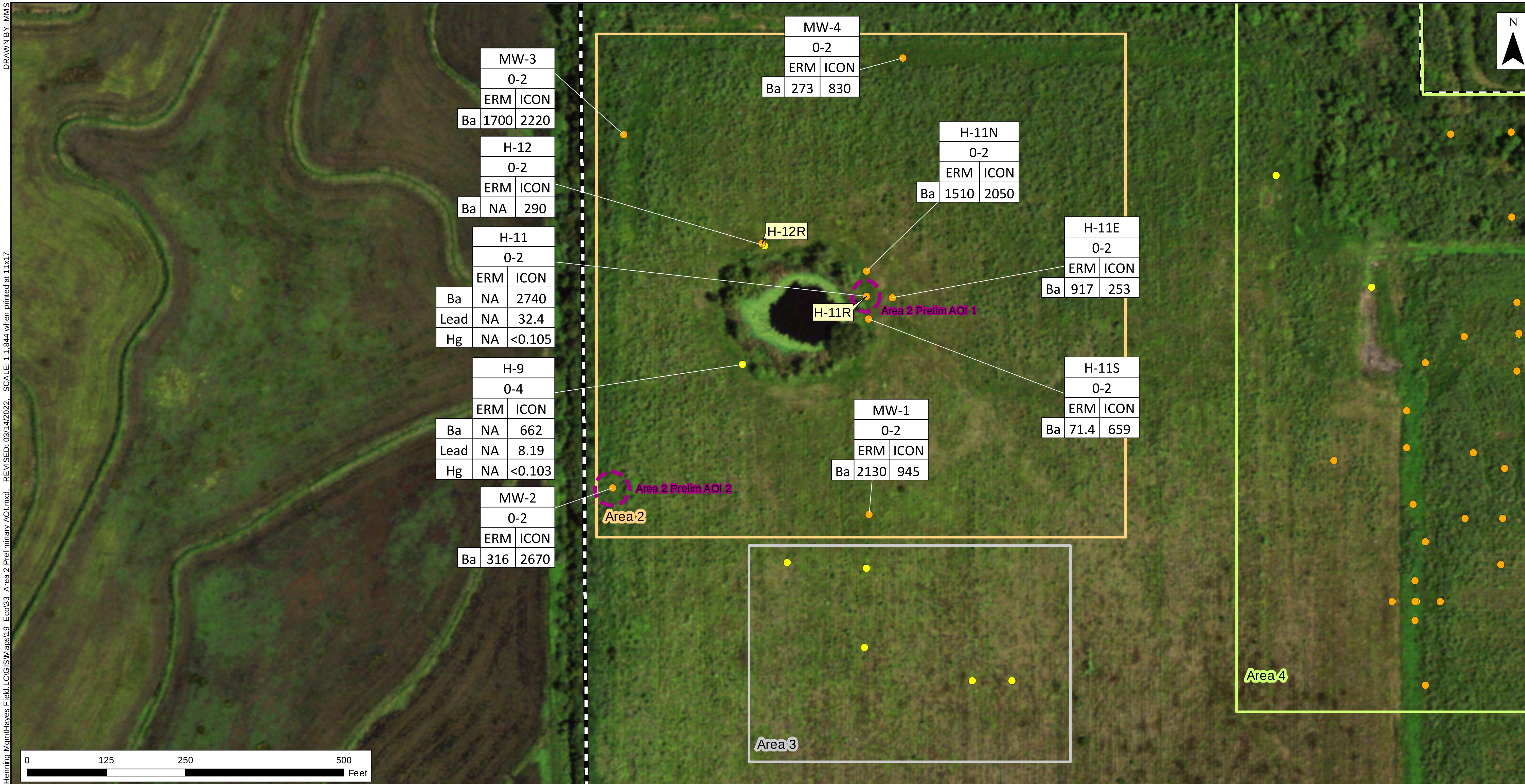
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
Preliminary AOI
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
Preliminary AOI boundaries are based on calculated barium soil screening value of 2424 mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 33
Area 2 Preliminary AOI
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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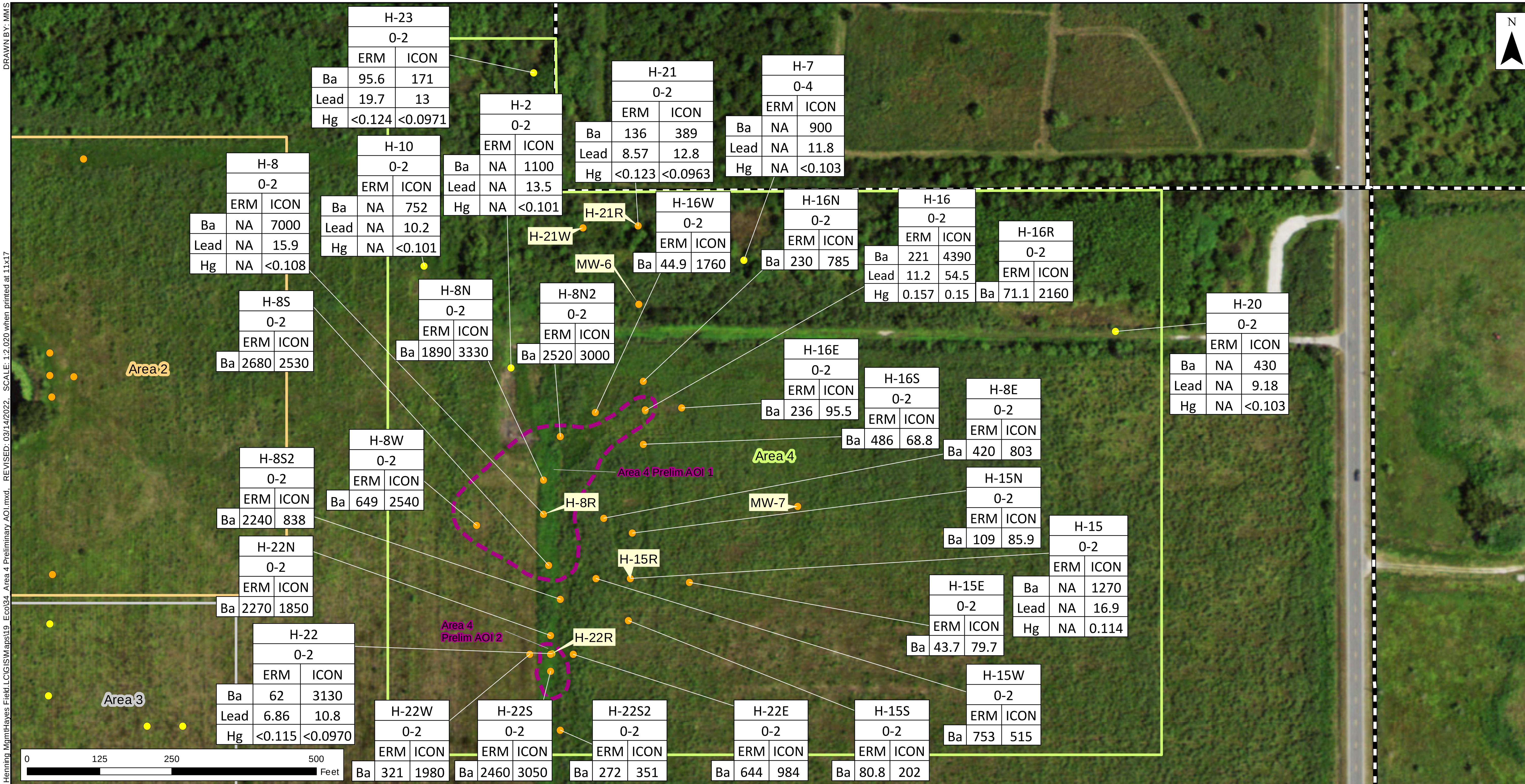

Property
Preliminary AOI
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 2
Area 3
Area 4

Sample ID		
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
Preliminary AOI boundaries are based on calculated barium soil screening value of 2424 mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 34
Area 4 Preliminary AOI
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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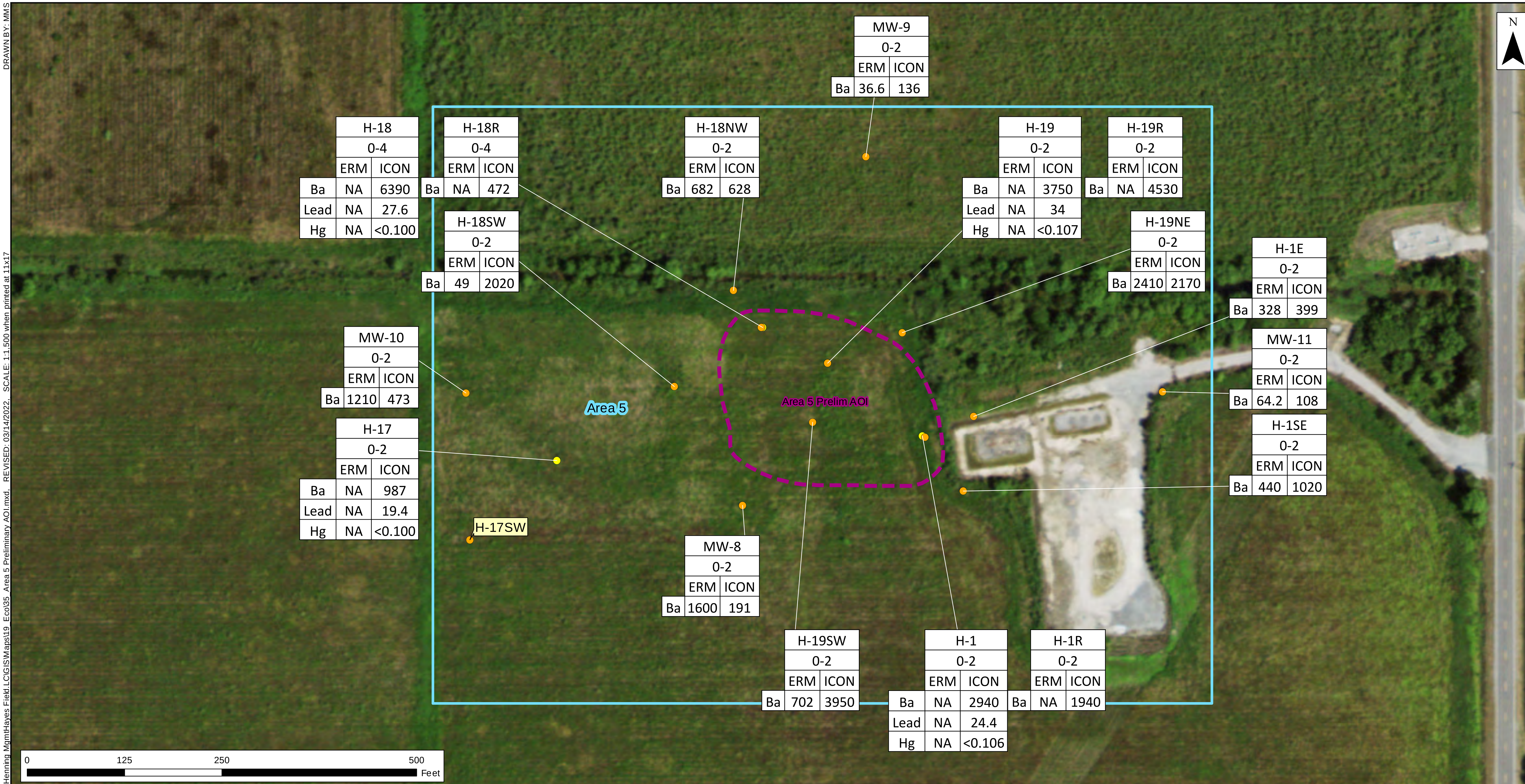

Property
Preliminary AOI
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 5

Sample ID		
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
Preliminary AOI boundaries are based on calculated barium soil screening value of 2424 mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 35
Area 5 Preliminary AOI
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

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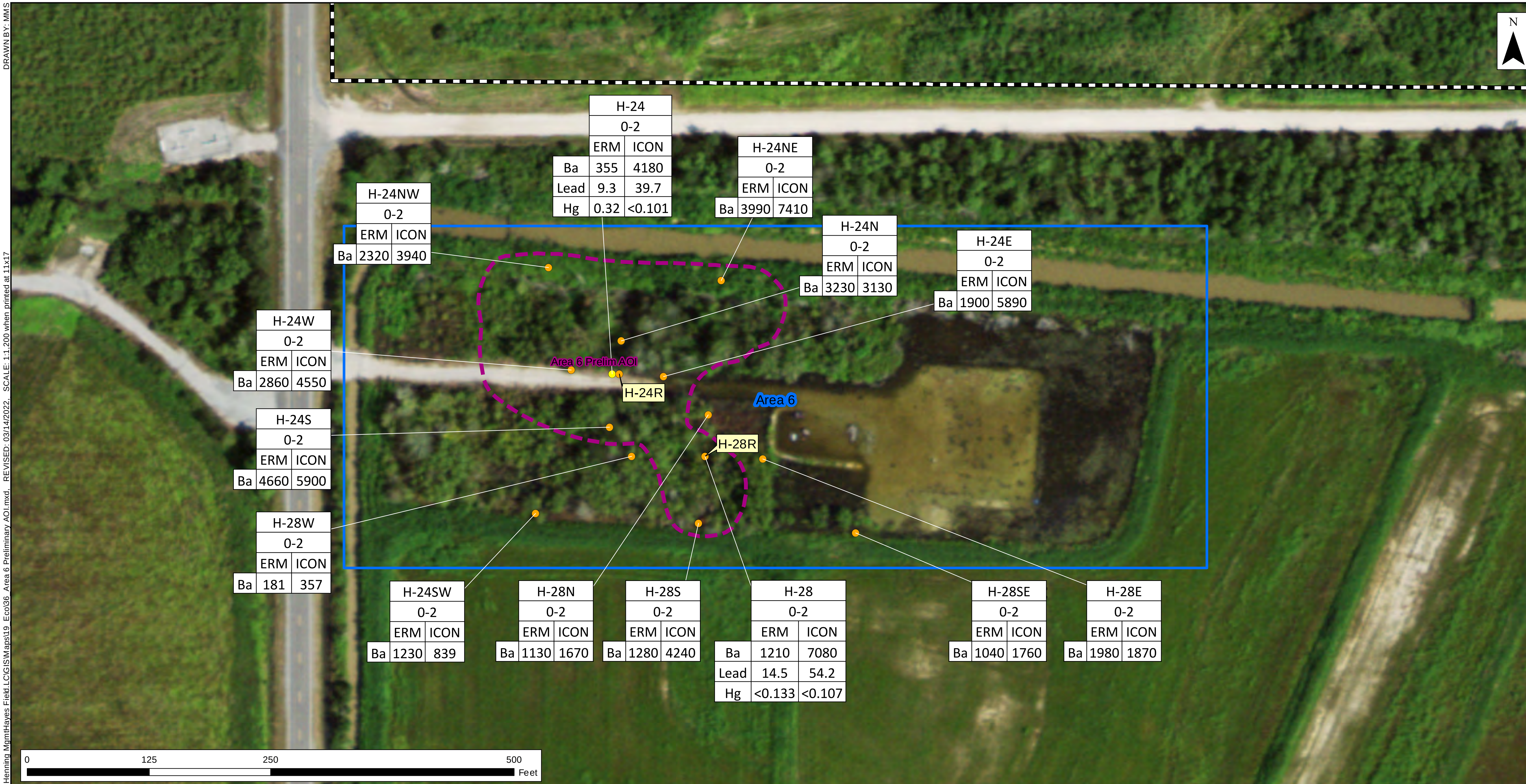

Property
Preliminary AOI
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas

Area 6

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
Preliminary AOI boundaries are based on calculated barium soil screening value of 2424 mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 36
Area 6 Preliminary AOI
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
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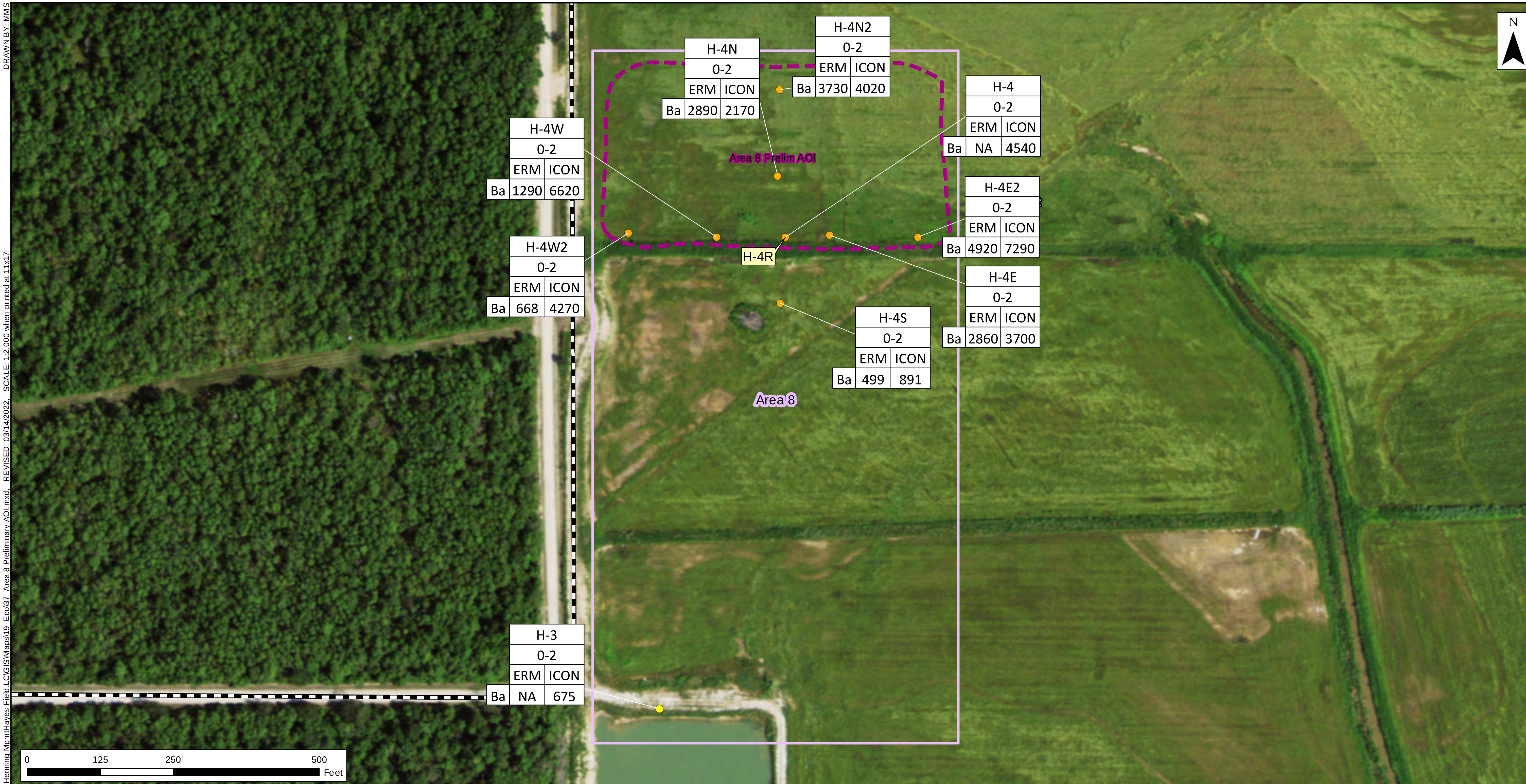
Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N



Property
Preliminary AOI
ERM Soil Sample Location
ICON Soil Sample Location

Sampling Areas
Area 8

	Sample ID	
	Depth	
	ERM	ICON
Analyte	Concentration	Concentration

Notes:
Results for soil 0-4' are shown.
Concentrations are reported in mg/kg-dry.
Preliminary AOI boundaries are based on calculated barium soil screening value of 2424 mg/kg-dry.
2019 Aerial via Earth Explorer

Figure 37
Area 8 Preliminary AOI
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
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Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

TABLES

15 March 2022

TABLE 1
List of Vegetation Observed at the Property
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Wetland Classification	Growth Habit	Aquatic
Alligatorweed	*Alternanthera philoxeroides*	OBL	Forb/herb	Yes
American black elderberry	*Sambucus nigra*	NA	Tree, Shrub	
American buckwheat vine	*Brunnichia ovata*	FACW	Vine	
American elm	*Ulmus americana*	FAC	Tree	
American pokeweed	*Phytolacca americana*	FACU	Forb/herb	
Annual blue-eyed grass	*Sisyrinchium rosulatum*	FAC	Forb/herb	
Annual bluegrass	*Poa annua*	FACU	Graminoid	
Annual marsh elder	*Iva annua*	FAC	Forb/herb	
Annual rabbitsfoot grass	*Polypogon monspeliensis*	FACW	Graminoid	
Annual yellow sweetclover	*Melilotus indicus*	FACU	Forb/herb	
Arrowhead	*Sagittaria sp.*	NA	Forb/herb	
Aster	*Symphyotrichum sp.*	NA	Forb/herb	
Bald cypress	*Taxodium distichum*	OBL	Tree	
Baldwin's spikerush	*Eleocharis baldwinii*	OBL	Graminoid	Yes
Balloon vine	*Cardiospermum halicacabum*	FAC	Forb/herb, Vine	
Beaked cornsalad	*Valerianella radiata*	FAC	Forb/herb	
Bedstraw	*Galium sp.*	NA	Forb/herb	
Bermudagrass	*Cynodon dactylon*	FACU	Graminoid	
Bigpod sesbania	*Sesbania herbacea*	FACW	Subshrub, Forb/herb	
Birdeye speedwell	*Veronica persica*	NA	Forb/herb	
Bittercress	*Cardamine sp.*	NA	Forb/herb	
Black medick	*Medicago lupulina*	UPL	Forb/herb	
Black willow	*Salix nigra*	OBL	Tree	
Blackberry	*Rubus sp.*	NA	Shrub	
Bluestem	*Andropogon sp.*	NA	Graminoid	
Brazilian vervain	*Verbena brasiliensis*	NA	Subshrub, Forb/herb	
Bristlegrass	*Setaria sp.*	NA	Graminoid	
Bristly greenbrier	*Smilax tamnoides*	FAC	Shrub, Vine	
Broadleaf arrowhead	*Sagittaria latifolia*	OBL	Forb/herb	Yes
Burclover	*Medicago polymorpha*	FACU	Forb/herb	
Bushy bluestem	*Andropogon glomeratus*	FACW	Graminoid	
Buttercup	*Ranunculus sp.*	NA	Forb/herb	
Butterweed	*Packera glabella*	OBL	Forb/herb	
Canada goldenrod	*Solidago altissima*	FACU	Forb/herb	
Canada toadflax	*Nuttallanthus canadensis*	NA	Forb/herb	
Carolina canarygrass	*Phalaris caroliniana*	FACW	Graminoid	
Carolina geranium	*Geranium carolinianum*	NA	Forb/herb	
Carolina mosquitofern	*Azolla caroliniana*	OBL	Forb/herb	Yes
Carolina ponysfoot	*Dichondra carolinensis*	FAC	Forb/herb	
Cattail	*Typha sp.*	NA	Forb/herb	Yes
Cherrybark oak	*Quercus pagoda*	FACW	Tree	
Chinese privet	*Ligustrum sinense*	FAC	Tree, Shrub	
Chinese tallow	*Triadica sebifera*	FAC	Tree	
Climbing hempvine	*Mikania scandens*	FACW	Forb/herb, Vine	
Columbian watermeal	*Wolffia columbiana*	OBL	Forb/herb	Yes
Common persimmon	*Diospyros virginiana*	FAC	Tree	
Common rush	*Juncus effusus*	OBL	Graminoid	Yes
Common threesquare	*Schoenoplectus pungens*	OBL	Graminoid	Yes
Common water hyacinth	*Eichhornia crassipes*	OBL	Forb/herb	Yes
Common yellow oxalis	*Oxalis stricta*	UPL	Forb/herb	
Creeping primrose-willow	*Ludwigia repens*	OBL	Forb/herb	
Creeping woodsorrel	*Oxalis corniculata*	UPL	Forb/herb	
Crowpoison	*Nothoscordum bivalve*	FACU	Forb/herb	
Cuman ragweed	*Ambrosia psilostachya*	FAC	Forb/herb	
Curly dock	*Rumex crispus*	FAC	Forb/herb	
Delta arrowhead	*Sagittaria platyphylla*	OBL	Forb/herb	Yes
Dock	*Rumex sp.*	NA	NA	
Dogfennel	*Eupatorium capillifolium*	FACU	Forb/herb	

Notes
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Species observed growing in water during ERM site investigations are marked 'Yes' in the aquatic column.

References

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TABLE 1 (Cont'd)
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Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	Scientific Name	Wetland Classification	Growth Habit	Aquatic
Dogwood	*Cornus sp.*	NA	Tree, Shrub	
Drummond red maple	*Acer rubrum var drummondii*	FAC	Tree	
Ducklettuce	*Ottelia alismoides*	OBL	Forb/herb	Yes
Duckweed	*Lemna sp.*	OBL	Forb/herb	Yes
Dwarf palmetto	*Sabal minor*	FACW	Tree, Shrub	
Eastern baccharis	*Baccharis halimifolia*	FAC	Tree, Shrub	
Eastern marsh fern	*Thelypteris palustris*	OBL	Forb/herb	
Eastern poison ivy	*Toxicodendron radicans*	FAC	Shrub, Subshrub, Forb/herb, Vine	
Ebony spleenwort	*Asplenium platyneuron*	FACU	Forb/herb	
Everlasting	*Gamochaeta sp.*	NA	Forb/herb	
Flatsedge	*Cyperus sp.*	NA	Graminoid	
Floating marshpennywort	*Hydrocotyle ranunculoides*	OBL	Forb/herb	Yes
Floating primrose-willow	*Ludwigia peploides*	OBL	Forb/herb	Yes
Florida mudmidget	*Wolffiella gladiata*	OBL	Forb/herb	Yes
Giant cane	*Arundinaria gigantea*	FACW	Shrub, Subshrub, Graminoid	
Giant cutgrass	*Zizaniopsis miliacea*	OBL	Graminoid	Yes
Giant duckweed	*Spirodela polyrhiza*	OBL	Forb/herb	Yes
Giant ragweed	*Ambrosia trifida*	FAC	Subshrub, Forb/herb	
Goldenrod	*Solidago sp.*	NA	Forb/herb	
Grape	*Vitis sp.*	NA	Shrub, Vine	
Grass	Poaceae	NA	Graminoid	
Grassy arrowhead	*Sagittaria graminea*	OBL	Forb/herb	Yes
Green flatsedge	*Cyperus virens*	FACW	Graminoid	
Green hawthorn	*Crataegus viridis*	FACW	Tree, Shrub	
Greenbrier	*Smilax sp.*	NA	NA	
Hairy buttercup	*Ranunculus sardous*	FAC	Forb/herb	
Heartleaf nettle	*Urtica chamaedryoides*	FAC	Forb/herb	
Herb-of-grace	*Bacopa monnieri*	OBL	Forb/herb	
Herbwilliam	*Ptilimnium capillaceum*	OBL	Forb/herb	
Hercules' club	*Zanthoxylum clava-herculis*	FAC	Tree, Shrub	
Hydrocotyle	*Hydrocotyle sp.*	NA	Forb/herb	
Indian goosegrass	*Eleusine indica*	FACU	Graminoid	
Indian strawberry	*Duchesnea indica*	FACU	Forb/herb	
Japanese climbing fern	*Lygodium japonicum*	FAC	Forb/herb, Vine	
Japanese honeysuckle	*Lonicera japonica*	FACU	Vine	
Japanese privet	*Ligustrum japonicum*	FAC	Tree, Shrub	
Johnsongrass	*Sorghum halepense*	FACU	Graminoid	
Jungle Rice	*Echinochloa colona*	FACW	Graminoid	
Knotweed (see Persicaria sp.)	*Polygonum sp.*	NA	Forb/herb	
Knotweed (see Polygonum sp)	*Persicaria sp.*	NA	Forb/herb	
Lateflowering thoroughwort	*Eupatorium serotinum*	FAC	Forb/herb	
Little duckweed	*Lemna obscura*	OBL	Forb/herb	Yes
Little quakinggrass	*Briza minor*	FAC	Graminoid	
Live oak	*Quercus virginiana*	FACU	Tree	
Longleaf pondweed	*Potamogeton nodosus*	OBL	Forb/herb	Yes
Louisiana vetch	*Vicia ludoviciana*	NA	Forb/herb, Vine	
Low spearwort	*Ranunculus pasillus*	OBL	Forb/herb	Yes
Lowland rotala	*Rotala ramosior*	OBL	Forb/herb	
Lyreleaf sage	*Salvia lyrata*	FACU	Forb/herb	
Maidencane	*Panicum hemitomon*	OBL	Graminoid	Yes
Malabar sprangletop	*Leptochloa fusca*	FACW	Graminoid	
Meadow garlic	*Allium canadense*	NA	Forb/herb	
Muskgrass	*Chara sp.*	NA	NA	Yes
Narrow plumegrass	*Saccharum baldwinii*	OBL	Graminoid	
Narrowleaf plantain	*Plantago lanceolata*	FACU	Forb/herb	
Oak	*Quercus sp.*	NA	Tree	
Paraguayan windmill grass	*Chloris canterai*	NA	Graminoid	
Pennsylvania everlasting	*Gamochaeta pensylvanica*	FACU	Forb/herb	

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TABLE 1 (Cont'd)
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Common Name	*Scientific Name*	Wetland Classification	Growth Habit	Aquatic
Peppervine	*Nekemias arborea*	FAC	Shrub, Vine	
Persian clover	*Trifolium resupinatum*	FACU	Forb/herb	
Philadelphia fleabane	*Erigeron philadelphicus*	FAC	Forb/herb	
Pickerelweed	*Pontederia cordata*	OBL	Forb/herb	Yes
Pinkladies	*Oenothera speciosa*	NA	Subshrub, Forb/herb	
Possumhaw	*Ilex decidua*	FACW	Tree, Shrub	
Poverty rush	*Juncus tenuis*	FAC	Graminoid	
Powderpuff	*Mimosa strigillosa*	FAC	Subshrub, Forb/herb	
Primrose-willow	*Ludwigia sp.*	NA	NA	
Purple passionflower	*Passiflora incarnata*	NA	Forb/herb, Vine	
Ragweed	*Ambrosia sp.*	NA	Forb/herb	
Red maple	*Acer rubrum*	FAC	Tree	
Rescuegrass	*Bromus catharticus*	NA	Graminoid	
Resurrection fern	*Pleopeltis polypodioides*	FACU	Forb/herb, Vine	
Rice	*Oryza sativa*	OBL	Graminoid	Yes
Riverhemp	*Sesbania sp.*	NA	NA	
Rosemallow	*Hibiscus sp.*	NA	NA	
Roughleaf dogwood	*Cornus drummondii*	FAC	Tree, Shrub	
Roundfruit hedgehyssop	*Gratiola virginiana*	OBL	Forb/herb	Yes
Roundhead rush	*Juncus validus*	FACW	Graminoid	
Rush	*Juncus sp.*	NA	Graminoid	
Saltmeadow cordgrass	*Spartina patens*	FACW	Graminoid	
Sand spikerush	*Eleocharis montevidensis*	FACW	Graminoid	
Saw greenbrier	*Smilax bona-nox*	FAC	Shrub, Vine	
Sawtooth blackberry	*Rubus argutus*	FAC	Subshrub	
Scarlet pimpernel	*Anagallis arvensis*	FACU	Forb/herb	
Seaside goldenrod	*Solidago sempervirens*	FACW	Forb/herb	
Sedge	*Carex sp.*	NA	Graminoid	
Sensitive plant	*Mimosa sp.*	NA	NA	
Seven sisters	*Crinum americanum*	OBL	Forb/herb	Yes
Shield fern	*Dryopteris carthusiana*	FACW	Forb/herb	
Smooth beggartick	*Bidens laevis*	OBL	Forb/herb	Yes
Smut grass	*Sporobolus indicus*	NA	Graminoid	
Southern cattail	*Typha domingensis*	OBL	Forb/herb	Yes
Southern cutgrass	*Leersia hexandra*	OBL	Graminoid	Yes
Southern dewberry	*Rubus trivialis*	FACU	Subshrub, Vine	
Spanish moss	*Tillandsia usneoides*	FAC	Forb/herb, vine	
Spikerush	*Eleocharis sp.*	NA	Graminoid	
Spiny sowthistle	*Sonchus asper*	FACU	Forb/herb	
Spinyfruit buttercup	*Ranunculus muricatus*	FACW	Forb/herb	
Spotted lady's-thumb	*Polygonum persicaria*	FACW	Forb/herb	Yes
Spring forget-me-not	*Myosotis verna*	UPL	Forb/herb	
Spurge	*Euphorbia sp.*	NA	Forb/herb	
Sticky chickweed	*Cerastium glomeratum*	FACU	Forb/herb	
Stickywilly	*Galium aparine*	FACU	Forb/herb, Vine	
Stiff dogwood	*Cornus foemina*	FACW	Tree, Shrub	
Stiff marsh bedstraw	*Galium tinctorium*	FACW	Forb/herb	
Sugarberry	*Celtis laevigata*	FACW	Tree, Shrub	
Sugarcane	*Saccharum officinarum*	FACU	Graminoid	
Sugarcane plumegrass	*Saccharum giganteum*	FACW	Graminoid	
Swamp smartweed	*Polygonum hydropiperoides*	OBL	Forb/herb	Yes
Sweetgum	*Liquidambar styraciflua*	FAC	Tree	
Thistle	*Cirsium sp.*	NA	Forb/herb	
Thoroughwort	*Eupatorium sp.*	NA	Forb/herb	
Timothy canarygrass	*Phalaris angusta*	FACW	Graminoid	
Twoheaded water-starwort	*Callitriche heterophylla*	OBL	Forb/herb	Yes
Vasey's grass	*Paspalum urvillei*	FAC	Graminoid	
Vetch	*Vicia sp.*	NA	Forb/herb, Vine	

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TABLE 1 (Cont'd)
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Common Name	*Scientific Name*	Wetland Classification	Growth Habit	Aquatic
Water oak	*Quercus nigra*	FAC	Tree	
Water spangles	*Salvinia minima*	OBL	Forb/herb	Yes
Water tupelo	*Nyssa aquatica*	OBL	Tree	
Watermeal	*Wolffia sp.*	OBL	Forb/herb	Yes
Watermoss	*Salvinia sp.*	OBL	Forb/herb	Yes
Waterthread pondweed	*Potamogeton diversifolius*	OBL	Forb/herb	Yes
Wax myrtle	*Morella cerifera*	FAC	Tree, Shrub, Subshrub	
Weedy dwarfdandelion	*Krigia caespitosa*	FAC	Forb/herb	
White clover	*Trifolium repens*	FACU	Forb/herb	
White mulberry	*Morus alba*	FACU	Tree, Shrub	
Whitenymph	*Trepocarpus aethusae*	FACW	Forb/herb	
Willow oak	*Quercus phellos*	FACW	Tree	
Winged lythrum	*Lythrum alatum var lanceolatum*	NA	Subshrub, Forb/herb	
Woodsorrel	*Oxalis sp.*	NA	Forb/herb	
Woolly rosette grass	*Dichanthelium scabriusculum*	OBL	Graminoid	
Yellow foxtail	*Setaria pumila*	FAC	Graminoid	
Yellow nutsedge	*Cyperus esculentus*	FAC	Graminoid	
Yellow pond-lily	*Nuphar lutea*	OBL	Forb/herb	Yes
Yellow thistle	*Cirsium horridulum*	FAC	Forb/herb	
Total Observed	229			38

Notes

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TABLE 2
List of Birds Observed at the Site
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Diet	Species of Greatest Conservation Need
American Crow	*Corvus brachyrhynchos*	Omnivore	
American Goldfinch	*Spinus tristis*	Seeds	
American Kestrel	*Falco sparverius*	Small Animals	
American Pipit	*Anthus rubescens*	Insects	
Anhinga	*Anhinga anhinga*	Fish	
Bald Eagle	*Haliaeetus leucocephalus*	Fish	Yes
Barred Owl	*Strix varia*	Mammals	
Belted Kingfisher	*Megaceryle alcyon*	Fish	
Black Vulture	*Coragyps atratus*	Carrion	
Blue Jay	*Cyanocitta cristata*	Omnivore	
Blue-gray Gnatcatcher	*Polioptila caerulea*	Insects	
Boat-tailed Grackle	*Quiscalus major*	Omnivore	
Brown-headed Cowbird	*Molothrus ater*	Seeds	
Carolina Chickadee	*Poecile carolinensis*	Insects	
Carolina Wren	*Thryothorus ludovicianus*	Insects	
Cedar Waxwing	*Bombycilla cedrorum*	Fruit	
Common Gallinule	*Gallinula galeata*	Plants	
Common Grackle	*Quiscalus quiscula*	Omnivore	
Common Yellowthroat	*Geothlypis trichas*	Insects	
Cooper's Hawk	*Accipiter cooperii*	Birds	
Crested Caracara	*Caracara plancus*	Omnivore	Yes
Downy Woodpecker	*Dryobates pubescens*	Insects	
Eastern Meadowlark	*Sturnella magna*	Insects	Yes
Eastern Phoebe	*Sayornis phoebe*	Insects	
Eastern Towhee	*Pipilo erythrophthalmus*	Omnivore	
Fish Crow	*Corvus ossifragus*	Omnivore	
Gray Catbird	*Dumetella carolinensis*	Insects	
Great Blue Heron	*Ardea herodias*	Fish	
Great Egret	*Ardea alba*	Fish	
Greater White-fronted Goose	*Anser albifrons*	Plants	
Greater Yellowlegs	*Tringa melanoleuca*	Aquatic Invertebrates	
Green Heron	*Butorides virescens*	Fish	
House Wren	*Troglodytes aedon*	Insects	
Killdeer	*Charadrius vociferous*	Insects	
King Rail	*Rallus elegans*	Aquatic Invertebrates	Yes
Laughing Gull	*Leucophaeus atricilla*	Aquatic Invertebrates	
Little Blue Heron	*Egretta caerulea*	Fish	Yes
Mottled duck	*Anas fulvigula*	Omnivore	Yes

Notes
Diet data provided by the The Cornell Lab (2022).
Louisiana Species of Greatest Conservation Need as per LDWF (2020).

References
Louisiana Department of Wildlife and Fisheries (LDWF). 2020. Louisiana's Animal Species of Greatest Conservation Need (SGCN) - Rare, Threatened, and Endangered Animals - 2020.
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TABLE 2 (Cont'd)
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Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Diet	Species of Greatest Conservation Need
Mourning Dove	*Zenaida macroura*	Seeds	
Neotropic Cormorant	*Phalacrocorax brasilianus*	Fish	
Northem Harrier	*Circus hudsonius*	Mammals	
Northern Bobwhite	*Colinus virginianus*	Plants	Yes
Northern Cardinal	*Cardinalis cardinalis*	Seeds	
Northern Mockingbird	*Mimus polyglottos*	Omnivore	
Orange-crowned Warbler	*Leiothlypis celata*	Insects	
Peregrine Falcon	*Falco peregrinus*	Birds	Yes
Pileated Woodpecker	*Dryocopus pileatus*	Insects	
Purple Martin	*Progne subis*	Insects	
Red-bellied Woodpecker	*Melanerpes carolinus*	Insects	
Red-shouldered Hawk	*Buteo lineatus*	Mammals	
Red-tailed Hawk	*Buteo jamaicensis*	Small Animals	
Red-winged Blackbird	*Agelaius phoeniceus*	Insects	
Ruby-crowned Kinglet	*Regulus calendula*	Insects	
Sandhill Crane	*Antigone canadensis*	Omnivore	Yes
Savannah Sparrow	*Passerculus sandwichensis*	Insects	
Sedge Wren	*Cistothorus platensis*	Insects	Yes
Snow Goose	*Anser caerulescens*	Plants	
Snowy Egret	*Egretta thula*	Fish	
Song Sparrow	*Melospiza melodia*	Insects	
Swamp Sparrow	*Melospiza georgiana*	Insects	
Tree Swallow	*Tachycineta bicolor*	Insects	
Turkey Vulture	*Cathartes aura*	Carrion	
Virginia Rail	*Rallus limicola*	Aquatic Invertebrates	
White Ibis	*Eudocimus albus*	Aquatic Invertebrates	
White-eyed Vireo	*Vireo griseus*	Insects	
White-faced Ibis	*Plegadis chihi*	Aquatic Invertebrates	
Wilson's Snipe	*Gallinago delicata*	Aquatic Invertebrates	
Wood duck	*Aix sponsa*	Plants	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Insects	
Yellow-rumped Warbler	*Setophaga coronata*	Insects	
Total Observed	71		10

Notes

Diet data provided by the The Cornell Lab (2022).

Louisiana Species of Greatest Conservation Need as per LDWF (2020).

References

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TABLE 3
List of Non-Avian Fauna Observed at the Site
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	Scientific Name	Trophic Level
Mammals		
Coyote	*Canis latrans*	Apex
Feral hog	*Sus scrofa*	Tertiary
Virginia opossum	*Didelphis virginiana*	Tertiary
Nine-banded armadillo	*Dasypus novemcinctus*	Secondary
Raccoon	*Procyon lotor*	Secondary
Nutria	*Myocastor coypus*	Primary
Rodent	Order Rodentia	Primary
Swamp rabbit	*Sylvilagus aquaticus*	Primary
White-tailed deer	*Odocoileus virginianus*	Primary
Reptiles		
American alligator	*Alligator mississippiensis*	Apex
Cottonmouth	*Agkistrodon piscivorus*	Tertiary
Eastern mud turtle	*Kinosternon subrubrum*	Tertiary
Rat snake	*Elaphe sp.*	Tertiary
Western rat snake	*Pantherophis obsoletus*	Tertiary
Western ribbon snake	*Thamnophis proximus*	Tertiary
Common five-lined skink	*Plestiodon fasciatus*	Secondary
Green anole	*Anolis carolinensis*	Secondary
Amphibians		
American bullfrog	*Lithobates catesbeianus*	Secondary
Blanchard's cricket frog	*Acris blanchardi*	Secondary
Cricket frog	*Acris sp.*	Secondary
Green frog	*Lithobates clamitans*	Secondary
Green tree frog	*Hyla cinerea*	Secondary
Leopard frog	*Lithobates sphenocephalus utricularius*	Secondary
Squirrel tree frog	*Hyla squirrella*	Secondary
Fish		
Least killifish	*Heterandria formosa*	Secondary
Mosquitofish	*Gambusia affinis*	Secondary
Terrestrial Invertebrates		
Ant lion	Family Myrmeleontidae	Secondary
Black-and-yellow mud dauber	*Sceliphron caementarium*	Secondary
Cricket	Superfamily Grylloidea	Secondary
Dragonfly	Infraorder Anisoptera	Secondary
Eastern pondhawk	*Erythemis simplicicollis*	Secondary
Leech	Subclass Hirudinea	Secondary
Organ pipe mud dauber	*Trypoxylon politum*	Secondary
Red imported fire ant	*Solenopsis invicta*	Secondary
Six-spotted fishing spider	*Dolonedes titron*	Secondary

Notes

Trophic levels are defined as follows:

Apex Predator: Carnivores; top predators at the top of the food chain without natural predators.
Tertiary Consumers: Carnivores and omnivores; organisms that consume primary and secondary consumers.
Secondary Consumers: Omnivores and carnivores; organisms that consume primary consumers (herbivores).
Primary Consumer: Herbivores; or organisms that consume plants and plant material (nectar, seeds, nuts, etc.).

TABLE 3 (Cont'd)
List of Non-Avian Fauna Observed at the Site
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	Scientific Name	Trophic Level
Wolf spider	Family Lycosidae	Secondary
Ants	Family Formicidae	Primary
Apple snail	*Promacea maculata*	Primary
Bees	Clade Anthophila	Primary
Beetles	Order Cleoptera	Primary
Blue dasher	*Pachydiplax longipennis*	Primary
Butterflies	Order Lepidoptera	Primary
Caterpillar	Order Lepidoptera	Primary
Checkered butterfly	*Burnsius communis*	Primary
Common buckeye butterfly	*Junonia coenia*	Primary
Eastern carpenter bee	*Xylocopa virginica*	Primary
European honey bee	*Apis mellifera*	Primary
Fly	Order Diptera	Primary
Groundselbush beetle grub	*Trirhabda bacharidis*	Primary
Ladybug	Family Coccinellidae	Primary
Mayfly	Order Ephemeroptera	Primary
Monarch butterfly	*Danaus plexippus*	Primary
Pearl crescent	*Phyciodes tharos*	Primary
Ramshorn snail	Class Gastropoda	Primary
Red admiral	*Vanessa atalanta*	Primary
Skeletonizing leaf Beetle	Subfamily Galerucinae	Primary
Aquatic Invertebrates		
Devil crawfish	*Lacunicambarus diogenes*	Secondary
Digger crawfish	*Creaserinus fodiens*	Secondary
Grass shrimp	*Palaemonetes sp.*	Secondary
Red swamp crawfish	*Procambarus clarkii*	Secondary
Swamp dwarf crawfish	*Cambarellus puer*	Secondary
Fingernail clam	*Sphaerium sp.*	Primary
Total Observed	62	

Notes

Trophic levels are defined as follows:

Apex Predator: Carnivores; top predators at the top of the food chain without natural predators.
Tertiary Consumers: Carnivores and omnivores; organisms that consume primary and secondary consumers.
Secondary Consumers: Omnivores and carnivores; organisms that consume primary consumers (herbivores).
Primary Consumer: Herbivores; or organisms that consume plants and plant material (nectar, seeds, nuts, etc.).

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sampling Area:	**Area 1**						**Area 2**																							
		Sample ID:	**H-25**		**H-26**		**H-27**		**H-9**	**H-11**	**H-11R**	**H-11E**		**H-11N**		**H-11S**		**H-12**	**H-12R**						**MW-1**		**MW-2**		**MW-3**		**MW-4**	
		Sample Date:	**4/7/2021**		**4/8/2021**		**4/9/2021**		**11/5/2019**	**11/12/2019**	**11/19/2021**	**11/19/2021**		**11/19/2021**		**11/19/2021**		**11/13/2019**	**11/17/2021**						**12/1/2021**		**12/9/2021**		**12/8/2021**		**12/8/2021**	
		Sample Depth (feet):	**0-2**		**0-2**		**0-2**		**0-4**	**0-2**	**0-2**	**0-2**		**0-2**		**0-2**		**0-2**	**0-1**		**1-2**		**2-3**		**0-2**		**0-2**		**0-2**		**0-2**	
Parameters	**Units**	**Soil Screening Value (a)**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ICON**	**ERM**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**
29B/Misc																																
% Moisture	wt%	N/S	15.4	14.3	16.2	14.8	14.3	13.7	24.5	17.7	16.9	17.3	21.2	16.1	16.2	17.2	15.3	19.6	10.4	12.6	13.9	15.8	17.3	16.8	18.2	19.6	15.7	16.6	16.1	16.6	13.9	14.0
Cation Exchange Capacity (CEC)	meq/100g	N/S	26.6	24.7	24.3	25.1	28.3	30.8	32.7	29.2	NA	NA	NA	NA	NA	NA	NA	30.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28.4	25.4
Electrical Conductivity (EC)	mmhos/cm	N/S	2.54	2.01	2	2.07	2.18	2.03	0.51	1.15	NA	NA	NA	NA	NA	NA	NA	2.33	NA	0.60	NA	0.76	NA	1.46	1.02	0.69	0.92	0.96	0.54	0.46	0.3	0.27
Exchangeable Sodium Percentage (ESP)	%	N/S	5.77	7.07	8.8	6.07	6.68	8.76	15.6	4.28	NA	NA	NA	NA	NA	NA	NA	11.8	5.45	4.92	12.6	10.8	17.4	9.72	3.14	4.8	3.84	3.23	2.3	2.14	1.74	1.70
Sodium Adsorption Ratio (SAR)	Unitless	N/S	5.43	6.42	5.12	9.84	6.5	8.9	8.56	4.63	NA	NA	NA	NA	NA	NA	NA	14.4	6.14	5.96	6.67	9.53	16.4	16.3	8.02	7.51	5.12	4.80	3.62	3.50	2.02	2.37
Soluble Calcium	meq/L	N/S	6.44	6.91	3.84	6.08	3.49	4.31	0.3	3.31	NA	NA	NA	NA	NA	NA	NA	2.09	1.29	1.16	0.53	0.56	1.03	0.86	1.36	1.38	2.5	2.27	1.65	1.19	0.96	0.63
Soluble Magnesium	meq/L	N/S	3.37	3.48	2.8	3.33	2.27	2.64	0.24	0.77	NA	NA	NA	NA	NA	NA	NA	0.84	0.39	0.34	0.49	0.34	0.45	0.38	0.45	0.56	0.74	0.64	0.65	0.35	0.58	0.32
Soluble Sodium	meq/L	N/S	12	14.6	9.34	21.3	11	16.6	4.42	6.61	NA	NA	NA	NA	NA	NA	NA	17.4	5.64	5.17	4.76	6.40	14.1	12.8	7.64	7.4	6.52	5.79	3.87	3.07	1.77	1.63
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40	42.9	73.5	80.6	220	184	NA	NA	NA	NA	NA	NA	NA	NA
True Total Barium	mg/kg-dry	N/S	260	203	97.3	535	124	165	697	3180	NA	NA	NA	NA	NA	NA	NA	334	NA	NA	NA	NA	NA	NA	NA	NA	2250	4250	2710	3430	1090	1150
Leachate and SPLP																																
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	0.206	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																																
Arsenic	mg/kg-dry	18	2.48	3.58	2.15	3.33	1.97	2.64	4.8	5.89	NA	NA	NA	NA	NA	NA	NA	<1.99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	mg/kg-dry	2424	149	160	149	389	46.6	103	662	2740	NA	917	253	1,510	2,050	71.4	659	290	NA	NA	NA	NA	NA	NA	2,130	945	316	2670	1700	2220	273	830
Cadmium	mg/kg-dry	0.8	<0.317	<0.497	<0.317	<0.498	<0.309	<0.499	<0.482	<0.498	NA	NA	NA	NA	NA	NA	NA	<0.498	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	mg/kg-dry	84	7.58	8.95	7.17	9.63	5.39	6.77	8.16	9.83	NA	NA	NA	NA	NA	NA	NA	10.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	mg/kg-dry	44	11	12.6	8.48	10.6	9.15	9.62	8.19	32.4	NA	NA	NA	NA	NA	NA	NA	10.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	mg/kg-dry	0.11	<0.117	<0.0974	<0.119	<0.0955	<0.116	<0.0996	<0.103	<0.105	NA	NA	NA	NA	NA	NA	NA	<0.106	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	mg/kg-dry	1	NA	<3.97	NA	<3.99	NA	<3.99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/kg-dry	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	mg/kg-dry	203	16	19.6	18.9	21.9	17	17.7	34.5	110	NA	NA	NA	NA	NA	NA	NA	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/kg-dry	140	8.17	12	9.39	13.3	5.05	6.92	15	121	NA	NA	NA	NA	NA	NA	NA	15.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydrocarbons																																
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Concentrations are reported as or converted to dry weight.
NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sample ID:	H-13		H-14	H-29		H-30		H-31	H-2	H-7	H-8	H-8R	H-8E		H-8N		H-8N2		H-8S		H-8S2		H-8W		H-10	H-15	H-15R	H-15E	
		Sampling Area:	Area 3								Area 4																				
		Sample Date:	11/14/2019		11/18/2019	4/12/2021		4/12/2021		4/12/2021	10/30/2019	11/5/2019	11/5/2019	11/11/2021	11/11/2021		11/11/2021		1/11/2022		11/11/2021		1/11/2022		11/11/2021		11/6/2019	11/19/2019	11/18/2021	11/19/2021	
		Sample Depth (feet):	0-2		0-2	0-2		0-2		0-2	0-2	0-4	0-2	0-2	0-2		0-2		0-2		0-2		0-2		0-2		0-2	0-2	0-2	0-2	
Parameters	**Units**	**Soil Screening Value (a)**	**ERM**	**ICON**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ICON**	**ICON**	**ICON**	**ERM**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ICON**	**ERM**	**ERM**	**ICON**
29B/Misc																															
% Moisture	wt%	N/S	18.7	17.4	17.2	20.4	20.6	18.4	17.3	21.3	14.9	21.9	12.7	11.1	18.1	20.3	13.3	13	19.2	20.6	14.3	13.1	15	16.9	20	18.5	15.8	15.6	NA	22.2	23.1
Cation Exchange Capacity (CEC)	meq/100g	N/S	28.8	32.1	25.8	44	33.4	32.8	25.4	38.5	30.2	23.1	11.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	24.9	27.6	NA	NA	NA
Electrical Conductivity (EC)	mmhos/cm	N/S	1.77	1.28	1.48	0.78	0.68	2.96	3.08	0.99	0.38	0.6	0.7	NA	NA	NA	NA	NA	1.11	1.1	NA	NA	1.27	1.83	NA	NA	0.36	1.44	NA	NA	NA
Exchangeable Sodium Percentage (ESP)	%	N/S	4.51	4.67	7.94	2.83	2.28	2.92	0.87	2.67	1.14	7.22	1.82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.21	5.07	NA	NA	NA
Sodium Adsorption Ratio (SAR)	Unitless	N/S	7.05	6.4	9.04	3.05	2.75	1.87	2.62	4.9	1.42	7.13	2.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.88	6.69	NA	NA	NA
Soluble Calcium	meq/L	N/S	3.93	2.91	1.52	2.38	1.79	24.1	22	1.85	1.36	0.57	3.11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.49	2.06	NA	NA	NA
Soluble Magnesium	meq/L	N/S	1.15	0.88	0.53	0.9	0.71	5.52	5.84	0.62	0.46	0.32	0.84	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.28	0.9	NA	NA	NA
Soluble Sodium	meq/L	N/S	11.2	8.81	9.13	3.91	3.08	7.18	9.78	5.45	1.35	4.77	3.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.01	8.14	NA	NA	NA
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
True Total Barium	mg/kg-dry	N/S	1,450	1610	891	408	477	464	170	163	1230	1030	22000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	850	1420	NA	NA	NA
Leachate and SPLP																															
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.83	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.000200	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																															
Arsenic	mg/kg-dry	18	2.05	5.34	3.4	2.78	2.61	<1.25	<2.00	<2.00	5.47	5.79	9.46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.81	4.68	NA	NA	NA
Barium	mg/kg-dry	2424	64	1360	862	132	354	94.2	137	85	1100	900	7000	NA	420	803	1,890	3330	2,520	3000	2,680	2530	2,240	838	649	2540	752	1270	NA	43.7	79.7
Cadmium	mg/kg-dry	0.8	<0.311	<0.500	<0.488	<0.324	<0.496	<0.311	<0.499	<0.499	<0.489	<0.47	<0.463	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.497	<0.494	NA	NA	NA
Chromium	mg/kg-dry	84	9.56	11.3	8.43	8.56	10.1	8.43	9.27	9.45	11.5	10.9	9.58	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.55	10.7	NA	NA	NA
Lead	mg/kg-dry	44	9.75	11.7	10.3	8.63	12.3	7.41	8.85	9.17	13.5	11.8	15.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.2	16.9	NA	NA	NA
Mercury	mg/kg-dry	0.11	<0.133	<0.100	<0.100	<0.117	<0.107	<0.122	<0.0936	<0.102	<0.101	<0.103	<0.108	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.101	0.114	NA	NA	NA
Selenium	mg/kg-dry	1	<2.5	NA	NA	NA	<3.97	NA	<3.99	<3.99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/kg-dry	4.2	<0.311	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	mg/kg-dry	203	NA	55.9	41.4	19.7	27.3	14.1	18.4	16.8	55.8	55	112	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	27.4	80.2	NA	NA	NA
Zinc	mg/kg-dry	140	6.11	31.6	15.5	11	14.7	8.14	10.4	10.3	22.9	20.1	20.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.4	18.1	NA	NA	NA
Hydrocarbons																															
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Concentrations are reported as or converted to dry weight.
NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sampling Area:	**Area 4**																												
		Sample ID:	**H-15N**		**H-15S**		**H-15W**		**H-16**		**H-16R**		**H-16E**		**H-16N**		**H-16S**		**H-16W**		**H-20**	**H-21**		**H-21R**						**H-21W**	
		Sample Date:	**11/18/2021**		**11/19/2021**		**11/18/2021**		**11/20/2019**		**11/15/2021**		**11/11/2021**		**11/11/2021**		**11/11/2021**		**11/11/2021**		**3/29/2021**	**3/30/2021**		**11/17/2021**						**11/18/2021**	
		Sample Depth (feet):	**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**	**0-2**		**0-1**		**1-2**		**2-3**		**0-2**	
Parameters	**Units**	**Soil Screening Value (a)**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**
29B/Misc																															
% Moisture	wt%	N/S	17.7	16.9	19.9	22.0	15.5	15.3	15.9	16.6	15.1	14.3	13.4	16.5	16.1	14.2	19	18.6	16.7	20	17.5	19.1	18.9	16.1	15.0	16	15.7	16.7	19.4	18.1	16.2
Cation Exchange Capacity (CEC)	meq/100g	N/S	NA	NA	NA	NA	NA	NA	31	29.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34.2	29.2	37.7	NA	NA	NA	NA	NA	NA	NA	NA
Electrical Conductivity (EC)	mmhos/cm	N/S	NA	NA	NA	NA	NA	NA	1.13	1.28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.91	2.06	1.64	0.64	0.60	0.79	0.63	1.32	1.15	0.68	0.88
Exchangeable Sodium Percentage (ESP)	%	N/S	NA	NA	NA	NA	NA	NA	5.51	6.81	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.77	23.8	12.1	4.05	5.77	16.3	14.9	24.7	20.8	4.63	5.43
Sodium Adsorption Ratio (SAR)	Unitless	N/S	NA	NA	NA	NA	NA	NA	6.74	7.94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.25	12.9	9.37	3.79	4.62	7.45	6.25	11.5	12.4	4.72	5.97
Soluble Calcium	meq/L	N/S	NA	NA	NA	NA	NA	NA	1.6	1.39	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.47	1.27	1.39	1.98	1.14	0.84	0.72	1.03	0.73	1.38	1.34
Soluble Magnesium	meq/L	N/S	NA	NA	NA	NA	NA	NA	0.56	0.62	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.79	0.54	0.64	0.7	0.56	0.57	0.45	0.76	0.35	0.69	0.75
Soluble Sodium	meq/L	N/S	NA	NA	NA	NA	NA	NA	7.01	7.96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.15	12.3	9.44	4.39	4.26	6.26	4.77	10.9	9.08	4.8	6.11
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	242	218	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	61.5	60.1	128	96.1	271	371	94.6	152
True Total Barium	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	5,100	6540	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	476	349	402	NA	NA	NA	NA	NA	NA	NA	NA
Leachate and SPLP																															
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	0.472	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	0.0147	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	<0.000200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																															
Arsenic	mg/kg-dry	18	NA	NA	NA	NA	NA	NA	3.59	7.79	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.23	3.1	3.7	NA	NA	NA	NA	NA	NA	NA	NA
Barium	mg/kg-dry	2424	109	85.9	80.8	202	753	515	221	4390	71.1	2160	236	95.5	230	785	486	68.8	44.9	1760	430	136	389	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	mg/kg-dry	0.8	NA	NA	NA	NA	NA	NA	<0.29	<0.491	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.500	<0.303	<0.500	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	mg/kg-dry	84	NA	NA	NA	NA	NA	NA	9.39	19.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.5	5.81	10.1	NA	NA	NA	NA	NA	NA	NA	NA
Lead	mg/kg-dry	44	NA	NA	NA	NA	NA	NA	11.2	54.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.18	8.57	12.8	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	mg/kg-dry	0.11	NA	NA	NA	NA	NA	NA	0.157	0.15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.103	<0.123	<0.0963	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	mg/kg-dry	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.400	NA	<4.00	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/kg-dry	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	mg/kg-dry	203	NA	NA	NA	NA	NA	NA	48.2	148	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	37.7	77.6	90.6	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/kg-dry	140	NA	NA	NA	NA	NA	NA	22.1	98.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.4	8.91	35.1	NA	NA	NA	NA	NA	NA	NA	NA
Hydrocarbons																															
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Concentrations are reported as or converted to dry weight.
NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sampling Area:	**Area 4**																	**Area 5**								
		Sample ID:	**H-22**		**H-22R**	**H-22E**		**H-22N**		**H-22S**		**H-22S2**		**H-22W**		**H-23**		**MW-6**		**H-1**	**H-1R**		**H-1E**		**H-1SE**		**H-17**	**H-18**
		Sample Date:	**4/1/2021**		**11/11/2021**	**11/11/2021**		**11/11/2021**		**11/11/2021**		**1/11/2022**		**11/11/2021**		**4/5/2021**		**11/18/2021**		**10/29/2019**	**12/13/2021**		**12/13/2021**		**12/13/2021**		**11/20/2019**	**11/21/2019**
		Sample Depth (feet):	**0-2**		**0-2**	**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**	**0-2**		**0-2**		**0-2**		**0-2**	**0-4**
Parameters	**Units**	**Soil Screening Value (a)**	**ERM**	**ICON**	**ERM**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ICON**
29B/Misc																												
% Moisture	wt%	N/S	14.4	13.8	16.3	13.4	16.2	11	10.3	12.7	10.6	14.7	14.7	19.6	22.6	19.6	18	19.5	20.1	13.6	17.0	15.4	19.9	18.8	10.4	14.3	16.7	18.5
Cation Exchange Capacity (CEC)	meq/100g	N/S	26	30.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	22.5	27	NA	NA	20.7	NA	NA	NA	NA	NA	NA	17.9	34.4
Electrical Conductivity (EC)	mmhos/cm	N/S	1.7	1.88	NA	NA	NA	NA	NA	NA	NA	0.67	0.68	NA	NA	0.75	0.6	1.25	1.58	1.32	0.94	2.07	NA	NA	0.58	0.52	1.06	1.64
Exchangeable Sodium Percentage (ESP)	%	N/S	2.77	5.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.68	4.58	9.55	7.70	5.12	NA	NA	NA	NA	1.00	1.40	6.97	17.6
Sodium Adsorption Ratio (SAR)	Unitless	N/S	3.87	4.69	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.19	3.34	8.18	8.76	5.79	NA	NA	NA	NA	1.99	2.84	7.1	14.6
Soluble Calcium	meq/L	N/S	3.92	5.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.44	1.04	2.22	3.41	2.58	NA	NA	NA	NA	2.57	1.63	1.07	0.79
Soluble Magnesium	meq/L	N/S	1.71	2.27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.13	0.79	0.57	0.73	0.77	NA	NA	NA	NA	1.03	0.67	0.54	0.45
Soluble Sodium	meq/L	N/S	6.5	9.08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.61	3.2	9.65	12.6	7.49	NA	NA	NA	NA	2.68	3.04	6.39	11.5
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	203	216	NA	NA	NA	NA	NA	NA	NA	NA	NA
True Total Barium	mg/kg-dry	N/S	3,790	8220	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	243	208	NA	NA	4210	NA	NA	NA	NA	NA	NA	1090	10900
Leachate and SPLP																												
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	1.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.41	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																												
Arsenic	mg/kg-dry	18	<1.17	3.45	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.25	5.32	NA	NA	7.03	NA	NA	NA	NA	NA	NA	5.02	7.33
Barium	mg/kg-dry	2424	62	3130	NA	644	984	2,270	1850	2460	3050	272	351	321	1980	95.6	171	NA	NA	2940	NA	1940	328	399	440	1020	987	6390
Cadmium	mg/kg-dry	0.8	<0.293	<0.499	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.325	<0.498	NA	NA	<0.493	NA	NA	NA	NA	NA	NA	<0.468	<0.493
Chromium	mg/kg-dry	84	7.56	7.36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.9	12.7	NA	NA	13.5	NA	NA	NA	NA	NA	NA	9.89	24.8
Lead	mg/kg-dry	44	6.86	10.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19.7	13	NA	NA	24.4	NA	NA	NA	NA	NA	NA	19.4	27.6
Mercury	mg/kg-dry	0.11	<0.115	<0.0970	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.124	<0.0971	NA	NA	<0.106	NA	NA	NA	NA	NA	NA	<0.100	<0.100
Selenium	mg/kg-dry	1	NA	<3.99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<3.99	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/kg-dry	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	mg/kg-dry	203	26.4	41.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.3	31	NA	NA	78.9	NA	NA	NA	NA	NA	NA	76.7	124
Zinc	mg/kg-dry	140	9.26	14.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.5	18	NA	NA	17	NA	NA	NA	NA	NA	NA	21.8	30.2
Hydrocarbons																												
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.89	NA	4.34	NA	2.99	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<5.8	NA	<6.17	NA	<5.83	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.41	NA	<2.5	NA	<2.23	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.41	NA	<2.5	NA	<2.23	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4.82	NA	<4.99	NA	<4.46	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<3.87	NA	<4.11	NA	<3.88	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.2	NA	<1.25	NA	<1.12	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.41	NA	<2.5	NA	<2.23	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.41	NA	<2.5	NA	<2.23	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.41	NA	<2.5	NA	<2.23	NA	NA	NA

Notes:
Concentrations are reported as or converted to dry weight.
NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sampling Area:	**Area 5**																										
		Sample ID:	**H-18R**								**H-18NW**		**H-18SW**		**H-19**	**H-19R**		**H-19NE**		**H-19SW**		**MW-8**		**MW-9**		**MW-10**		**MW-11**	
		Sample Date:	**12/3/2021**								**12/3/2021**		**12/14/2021**		**11/22/2019**	**12/14/2021**		**12/14/2021**		**12/14/2021**		**12/14/2021**		**12/2/2021**		**12/13/2021**		**12/7/2021**	
		Sample Depth (feet):	**0-1**		**0-4**		**1-2**		**2-3**		**0-2**		**0-2**		**0-2**	**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**	
Parameters	**Units**	**Soil Screening Value (a)**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**
29B/Misc																													
% Moisture	wt%	N/S	15.7	17.3	21.4	17.9	19.5	20.2	16.4	17.8	13.4	14.4	16.6	15.9	16	15.4	18.6	14.0	14.5	17.5	16.8	12.9	15.4	13.9	14.2	12.9	13.3	16.3	16.9
Cation Exchange Capacity (CEC)	meq/100g	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Electrical Conductivity (EC)	mmhos/cm	N/S	1.26	1.08	NA	NA	1.37	1.71	0.85	1.3	NA	NA	NA	1.00	1.34	NA	NA	NA	2.07	NA	0.60	0.83	0.45	0.77	0.81	0.80	0.67	2.38	2.99
Exchangeable Sodium Percentage (ESP)	%	N/S	12	10.5	NA	NA	13.7	14.4	14.3	18.6	NA	NA	NA	NA	4.82	NA	NA	NA	NA	NA	NA	2.74	6.20	7.3	8.28	2.21	4.57	10.4	11.0
Sodium Adsorption Ratio (SAR)	Unitless	N/S	10.7	9.81	NA	NA	16.1	19	13.5	18.7	NA	NA	NA	NA	5.78	NA	NA	NA	NA	NA	NA	4.04	5.20	7.15	7.38	4.22	4.84	10.2	10.9
Soluble Calcium	meq/L	N/S	1.17	1.06	NA	NA	0.65	0.83	0.35	0.4	NA	NA	NA	NA	2.25	NA	NA	NA	NA	NA	NA	2.90	0.60	0.91	1	2.09	1.75	3.68	4.16
Soluble Magnesium	meq/L	N/S	0.66	0.5	NA	NA	0.44	0.48	0.28	0.32	NA	NA	NA	NA	0.92	NA	NA	NA	NA	NA	NA	0.57	0.22	0.62	0.59	1.03	0.97	1.84	2.04
Soluble Sodium	meq/L	N/S	10.3	8.76	NA	NA	11.9	15.3	7.59	11.3	NA	NA	NA	NA	7.29	NA	NA	NA	NA	NA	NA	5.33	3.34	6.27	6.57	5.27	5.65	16.9	19.2
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	745	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
True Total Barium	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9360	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4120	661	NA	NA
Leachate and SPLP																													
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	0.885	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.775	NA	12.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																													
Arsenic	mg/kg-dry	18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.87	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	mg/kg-dry	2424	NA	NA	NA	472	NA	NA	NA	NA	682	628	49	2020	3750	NA	4530	2410	2170	702	3950	1600	191	36.6	136	1210	473	64.2	108
Cadmium	mg/kg-dry	0.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.496	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	mg/kg-dry	84	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	mg/kg-dry	44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	mg/kg-dry	0.11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.107	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	mg/kg-dry	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/kg-dry	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	mg/kg-dry	203	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	77.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/kg-dry	140	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydrocarbons																													
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
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NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sampling Area:	**Area 6**																													
		Sample ID:	**H-24**		**H-24R**	**H-24E**		**H-24N**		**H-24S**		**H-24W**		**H-24NW**		**H-24NE**		**H-24SW**		**H-28**		**H-28R**	**H-28E**		**H-28N**		**H-28S**		**H-28W**		**H-28SE**	
		Sample Date:	**4/6/2021**		**11/12/2021**	**11/12/2021**		**11/12/2021**		**11/11/2021**		**11/12/2021**		**1/11/2022**		**1/11/2022**		**1/11/2022**		**4/12/2021**		**11/11/2021**	**11/11/2021**		**11/12/2021**		**11/11/2021**		**11/11/2021**		**1/11/2022**	
		Sample Depth (feet):	**0-2**		**0-2**	**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**	**0-2**		**0-2**		**0-2**		**0-2**		**0-2**	
Parameters	**Units**	**Soil Screening Value (a)**	**ERM**	**ICON**	**ERM**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**
29B/Misc																																
% Moisture	wt%	N/S	17.2	16.6	17.6	14.4	16.2	22.4	23.4	28.1	29.6	16	17.1	20.7	20.7	17	18.6	28.9	27.7	25.3	22.9	24.5	32.4	22.9	25.7	26.1	22.4	25.1	23.7	23.2	12.2	20.1
Cation Exchange Capacity (CEC)	meq/100g	N/S	21.7	30.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35	30.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Electrical Conductivity (EC)	mmhos/cm	N/S	1.25	1.16	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.45	0.52	0.4	0.46	0.32	0.31	1.08	1.03	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.55	0.57
Exchangeable Sodium Percentage (ESP)	%	N/S	3.93	5.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.95	13.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Adsorption Ratio (SAR)	Unitless	N/S	5.19	4.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.94	7.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soluble Calcium	meq/L	N/S	2.87	3.31	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.37	1.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soluble Magnesium	meq/L	N/S	0.79	0.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.56	0.53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soluble Sodium	meq/L	N/S	7.02	6.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.81	6.96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
True Total Barium	mg/kg-dry	N/S	8,310	14200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15,400	17200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Leachate and SPLP																																
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	1.65	NA	NA	NA	NA	9.48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	<0.000200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																																
Arsenic	mg/kg-dry	18	1.4	2.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.32	3.81	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	mg/kg-dry	2424	355	4180	NA	1,900	5890	3,230	3130	4,660	5900	2,860	4550	2,320	3940	3,990	7410	1,230	839	1210	7080	NA	1,980	1870	1130	1670	1280	4240	181	357	1,040	1760
Cadmium	mg/kg-dry	0.8	<0.304	<0.497	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.329	0.538	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	mg/kg-dry	84	6.32	14.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.95	63.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	mg/kg-dry	44	9.3	39.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14.5	54.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	mg/kg-dry	0.11	0.32	<0.101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.133	<0.107	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	mg/kg-dry	1	NA	<3.98	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<3.98	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	mg/kg-dry	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	mg/kg-dry	203	44.6	89.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	123	278	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/kg-dry	140	6.91	35.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13	67.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydrocarbons																																
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Concentrations are reported as or converted to dry weight.
NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 4
Soil Analytical Data and Screening (0-4')
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil and Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

		Sampling Area:	**Area 7**					**Area 8**																			**Area 9**				
		Sample ID:	**H-5**		**HH-5B**	**H-6**		**H-3**	**H-4**	**H-4R**	**H-4E**		**H-4E2**		**H-4N**		**H-4N2**		**H-4S**		**H-4W**		**H-4W2**		**H-32**		**H-33**		**H-34**
		Sample Date:	**11/4/2019**		**1/11/2022**	**11/5/2019**		**10/31/2019**	**11/4/2019**	**11/12/2021**	**11/12/2021**		**1/10/2022**		**11/12/2021**		**1/10/2022**		**11/12/2021**		**11/12/2021**		**1/10/2022**		**8/17/2021**		**8/18/2021**		**8/19/2021**
		Sample Depth (feet):	**0-2**	**2-4**	**0-2**	**0-2**	**2-4**	**0-2**	**0-2**	**0-2**	**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**0-2**		**2-4**		**2-4**		**2-4**
Parameters	**Units**	**Soil Screening Value (a)**	**ICON**	**ICON**	**ICON**	**ICON**	**ICON**	**ICON**	**ICON**	**ERM**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ERM**	**ICON**	**ICON**
29B/Misc																															
% Moisture	wt%	N/S	19.2	16.6	21	16.3	18	12.8	18.7	18.1	27	23.5	20.3	22.1	21.1	18.6	21.2	20.9	25.3	24.6	17.3	17.9	24.6	20.5	15.4	13	16.1	16.7	17.8
Cation Exchange Capacity (CEC)	meq/100g	N/S	23.2	26	NA	16.3	22.6	22.7	18.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25.8	28.9	21.1	17.6	27.4
Electrical Conductivity (EC)	mmhos/cm	N/S	1.56	2.56	NA	2.29	2.43	0.77	0.38	NA	NA	NA	0.58	0.69	NA	NA	0.35	0.35	NA	NA	NA	NA	0.62	0.62	0.54	0.4	0.58	0.48	0.78
Exchangeable Sodium Percentage (ESP)	%	N/S	12.8	25.8	NA	32.5	27.1	1.6	1.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.17	2.17	1.25	2.31	1.47
Sodium Adsorption Ratio (SAR)	Unitless	N/S	14.9	25.2	NA	25.3	25.4	1.85	1.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.76	3.45	3.65	3.11	2.7
Soluble Calcium	meq/L	N/S	0.99	1.08	NA	0.88	0.9	2.75	1.97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.75	0.59	0.84	0.75	2.29
Soluble Magnesium	meq/L	N/S	0.43	0.43	NA	0.32	0.36	1.03	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.47	0.35	0.53	0.49	0.84
Soluble Sodium	meq/L	N/S	12.5	21.9	NA	19.7	20.1	2.54	1.89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.94	2.37	3.02	2.45	3.37
Chloride	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
True Total Barium	mg/kg-dry	N/S	12000	667	NA	1210	394	676	12300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	144	319	102	74.4	111
Leachate and SPLP																															
Leachate Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Chloride	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Sodium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Barium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	2.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Lead	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Mercury	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPLP Strontium	mg/L	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals																															
Arsenic	mg/kg-dry	18	6.12	3.05	NA	4.98	4.76	6.7	7.65	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.11	5.32	2.74	3.5	4.44
Barium	mg/kg-dry	2424	4440	393	9000	1030	343	675	4540	NA	2,860	3700	4,920	7290	2,890	2170	3,730	4020	499	891	1,290	6620	668	4270	55.4	222	32.2	39.3	205
Cadmium	mg/kg-dry	0.8	<0.472	<0.48	NA	<0.487	<0.481	<0.482	<0.479	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.296	<0.457	<0.309	<0.464	<0.483
Chromium	mg/kg-dry	84	8.2	5.66	NA	7.9	20.3	12	9.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.5	11.6	7.65	8.27	11.8
Lead	mg/kg-dry	44	10.4	7.96	NA	8.73	8.29	14.6	11.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.3	14.3	9.54	9.62	17.4
Mercury	mg/kg-dry	0.11	<0.108	<0.107	NA	<0.109	<0.105	<0.102	<0.109	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.119	<0.0986	<0.125	<0.108	<0.109
Selenium	mg/kg-dry	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.36	<3.65	<2.47	<3.71	<3.87
Silver	mg/kg-dry	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.296	NA	<0.309	NA	NA
Strontium	mg/kg-dry	203	99.9	76.3	NA	95.9	83.4	19	39.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.19	NA	6.75	10.7
Zinc	mg/kg-dry	140	10.6	7.48	NA	9.06	14.9	19.1	12.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.8	11.6	6.64	7.28	23
Hydrocarbons																															
TPH-D	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH-O	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic C6-C8	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aliphatic >C16-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C8-C10	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C10-C12	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C12-C16	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C16-C21	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aromatic >C21-C35	mg/kg-dry	N/S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Concentrations are reported as or converted to dry weight.
NA - Not Available; NS - No Standard
(a) Based on higher of background and lowest Eco-SSL, except barium.
Barium is based on calculated soil screening value of 2424 mg/kg-dry.
Yellow shaded cell indicates exceedance of soil screening value.

TABLE 5
Toxicity Reference Values (TRVs) for BERA
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Constituent	TRV			
	Avian (Mourning Dove, Red-winged Blackbird, Common Yellowthroat, Red-tailed Hawk)		Mammal (Swamp Rabbit, Raccoon, Coyote)	
	mg/kg/day	Source	mg/kg/day	Source
Barium	600[a]	Brown et al. (2014); Silverman and Tell (2010); Kubiak (2012)	5433[b]	Boyd and Abel (1966)
Lead	1.63	USEPA (2005b)	4.7	USEPA (2005b)
Mercury	3.25[c]	USEPA (1999; Table E-8)	1.01[d]	USEPA (1999; Table E-7)

NOTES:

[a]Barium sulfate; Recommended x-ray imaging dose for birds of 6,000 to 15,000 mg/kg bw. Low range value of 6,000 mg/kg bw used as proxy NOAEL; uncertainty factor of 10 for acute to chronic endpoint applied.

[b]Barium sulfate; Acute (14 day) NOAEL (mortality) for rat of 163,000 mg/kg bw; uncertainty factor of 10 for acute to chronic endpoint; and 3 for species variability.

[c]Mercuric chloride; Acute (5 day) LOAEL (mortality) for quail of 325 mg/kg/d; uncertainty factor of 10 applied to estimate from an acute to chronic endpoint (produces a very conservative TRV estimate.)

[d]Mercuric chloride; Chronic (6 month) NOAEL (reproduction) for mink of 1.01 mg/kg/day.

TABLE 6
Soil/Sediment Bioavailability Factors for BERA
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

COPEC	Soil/Sediment Bioavailability Factor	Citation
Barium	0.0002	Engdahl et al. (2008); Cappuyns (2018); Environment International Ltd. (2010); USGS (2002)
Lead	0.01	Hettiarachchi and Pierzynski (2004); Luo et al. (2014); Feijtel (1986)
Mercury	0.00031	Xu et al. (2019); Chibunda et al. (2009); Chalmers et al. (2013)

TABLE 7
Bioconcentration Factors (BCFs) for Food Items for BERA
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

COPEC	Soil- Plant BCF	Citation	Soil-Earthworm BCF	Citation	Soil-Mammal BCF	Citation
Barium	0.0046	Nelson et al. (1984); Lamb et al. (2013)	0.091	Sample et al. (1998a; Table C.1)	0.0566	Sample et al. (1998b; Table 7)
Lead	0.0389	Bechtel-Jacobs (1998a; Table 6)	0.266	Sample et al. (1998a; Table 11)	0.1504	Sample et al. (1998b; Table 7)
Mercury	0.2700	Fernández-Martínez (2015); Rodriguez (2007); Hamilton (2008)	1.693	Sample et al. (1998a; Table 11)	0.0534	Sample et al. (1998b; Table 7)

TABLE 7
Bioconcentration Factors (BCFs) for Food Items for BERA
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

COPEC	Soil-Bird BCF	Citation	Soil/Sediment - Benthic Invertebrate BCF	Citation	Sediment - Fish BCF	Citation
Barium	0.0566	Sample et al. (1998b; Table 7) [Barium soil-mammal BCF used as surrogate]	0.023	Finerty et al. (1990); ERM (2019)	0.028	Ohio EPA (1991); Teck American, Inc. (2010); ERM (2019)
Lead	0.191	Beyer et al. (1985)	0.066	Bechtel Jacobs (1998b; Table 2)	0.0000018	Davis et al. (1996; p.420)
Mercury	0.148	White & Cromartie (1985); Adair et al. (2003)	0.48	Razavi (2013); USFWS (1994); Ridal et al. (2010); ERM (2019)	1.1	LDEQ LEAU database (2019); ERM (2019)

TABLE 8
Species Factors for BERA
Wylie Corporation, et al. v Baby Oil, Inc., et al.
Humphreys and Orange Grove Oil and Gas Fields
Terrebonne Parish, Louisiana

Parameter	Description	Units	Mourning Dove	Source	Red-winged Blackbird	Source	Common Yellowthroat	Source
BW	Body weight of receptor	Kg	0.12	The Cornell Lab of Ornithology (2020)[a]	0.050	The Cornell Lab of Ornithology (2020)[d]	0.010	The Cornell Lab of Ornithology (2020)[f]
Food IR	Ingestion rate of food	Kg/Kg BW/d	0.14	Nagy (2001)[b]	0.19	Nagy (2001)[b]	0.15	Nagy (2001)[b]
Soil / Sediment Ingestion	Ingestion Proportion of soil or sediment	Fraction of Total Diet	0.093	Beyer et al. (1994)[c]	0.093	Beyer et al. (1994)[c]	0.093	Beyer et al. (1994)[c]
Fd (plants)	Fraction of diet consisting of plants		1	The Cornell Lab of Ornithology (2020)	0.64	The Cornell Lab of Ornithology (2020)[e]	0	
Fd (inverts)	Fraction of diet consisting of soil invertebrates		0		0.36	The Cornell Lab of Ornithology (2020)[e]	1	The Cornell Lab of Ornithology (2020)
Fd (mammals)	Fraction of diet consisting of mammals		0		0		0	
Fd (benthic inverts)	Fraction of diet consisting of benthic invertebrates		0		0		0	
Fd (fish)	Fraction of diet consisting of fish		0		0		0	
Fd (birds)	Fraction of diet consisting of birds		0		0		0	

NOTES:

[a]Mourning Dove body weight: Average of mean body weights for adult males and females for *Z. m. carolinensis* and *Z. m. marginella*, based on site location potentially in zone of overlap (Aldrich and Duvall, 1958).

[b]Food ingestion rate using all birds dry matter intake equation.

[c]Surrogate soil ingestion rate based on a consumer of terrestrial plants and insects.

[d]Red-winged Blackbird body weight: Average of body weight ranges for adult males and females.

[e]Red-winged Blackbird diet: Average year-round, including breeding and non-breeding seasons.

[f]Common Yellowthroat: Average of mean body weights for males and females.

TABLE 8
Species Factors for BERA
Wylie Corporation, et al. v Baby Oil, Inc., et al.
Humphreys and Orange Grove Oil and Gas Fields
Terrebonne Parish, Louisiana

Parameter	Description	Units	Red-tailed Hawk	Source
BW	Body weight of receptor	Kg	1.1	USEPA (1993; Page 2-82); [Source: Craighead & Craighead (1956), Steenhof (1983), Springer & Osborne (1983)][a]
Food IR	Ingestion rate of food	Kg/Kg BW/d	0.070	Nagy (2001)[b]
Soil / Sediment Ingestion	Ingestion Proportion of soil or sediment	Fraction of Total Diet	0	Sample and Suter (1994; Section 4.15)
Fd (plants)	Fraction of diet consisting of plants		0	
Fd (inverts)	Fraction of diet consisting of soil invertebrates		0	
Fd (mammals)	Fraction of diet consisting of mammals		0.87	USEPA (1993; Page 2-83); [Source: Adamcik et al. (1979), Janes (1984), Fitch et al. (1946)][c]
Fd (benthic inverts)	Fraction of diet consisting of benthic invertebrates		0	
Fd (fish)	Fraction of diet consisting of fish		0	
Fd (birds)	Fraction of diet consisting of birds		0.13	USEPA (1993; Page 2-83); [Source: Adamcik et al. (1979), Janes (1984), Fitch et al. (1946)][c]

NOTES:

[a]Red-tailed hawk body weight: Average of adult males and adult females, all studies in USEPA 1993.
[b]Food ingestion rate using all birds dry matter intake equation.
[c]Average for diet items of mammals and birds, all studies in USEPA 1993.

TABLE 8
Species Factors for BERA
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Parameter	Description	Units	Swamp Rabbit	Source	Raccoon	Source	Coyote	Source
BW	Body weight of receptor	Kg	2.118	Bond et al. (2006)[a]	5.78	USEPA (1993; Page 2-236); [source: Sanderson (1984); Nagel (1943); Johnson (1970); Hamilton (1936)][d]	14	University of Michigan (2001)[g]
Food IR	Ingestion rate of food	Kg/Kg BW/d	0.13	Sample and Suter (1994; Section 4.5, Page 16)[b]	0.035	Nagy (2001)[e]	0.028	Nagy (2001)[e]
Soil / Sediment Ingestion	Ingestion Proportion of soil or sediment	Fraction of Total Diet	0.063	Sample and Suter (1994; Section 4.5, Page 17)[b]	0.094	Beyer et al. (1994)	0.028	Beyer et al. (1994)[h]
Fd (plants)	Fraction of diet consisting of plants		1	USEPA (1993; Page 2-356); [Source: Spencer & Chapman (1986)][c]	0.743	USEPA (1993; Page 2-237); [Source: Tabatabai & Kennedy (1988), Hamilton (1951)][f]	0.1	University of Michigan (2001)
Fd (inverts)	Fraction of diet consisting of soil invertebrates		0		0.123	USEPA (1993; Page 2-237); [Source: Tabatabai & Kennedy (1988), Hamilton (1951)][f]	0	
Fd (mammals)	Fraction of diet consisting of mammals		0		0.089	USEPA (1993; Page 2-237); [Source: Tabatabai & Kennedy (1988), Hamilton (1951)][f]	0.9	University of Michigan (2001)
Fd (benthic inverts)	Fraction of diet consisting of benthic invertebrates		0		0.021	USEPA (1993; Page 2-237); [Source: Tabatabai & Kennedy (1988), Hamilton (1951)][f]	0	
Fd (fish)	Fraction of diet consisting of fish		0		0.004	USEPA (1993; Page 2-237); [Source: Tabatabai & Kennedy (1988), Hamilton (1951)][f]	0	
Fd (birds)	Fraction of diet consisting of birds		0		0.020	USEPA (1993; Page 2-237); [Source: Tabatabai & Kennedy (1988), Hamilton (1951)][f]	0	

NOTES:

[a]Swamp rabbit body weight: arithmetic mean of adult males and females (Bond et al. (2006)).
[b]Swamp rabbit diet (based on Eastern cottontail) is converted to dry weight assuming 45% moisture in food.
[c]Swamp rabbit soil ingestion rate is based on black-tailed jackrabbit.
[d]Average of adult males and adult females, all studies in USEPA 1993.
[e]Food ingestion rate using all mammal dry matter intake equation.
[f]Average of diet items for Tennessee and New York, terrestrial food consumption habitats.
[g]Average of body weight range.
[h]Coyotes soil ingestion rate based on carnivorous mammal.

TABLE 9
Exposure Modifying Factors (EMFs) for Receptors for BERA
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Parameter	Description	Mourning Dove	Red-winged Blackbird	Common Yellowthroat	Red-tailed Hawk	Swamp Rabbit	Raccoon	Coyote	Citations
Home Range	Home Range of receptor (acres)	27,157[a]	0.49[b]	2.3[c]	2081[e]	7.9[f]	366[g]	70,026[h]	The Cornell Lab of Ornithology (2020, 2020, 2020), Smith (2014), USEPA (1993) [Source: Fitch et al. (1946), Craighead & Craighead (1956), Andersen & Rongstad (1989)], Gould (1974), Byrne and Chamberlin (2011), University of Michigan (2022).
Spatial Factor	Fraction of home range that may be contaminated	Spatial Factor = potentially affected area ÷ receptor home range, with an upperbound value of 1 (100%)							Calculated based on estimated size of potentially affected area (See Notes for estimated size of prelim AOIs)
Time (Temporal) Factor	Fraction of time spent in presumed contaminated area	0.3	0.3	0.3	0.3	0.3	0.3	0.3	Based on the amount of time the animal spends in the affected area

NOTES:

[a]The Cornell Lab of Ornithology (2020); Average of maximums for adults, areas based on circle radii.
[b]The Cornell Lab of Ornithology (2020); Mean territory size for habitats.
[c]The Cornell Lab of Ornithology (2020); Average of territory ranges for 8 states.
[d]Smith (2014); Mandalay NWR.
[e]USEPA (1993) [Source: Fitch et al. (1946), Craighead & Craighead (1956), Andersen & Rongstad (1989)]; Average of all territory ranges in USEPA 1993.
[f]Gould, A. (1974); Average of adult male (10.6 acres) and female (5.14 acres) home ranges.
[g]Byrne and Chamberlain (2011); Average of adult male and female home ranges, all seasons, Louisiana Atchafalaya bottomland hardwood habitat.
[h]University of Michigan (2022); Maximum home range.

		Spatial Factors						
Prelim AOI	Estimated Area (acres)	Mourning Dove	Red-winged Blackbird	Common Yellowthroat	Red-tailed Hawk	Swamp Rabbit	Raccoon	Coyote
	Home Range:	27,157	0.49	2.3	2,081	7.9	366	70,026
Area 4 [1]	1.2	4.4E-05	1.0E+00	5.2E-01	5.8E-04	1.5E-01	3.3E-03	1.7E-05
Area 4 [2]	0.1	3.7E-06	2.0E-01	4.3E-02	4.8E-05	1.3E-02	2.7E-04	1.4E-06
Area 5	1.2	4.4E-05	1.0E+00	5.2E-01	5.8E-04	1.5E-01	3.3E-03	1.7E-05
Area 6	1.2	4.4E-05	1.0E+00	5.2E-01	5.8E-04	1.5E-01	3.3E-03	1.7E-05
Area 8	4.1	1.5E-04	1.0E+00	1.0E+00	2.0E-03	5.2E-01	1.1E-02	5.9E-05

APPENDIX A CV

15 March 2022

Helen R. Connelly, PhD

Toxicologist

Helen's experience includes evaluation of ecological and human health risk due to exposure to petroleum hydrocarbons, metals, PCBs, PAHs, salts, chlorinated compounds, and other organic and inorganic compounds. She is experienced in designing and completing complex sampling and analysis plans and biological surveys in wetland, industrial, agricultural, and rural settings. Helen's skills include managing teams to accomplish large projects, working collaboratively with other consultants and experts, and completing complex ecological and human health risk assessments. Helen has successfully provided expert testimony at trial, in regulatory hearings, and in depositions in support of litigation, and has provided expert opinions and expert reports for human and ecological exposures.

Experience: 19 years of experience in environmental toxicology, ecological and human health risk assessment

Email: helen.connelly@erm.com

Education

- Ph.D., Veterinary Medical Sciences in Physiology, Pharmacology and Toxicology, Louisiana State University School of Veterinary Medicine, US, 1997
- B.S., Geology, Louisiana State University, 1985

Professional Affiliations and Registrations

- Adjunct Faculty, Louisiana State University Department of Environmental Sciences
- Baton Rouge Geological Society
- American Association of University Women
- Society of Environmental Toxicology and Chemistry

Languages

- English, native speaker
- French, limited working proficiency

Honors and Awards

- US Department of Energy Graduate Research Fellowship
- US Department of Energy Post-Doctoral Research Fellowship

Fields of Competence

- Environmental Toxicology
- Ecological Risk Assessment
- Human Health Risk Assessment
- Freshwater and Estuarine Field Studies
- Project Management
- LDEQ RECAP Risk Assessment
- Freshwater Fish Culturing
- Conservation Biology
- Environmental Data Analysis
- Biological Species Surveys
- Wetlands Rapid Assessments

Key Industry Sectors

- Oil and Gas
- Litigation
- Chemical Production
- Pipeline

Publications

- Connelly, H. and Means, J. International Journal of Toxicology, 2010 29: 532: Immunomodulatory Effects of Dietary Exposure to Selected Polycyclic Aromatic Hydrocarbons in the Bluegill (*Lepomis macrochirus*).

Key Projects

Airborne Sulfur Dioxide and Hydrogen Sulfide Human Health Risk Assessment
Calculated human health risk due to airborne SO2 and H2S release from a major petrochemical refinery on the Gulf Coast. Potentially exposed receptors included neighborhood residents adjacent to the refinery. Health risks were calculated by comparing LDEQ monitoring station data and air data collected in the neighborhood to site specific calculated protective standards. Protective standards were calculated using exposure studies from a full review of the scientific literature. Prepared two expert reports for this study. Was deposed for opinion and testified in federal court in this matter.

Coastal Sediment Ecological Risk Assessment: PAHs, PCBs, Dioxins/Furans, TPH, and Metals
Completed a screening ecological risk assessment for a brackish to saline coastal open water area based on concentrations in sediments. Ecological exposures to PCBs, Dioxins/Furans, PAHs, TPH, and metals were assessed using metals and organics comparison values, PAH toxic unit values, and metals speciation and AVS data. Receptors were assumed to be birds, mammals, and fish.

Airborne PM10 Human Health Risk Assessment
Calculated human health risk due to an airborne catalyst release from a major petrochemical refinery on the Gulf Coast for an expert report. Potentially exposed receptors included neighborhood residents adjacent to the refinery. Risk was calculated using EPA National Ambient Air Quality Standards (NAAQS) for particulate matter (PM10), PM10 data from the nearby LDEQ monitoring station, and modeled air concentrations. Wipe sample data was collected from surfaces in the neighborhood, and were compared to US Army wipe standards. The health effects portion of this lawsuit was dropped by opposing counsel on the day that my deposition on the matter was to occur.

Benzene Human Health Risk Assessment
Prepared a human health risk assessment for recreational (swimming) exposure to creek surface water. Protective standards for creek surface water were calculated, using EPA guidelines, to represent concentrations that did not pose unacceptable risk of cancer. The setting for this risk assessment was a natural creek in a wooded area. There were 10 years of data for this evaluation, which reduced some levels of uncertainty normally present in a risk assessment.

Benzene Air Sampling Plan for Human Health Risk Assessment
Wrote air sampling and analysis plan to evaluate airborne volatile hydrocarbons in the area of a residence near an underground petroleum pipeline. Researched and described best current technology for air sample collection and for identifying low levels of compounds in air. Calculated protective health-based standards for benzene in air based on LDEQ RECAP and EPA guidelines.

Screening Level Ecological and Human Health Risk Assessment of TPH-Impacted Canal Sediments
Initiated a preliminary ecological risk screening of a heavily TPH impacted canal in St. Charles Parish. Compared sediment, water, and sheen concentrations in the samples collected to proxy MO-1 human health standards and NOAA SQUIRT standards. Attempted electrofishing sample collection, but the conductivity of the water was prohibitive.

Pipeline Spill Human Health Risk Assessment
Planned, collected and analyzed soil and ground water samples for a major petrochemical client in response to their request for RECAP compliant investigation report for a gasoline pipeline spill near a sugar cane field. Analyzed reported constituent concentrations using LDEQ RECAP Screening Standards and prepared RECAP report for submittal to LDEQ.

Human Health Pipeline Worker Risk Assessment
Evaluated health risks to pipeline workers installing a pipeline thirty feet below ground surface across a Superfund site in an area with thick clay strata in the soil lithology. Surface soil constituents included heavy metals and carcinogens. Considered inhalation, dermal and ingestion routes of exposure to workers. Used RECAP and TCEQ standards as references for toxicity assessment. Estimated the potential for constituents to migrate from the pipeline excavation via groundwater to other areas. Wrote a brief summary type letter to EPA for the client to obtain approval for the pipeline installation. EPA granted approval.

Oil Spill PAH Fish Immunotoxicity Study
Designed and successfully executed a freshwater fish toxicity study to evaluate the effects of polycyclic aromatic hydrocarbons (PAH) from energy related wastes, such as oil spills, on the proliferative behavior of immune cells in a native bluegill fish model (Lepomis macrochirus). Worked with the Louisiana Department of Wildlife and Fisheries to collect bluegill from the LSU lakes using electrofishing. Maintained the fish in indoor tanks. Collected lymphocytes from fish after feeding them a diet of 2-methylnaphthalene, 9,10-dimethylanthracene, and 2-aminoanthracene for a period of weeks. Published the results in a peer reviewed journal. Presented this research at the Society of Environmental Toxicology and Chemistry (SETAC) annual meeting in San Francisco, 1997.

LDEQ RECAP MO-1 Human Health Risk Assessment of Salt and TPH Impacted Agricultural Field
Calculated human health risk using LDEQ RECAP protocol for two agricultural sites of former and current oil and gas production in the central Louisiana area. Both sites had salt impacted soils and groundwater. Used identified background concentrations for groundwater standards. Soil was evaluated using Screening standards and MO-1 standards for metals and hydrocarbons. LDNR standards and SPLP methods were used to assess salt in soils, and to delineate areas of impact. Both projects involved collaboration with environmental scientists from many disciplines all working together on the projects. Both projects involved managing, analyzing and reporting on large data sets. Wrote portions of the risk assessment for two reports, including calculating RECAP standards.

Barium Ambient Water Quality Standard Development
Developed a barium ambient water quality standard for protection of aquatic organisms. Followed US EPA guidelines and very specific protocol for developing a chronic exposure standard based on a complete review of the scientific literature. Developed an EPA compliant standard that is one order of magnitude larger than current available standards.

Sediment Barium, PAH, and Mercury AOI Delineation in Fresh to Brackish Marsh
Worked collaboratively with a team of risk assessors to develop a sampling and analysis plan to delineate areas for sediment remediation investigation in a fresh to brackish marsh. Analytical methods involved PAH pore water analysis to estimate toxic units and metals speciation by QEMSCAN to estimate metals toxicity. Calculated site-specific sediment screening for barium and mercury, which as accepted as appropriate methodology by LDEQ and LDNR.

LDEQ RECAP Human Health Risk Assessments
Established human health exposure pathways and receptors and/or calculated site specific RECAP standards for the following sites: creosoting wood treatment facility, dry cleaning establishment, former industrial waste disposal site, gasoline spill site, paper mill, and former exploration and production sites.

Shipyard Human Health Risk Assessment
Calculated the human health risk associated with exposure to sediments containing lead, arsenic, cadmium, and chromium at a former shipyard in St. Mary Parish.

Two Year Crawfish Bioaccumulation Study
Planned and executed two crawfish collection studies in surface waters in St. Charles Parish in ditches impacted with chlorinated compounds and other organic compounds. Prepared an analysis of crawfish abundance as affected by drought and surface water contaminants. Analyzed crawfish tissues for compounds detected in surface waters to determine if accumulation was occurring. Presented this research to the LSU Department of Environmental Sciences and was unanimously accepted as an adjunct faculty member based on the research.

Blue Crab Population Study
Analyzed crab weight, size, and fullness as related to crab habitat characteristics in a study area of natural bayou, lake, and marsh ecosystems, as well as man-made oilfield canals. Collected crabs and fish under a Louisiana Department of Wildlife and Fisheries collection permit as part of a team of risk assessors working on a study of heavy metal toxicity in aquatic organisms. Reported the crab and fish collection techniques in a detailed sampling methods and results report that was submitted to LDEQ, LDHH, and LDWF. Compared the measured weights, sizes and abundance of the crabs collected in this project to annual crab studies done by LDEQ, LSU and the Gulf States Marine Fisheries Commission.

Freshwater/Brackish Marsh Functions and Services Analysis
Planned and executed a field study to assess wetland functions and services in a fresh to intermediate marsh ecosystem. Evaluation methods used were based on USEPA Rapid Wetlands Assessment techniques. The study area setting was man-made canals, a bayou and a lake. The field study involved trapping native bait fish and blue crabs (*Callinectes sapidus*), recording vegetation in the habitats, and recording birds and other wildlife present. At each location, an evaluation was done using a wetlands assessment tool to quantify the functioning of the ecosystem. This wetlands function assessment report was submitted to LDEQ, LDHH, and LDWF.

Personal Injury Expert Reports
Researched and prepared health toxicity expert reports for human exposures to two different compounds: carbon monoxide and gluteraldehyde, both for litigation not in the petrochemical industry. Was deposed for opinion each time.

Crawfish Ingestion Human Health Risk Assessment
Performed a crawfish ingestion analysis based on potential shellfish consumption from a ditch impacted with low levels of chlorinated compounds and other organic compounds for presentation to LDEQ for a petrochemical client. Used LDEQ RECAP ingestion and exposure parameters to calculate crawfish consumption risk assessment.

Data Analysis/Data Management
Managed large amounts of soil, sediment, water and biological data for several projects. Data analysis includes work such as: identifying and analyzing effects of non-detected analytes on calculated results, analyzing effects of sample depths by location, calculating dry weights/wet weights, identifying data gaps and uncertainty, comparing results from different labs, identifying unusable data, statistical comparison of site to background concentrations, calculation of mean 95%UCL and UTL, and identifying trends and patterns in constituent concentrations.

Biological and Non-Biological Field Sampling
Collected and recorded field samples under chain of custody for environmental media and biological species for many projects including: soil and sediment sampling, shallow and deep groundwater and drinking well sampling, surface water and vegetation sampling, periphyton collection, macroinvertebrate collection, crawfish trapping, blue crab trapping, electrofishing for freshwater fish species, dip netting small freshwater fish and invertebrates in submerged aquatic vegetation, and trawling for fresh and intermediate salinity fish.

LDEQ Community Relations

Assisted in writing and publishing LDEQ community relations newsletters and planning town meetings in order to communicate health risks associated with Superfund sites and other inactive and abandoned sites with nearby residents. Provided public health information to communities surrounding Superfund sites such as Old Inger, Lincoln Creosote, and Combustion.

Fresh Marsh Flooded Forest Vegetation Survey

Evaluated and recorded vegetation assemblages in six locations in the southern portion of the Louisiana Department of Wildlife and Fisheries White Lake Wetlands Conservation Area. Performed the study of the fresh marsh and wooded wetlands with natural and man-made canals with my graduate students. Identified common plant species and measured associated water salinity, turbidity, pH and temperature.

Graduate Student Mentor Masters of Natural Science Degree in Biology

Mentored and taught a total of eighteen graduate students over a three year period in the Gordon A. Cain Center Department at Louisiana State University. All eighteen candidates completed projects and final exams and were awarded Master's Degrees in Natural Sciences with a specialization in Biology. During the three year period, I taught classes in Biology, Environmental Science and Ecology, and led field and laboratory exercises during all semesters.

LDEQ MO-3 Human Health and Ecological Risk Assessment of Flooded Forest Fresh Marsh

Completed and submitted to LDEQ, at the request of LDNR, both a human health and an ecological risk assessment of sediments from canal bottoms in a fresh marsh and flooded forest environment. Co-managed with one of my peers**,** all phases of the risk assessment from the initiation of sample collection planning to the final calculations of risk. Used innovative statistical methods to identify background concentrations, extensive research to identify freshwater marsh-specific/species-specific exposure parameters. Risk assessment included calculating hazard quotients for native species based on measured levels of metals in sediments and soils in a setting frequented by recreational hunters and fishermen. Sediment constituents of concern were barium, TPH, and polycyclic aromatic hydrocarbons. RECAP algorithms using recreational exposure values were used to assess potential hazard due to the human direct contact pathway. For the ecological assessment, barium exposure was assessed based on identifying the locations where soluble barium may exist (TCLP analysis) and evaluating those locations based on probable no-effects concentrations for barium in sediments. TPH and barium were evaluated for their potential for accumulation in fish, based on accumulation factors from the scientific literature. Modeled concentrations in fish were then compared to LDEQ/LDHH calculated fish tissue screening levels for human consumption. LDEQ and LDNR has granted a no further action at this time status to the site, based on the MO-3 analysis.

LDNR Pit Closure Plan

Prepared with a co-worker, and submitted to LDNR, a work plan to close four pits that exceeded 29-B standards for O&G and/or barium using site specific RECAP MO-1 industrial standards. The work plan included confirmatory sampling to completely delineate the pits to 29-B standards and sampling to complete a TPH fractions and barium RECAP assessment. The rationale behind the plan was to only excavate soils if analysis showed that the soils exceed both 29-B and RECAP standards, indicating potential effects to human health and the environment. The four former pits are lushly vegetated, in a remote setting accessible only by boat, and do not include any residences. Excavation of soils that do not demonstrate health hazards can be avoided in a setting like this, limiting destruction to the ecosystem. Also included in the work plan was a vegetation survey/wetlands assessment at each of the four pits to document expected vegetation and ecosystem functioning.

Vegetation as part of ecosystem function was assessed by estimating that percentage cover of each category of vegetation was appropriate to the setting, as well as by comparing the vegetation species present to species documented in the scientific literature for each habitat type. Presented the concepts and data behind this closure approach to LDNR, prior to submitting the work plan to them, in order to include all LDNR input/comments in the plan prior to submittal.

Ecological Risk Assessment Brackish Marsh Estuary Approved by LDEQ and LDNR

Worked collaboratively with a team of risk assessors to design and execute a complex data collection and ecological risk assessment in a brackish marsh estuary. Sampling included soils, sediments, surface waters, fish, and crabs. Vegetation was recorded and analyzed for providing functions and services. Crab, fish, and avian population data were compared to reference marsh data identified in the primary scientific literature. PAH and TPH ecotoxicity were assessed via USEPA 34 PAH porewater invertebrate toxicity assessment (toxic units). Barium was speciated using scanning electron microscopy energy dispersive spectometry (QEMSCAN). Barium sediment screening values were calculated based on the results of a large literature review. Mercury sediment screening values were calculated based on a large literature review. Mercury biomagnification was calculated based on measured levels in crab tissues and modeled levels in bird eggs. Mercury benchmarks were calculated for wildlife health. Bioaccumulation factors were calculated based on field data and literature review for barium sulfate, methylmercury and PAH. The methods used in the risk assessment and the planned further investigation were approved by LDEQ and LDNR.

Fish and Vegetation Quantitative Assessment Freshwater Swamp and Bayou

Completed a vegetation survey and fish collection to support conclusions of a large scale ecological risk assessment in a south Louisiana bayou and cypress tupelo swamp setting. Collected and released more than a thousand native freshwater fish and recorded vegetation in 30 unique quadrats. Vouchered each unique fish species. Collected fish from bayous, swamps and open water using cast netting, hoop nets and wire net traps, and recorded fish by genus and species. Surveyed and recorded vegetation at each location where fish were collected. Photographed each habitat, fish collection and vegetation location in detail. Worked collaboratively with a team of scientists to complete this bioassessment.

Visiting Guest Lecturer

Delivered several lecture presentations to educate peers, industry, attorneys and regulators in various fields of toxicology. Presented a talk and photos at an on-site event describing phytoremediation, natural attenuation, and constituent toxicity at a Superfund site at the request of USEPA. Presentation was for public service and done at the request of community members. Worked as a member of a team along with other scientist presenters for this event. Presented methods for interpreting metals data in biological tissues for both human health and ecological risk assessments to large groups of environmental attorneys on several occasions. Presented toxicity and effects of acute exposure to benzene and arsenic to members of the Louisiana Environmental Health Association at their monthly meeting at LDEQ at the request of Bill Schramm with LDEQ. Gave a lecture on accumulation of total petroleum hydrocarbons (TPH) in fish and sediments at the Louisiana 2016 Solid Waste Conference in Lafayette, Louisiana. Presented annually to my co-workers the toxicology portion of the 40 hour health and safety training over a five year period.

Groundwater Sampling in Vicinity of Brine Sinkhole

Worked collaboratively in the field to collect and analyze groundwater samples from onsite and offsite monitoring wells at a south Louisiana industrial facility. Collected from each well more than sixty samples for metals, volatiles, hydrocarbons, salt parameters, and radionuclides analysis.

Collected field data on water pH, turbidity, conductivity, temperature, well depth, and water depth. Supervised as many as six other parties at each well collecting duplicate water samples. Maintained chain of custody and sample documentation prior to transport to the lab for analytical testing. Have analyzed this data, along with three additional years of data from this location to complete an LDEQ complaint MO-2 human health risk assessment based on human exposure to well water. LDEQ and LDNR approved the risk assessment.

Rapid Bioassessment of Wadeable Streams in Mississippi

Completed Rapid Bioassessments of four streams in 100 meter reach segments. Collected macroinvertebrates, periphyton and native fish following a prescribed EPA protocol. Fish were collected by electroshocking, macroinvertebrates were collected using a jabbing dip net process and periphyton were collected by hand scraping. Each habitat was sampled in each stream according to the percentage the habitat represented of that stream. Sampling included duplicate sampling for periphyton and voucher collection for each fish species collected. Performed a scored habitat assessment comparison of the four streams and presented an evaluation of fish species diversity and richness. The entire process was photo documented in detail.

LDEQ MO-2 and MO-3 Human Health and Ecological Risk Assessments for Brine Sinkhole

Completed and submitted LDEQ RECAP compliant MO-2 and MO-3 Work Plans for a Louisiana brine mining operation for review by LDNR and LDEQ. The Work Plans encompass the results of over three years of surface water and groundwater data collection and analysis. The efforts to complete the Work Plans included analysis of over 170,000 data points of more than 300 different constituents. The intended methods were presented to LDEQ and LDNR prior to creating the actual Work Plans to obtain comments. The plans describe RECAP compliant human health risk assessment for groundwater and ecological risk assessment and human health risk assessment for the surface waters. The effort involved statistical comparison of data sets using PROUCL software, calculation of RECAP health based standards and scientific literature review for ecological toxicity values. These human health and ecological risk assessment work plans represented complete assessment, even though they were termed work plans. The human health work plan was approved by LDNR and LDEQ.

Calculation of Worker Exposure to Volatiles During Oil Spill Clean-Up

Prepared opinion for Mike Pisani while he was in the midst of a trial on worker exposure to volatiles during an oil spill clean-up. Estimates of likely exposure were made using data from two other oils spills, EPA, and OSHA data. Estimated levels and durations of exposure were compared to concentrations predicted to have long term or irreversible health effects, and to levels sufficient to cause short term, reversible health effects in oil spill workers. This opinion was used by Pisani to respond to questioning during the trial.

Human Health Lead Exposure Risk Assessment

Performed EPA-compliant risk assessment for a lead-impacted bayou near a major petroleum refinery in St. Charles Parish. Calculated health risks to hunters and fishers consuming fish, crabs and game from the bayou area. Used the Integrated Exposure Uptake Biokinetic (IEUBK) model and the Adult Lead Model to assess lead human health risks.

Screening Level Chemical Plant Human Health Risk Assessment

Estimated the toxicity and calculated risk based standards for more than 150 compounds, including many tin compounds, for which no RECAP standards exist, at a chemical plant in South Louisiana. Used chemically similar compounds with known toxicities as proxies for compounds with limited toxicity information.

PCB Fingerprinting Analysis in Soils and Sediments

Compared polychlorinated biphenyl concentrations (PCB) in soils and sediments at an industrial facility to PCB concentrations in an adjacent ditch and connecting bayou to determine if site PCBs were the source of the ditch PCBs. The analysis involved a detailed review of the congeners on site by depth and by congener ratio. We provided the client with support for our conclusions in the form of statistics and graphs. We also provided an opinion as to the original Aroclor formulation that was the source of the PCBs on site. This project involved creating an extensive database from PDF files, as no Excel versions were available, as well as converting congener identifying names from different labs to consistent names for all data.

Chlorinated Groundwater Human Health Risk Assessment

Worked collaboratively with the in-house research division of a large petrochemical company in St. Charles Parish to complete the risk assessment portions of a RCRA Corrective Measures Study Work Plan. Performed a detailed QA/QC evaluation of current and historical data used in the assessment. Assessed human health risk due to exposure to chlorinated compounds in shallow and deep groundwater.

LDNR Hearings Ecological Risk Assessment

Presented testimony and was questioned by attorneys and LDNR regulators on my findings and results from ecological risk assessments on three separate occasions. The hearings were accomplished in order to present to the agency, in each instance, a most feasible plan for investigation and remediation of legacy E&P sites. In each instance, I was one of many experts presenting project results. One of the investigations was for a cypress tupelo swamp and the other two were for bottomland hardwood wetland ecosystems.

Expert Testimony Jury Trial

Presented the findings and results of an ecological risk assessment performed at an industrial facility and adjacent bottomland hardwood forest to a judge and jury. The risk assessment results included evaluation of habitat for mammals, birds, and invertebrates and results of a salinity study. Data presented included avian and vegetation survey results and risk calculations based on soil TPH, PAH, and metals data. The result of the trial was a finding of no damages by the jury.

Bottomland Hardwoods Ecological Risk Assessments Submitted to LDNR

Performed an ecological risk assessment of bottomland hardwood wetlands in four different locations. These projects are throughout South Louisiana in locations of Plaquemines Parish, St. Mary Parish, and in the Lafayette area. Compared vegetation diversity to CRMS data and wildlife refuges, completed vegetation and avian surveys, documented salinity indicators, performed metals speciation analysis, SPLP analysis, hazard quotient analysis, photo documentation, and literature review. Expert reports were completed for all four ecological risk assessments. Two of the risk assessments were submitted to LDNR in support of a Limited Admission to the agency.

Cypress Tupelo Swamp Ecological Risk Assessment Submitted to LDNR

Performed an ecological risk assessment of a cypress tupelo swamp in Iberia Parish. Measured cypress tree circumferences, investigated salinity indicators, recorded birds and vegetation, researched the cypress tree scientific literature, calculated risk for avian and mammalian receptors, and made comparisons to nearby wildlife refuges. We performed a submerged wetlands assessment based on surface elevations and nearby USACOE gauging data. This risk assessment was presented to the LDNR in a hearing associated with a limited admission.

Prairie Grasslands Ecological Risk Assessment
Performed an ecological risk assessments of prairie grassland species in industrial and agricultural settings in two locations in the Lafayette area. For assessing the grasslands, we used comparisons to wildlife refuges, vegetation and avian surveys, metals speciation analysis, SPLP analysis, hazard quotient analysis, photo documentation, and literature review. Expert reports were completed for both ecological risk assessments.

Salt Marsh Ecological Risk Assessment
Performed an ecological risk assessments of a salt marsh in Cameron Parish. For this assessment, we reviewed historical records of species native to the area and to the nearby wildlife refuge. We identified birds and mammals dedicated to salt marshes and performed risk calculations for those animals. We compared the site vegetation to expected species for the salt marsh, based on the literature review. The project included a sediment and a marsh ecological risk assessments.

Flooded Forest Ecological Risk Assessment
Performed a screening level ecological risk assessment of a flooded forest and marsh that is in direct communication with the Atchafayla River. Soils and sediments were below background levels, so the risk assessment did not advance beyond the screening level. Performed a thorough investigation of the forested area, by measuring diversity within quadrats along a transect. The flooded nature of the land made the work difficult. The quadrat vegetation data was compared to CRMS data in the nearest CRMS reference stations. We performed a submerged wetlands assessment for this risk assessment based on measured surface elevations and nearby USACOE gauging data.

Mentor to Indonesian Ph.D. Candidate
Working with a young woman in Indonesia to assist and mentor her during the process of applying for a Ph.D. program in the US. Meeting with her weekly.

Presentation of Ecological Risk Assessment Methods to Oil and Gas In-House Scientists
Invited to present bespoke mercury methylation assessment methods, barium SEM EDS speciation methods, and PAH ex situ porewater methods to in-house science team and attorney team for a global oil and gas client. Was afterwards requested to send to the client the methods I developed for modeling methylmercury biomagnification, to be shared with the in house science team. The methods are first of their kind and are not currently available through EPA.

APPENDIX B SITE PHOTOGRAPHS

15 March 2022

Appendix B-1

Vegetative Communities Observed at the Site

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Early Successional Grassland

Area 1: H-26

Manmade Waterbody

Area 1: H-26

Fringe Wetlands

Area 2: 12-A

Fringe Wetlands

Area 2: 12-A

Wetland Scrub-Shrub

South of Area 2: 13-A

Scrub-Shrub

Area 3: H-13

Scrub-Shrub

Area 3: H-13

Scrub-Shrub

Area 4: H-8

Scrub-Shrub

Area 4: H-8

Scrub-Shrub

Area 4: H-15

Emergent Wetland

Area 4: H-15

Scrub-Shrub

Area 4: H-16

Emergent Wetland in Former Tank Battery

Area 5: 11-A

Emergent Wetland in Former Tank Battery

Area 5: 11-A

Emergent Wetland

Area 5: 11-A

Riparian Forest

East of Area 5: 11-F

Riparian Forest

East of Area 5: 11-F

January 12, 2022 JCS

Early Successional Grassland

Area 5: 6-D

Early Successional Grassland

West of Area 5: 8-A


March 24, 2021 PMR

Early Successional Grassland

West of Area 5: 8-A

Early Successional Grassland

West of Area 5: 8-B

Emergent Wetland

Area 5: 11-C

Early Successional Grassland

Area 5: 11-D

Early Successional Grassland

Area 5: 11-D

Early Successional Grassland

Area 5: 11-E

Riparian Forest

East of Area 5: 10-A

Scrub-Shrub

Area 6: H-24

Scrub-Shrub

Area 6: H-24

Floating Aquatic Vegetation

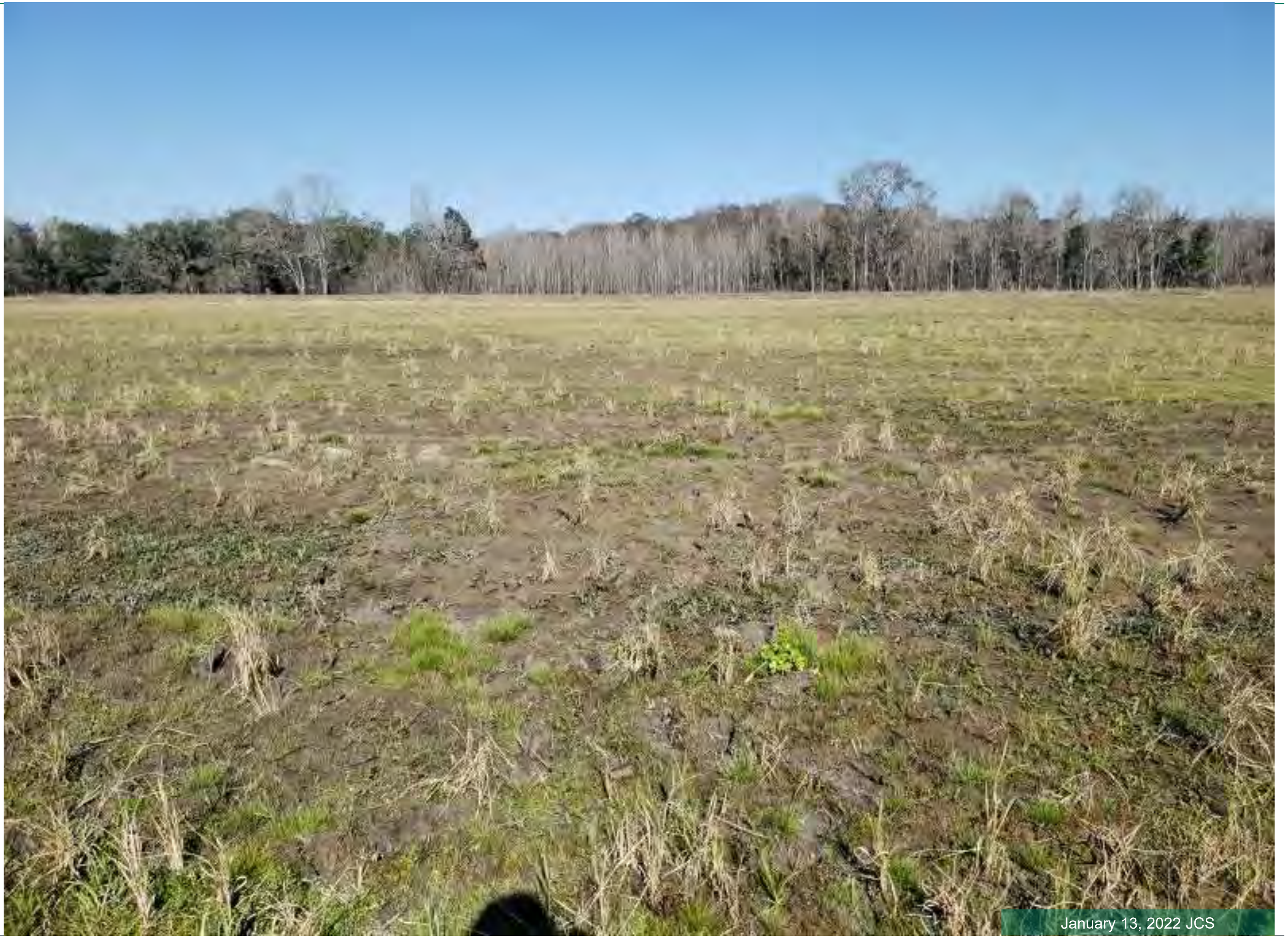
East of Area 8: East of H-3

Fallow Rice Field

Area 8: H-4

Fallow Rice Field

Area 8: H-4



Farm Burn Pile

Area 8: H-4

Rice Field

Area 8: 1-C

Open Water

Bayou Lacassine NE of H-32

January 12, 2022 JCS

Floating Aquatic Vegetation

Bayou Lacassine NE of H-32


Crowpoison
January 13, 2022 JCS

Appendix B-2

Flora Observed at the Site

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Yellow thistle

Cirsium horridulum

Wetland Class

Facultative

Area 2: 12-A

March 25, 2021 JCS

Lowland rotala

Rotala ramosior

Wetland Class
Obligate

Area 4: 7-A

American pokeweed

Phytolacca americana

Wetland Class

Facultative Upland

Area 4: 7-C

Vetch

Vicia sp.

Wetland Class

Varies per species

Area 4: 7-E-F Area

Heartleaf nettle

Urtica chamaedryoides

Wetland Class

Facultative

Area 4: 7-E-F Area

Ebony spleenwort

Asplenium platyneuron

Wetland Class

Facultative Upland

Area 4: 7-H-G Area

Philadelphia Fleabane

Erigeron philadelphicus

Wetland Class

Facultative

Area 4: 7-G-J Area

White mulberry

Morus alba

Wetland Class

Facultative Upland

Area 4: 7-J Area

Possumhaw

Ilex decidua

Wetland Class

Facultative Wetland

Area 4: 7-J-G-K Area

March 25, 2021 JCS

Lyreleaf sage

Salvia lyrata

Wetland Class
Facultative Upland

Area 4: 7-G

Beaked cornsalad

Valerianella radiata

Wetland Class

Facultative

Area 4: 7-J

Little quakinggrass

Briza minor

Wetland Class

Facultative

Area 4: 7-J

Stiff marsh bedstraw

Galium tinctorium

Wetland Class

Facultative Wetland

Area 4: 7-J

Hairy buttercup

Ranunculus sardous

Wetland Class
Facultative

Area 4: 7-K

March 25, 2021 JCS

Flatsedge

Cyperus sp.

Wetland Class

Varies per species

Area 5: 11-A

Burclover

Medicago polymorpha

Wetland Class

Facultative Upland

Area 5: 11-A

Southern cutgrass

Leersia hexandra

Wetland Class

Obligate

Area 5: 11-A

Water spangles

Salvinia minima

Wetland Class

Obligate

Area 6: H-28

Florida mudmidget

Wolffiella gladiata

Wetland Class

Obligate

Area 6: H-28

Bald cypress

Taxodium distichum

Wetland Class

Obligate

Area 7: 4-A

Canada toadflax

Nuttallanthus canadensis

Wetland Class

Not Assigned

Area 8: 1-A

Aster

Aster sp.

Wetland Class

Varies per species

Area 8: 1-B

Hairy buttercup

Ranunculus sardous

Wetland Class
Facultative

Area 8: H-4

Grassy Arrowhead

Sagittaria graminea

Wetland Class

Obligate

Area 8: H-4

January 13, 2022 JCS

Crowpoison

Nothoscordum bivalve

Wetland Class

Facultative Upland

Area 8: H-4

Timothy canarygrass

Phalaris angusta

Wetland Class

Facultative Wetland

9-D-E Area

March 25, 2021 JCS

Everlasting

Gamochaeta sp.

Wetland Class
Varies per species

9-D-E Area

Reversed clover

Trifolium resupinatum

Wetland Class

Facultative Upland

9-E Area

Bedstraw

Galium sp.

Wetland Class

Varies per species

9-E

Blue-gray Gnatcatcher
January 11, 2022 JCS

Appendix B-3

Birds Observed at the Site

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Great Blue Heron

Ardea herodias

Diet

Fish

Area 1: H-26

White-faced Ibis

Plegadis chihi

Diet

Aquatic invertebrates

Area 1: H-26

White-faced Ibis

Plegadis chihi

Diet

Aquatic invertebrates

Area 1: H-26

White-faced Ibis

Plegadis chihi

Diet

Aquatic invertebrates

Area 1: H-26

January 13, 2022 JCS

White-faced Ibis

Plegadis chihi

Diet

Aquatic invertebrates

Area 1: H-26

Red-tailed Hawk

Buteo jamaicensis

Diet

Small Animals

Area 1: H-26

Red-tailed Hawk

Buteo jamaicensis

Diet

Small Animals

Area 1: H-26

Wilson’s Snipe

Gallinago delicata

Diet

Aquatic invertebrates

Area 1: H-26

January 13, 2022 JCS

Yellow-rumped Warbler

Setophaga coronata

Diet

Insects

Area 2: H-11

Anhinga

Anhinga anhinga

Diet

Fish

Area 2: H-11 and 12-A

Boat-tailed Grackle

Quiscalus major

Diet

Omnivore

Area 2: 12-A

March 26, 2021 CEI

Snow Goose

Anser caerulescens

Diet

Plants

Area 3: 12-B

Snow Goose

Anser caerulescens

Diet

Plants

Area 3: H-13

Greater White-fronted Goose

Anser albifrons

Diet

Plants

Area 3: H-13

Sedge Wren

Cistothorus stellaris

Diet

Insects

Area 4: H-8

January 13, 2022 JCS

Greater White-fronted Goose

Anser albifrons

Diet

Plants

Area 4: H-15

January 13, 2022 JCS

Savannah Sparrow

Passerculus sandwichensis

Diet

Insects

Area 4: H-15

January 13, 2022 JCS

Savannah Sparrow

Passerculus sandwichensis

Diet

Insects

Area 4: H-16

Sandhill Crane

Antigone canadensis

Diet

Omnivore

Area 5: H-1

Orange-crowned Warbler

Leiothlypis celata

Diet

Insects

Area 4: H-16

Yellow-rumped Warbler

Setophaga coronata

Diet

Insects

Area 4: H-16

Yellow-rumped Warbler

Setophaga coronata

Diet

Insects

Area 4: H-16

Ruby-crowned Kinglet

Corthylio calendula

Diet

Insects

Area 4: H-16

Ruby-crowned Kinglet

Corthylio calendula

Diet

Insects

Area 4: H-16

Snow Goose

Anser caerulescens

Diet

Plants

Area 5: H-18

Ruby-crowned Kinglet

Corthylio calendula

Diet

Insects

Area 6: H-24

Great Egret

Ardea alba

Diet

Fish

Area 6: H-24

Gray Catbird

Dumetella carolinensis

Diet

Insects

Area 6: H-24

Blue-gray Gnatcatcher

Polioptila caerulea

Diet

Insects

Area 6: H-24

Greater White-fronted Goose

Anser albifrons

Diet

Plants

Area 6: H-24

Turkey Vulture

Cathartes aura

Diet

Carrion

Area 8: H-3

American Kestrel

Falco sparveriu

Diet

Small Animals

Area 8: H-3

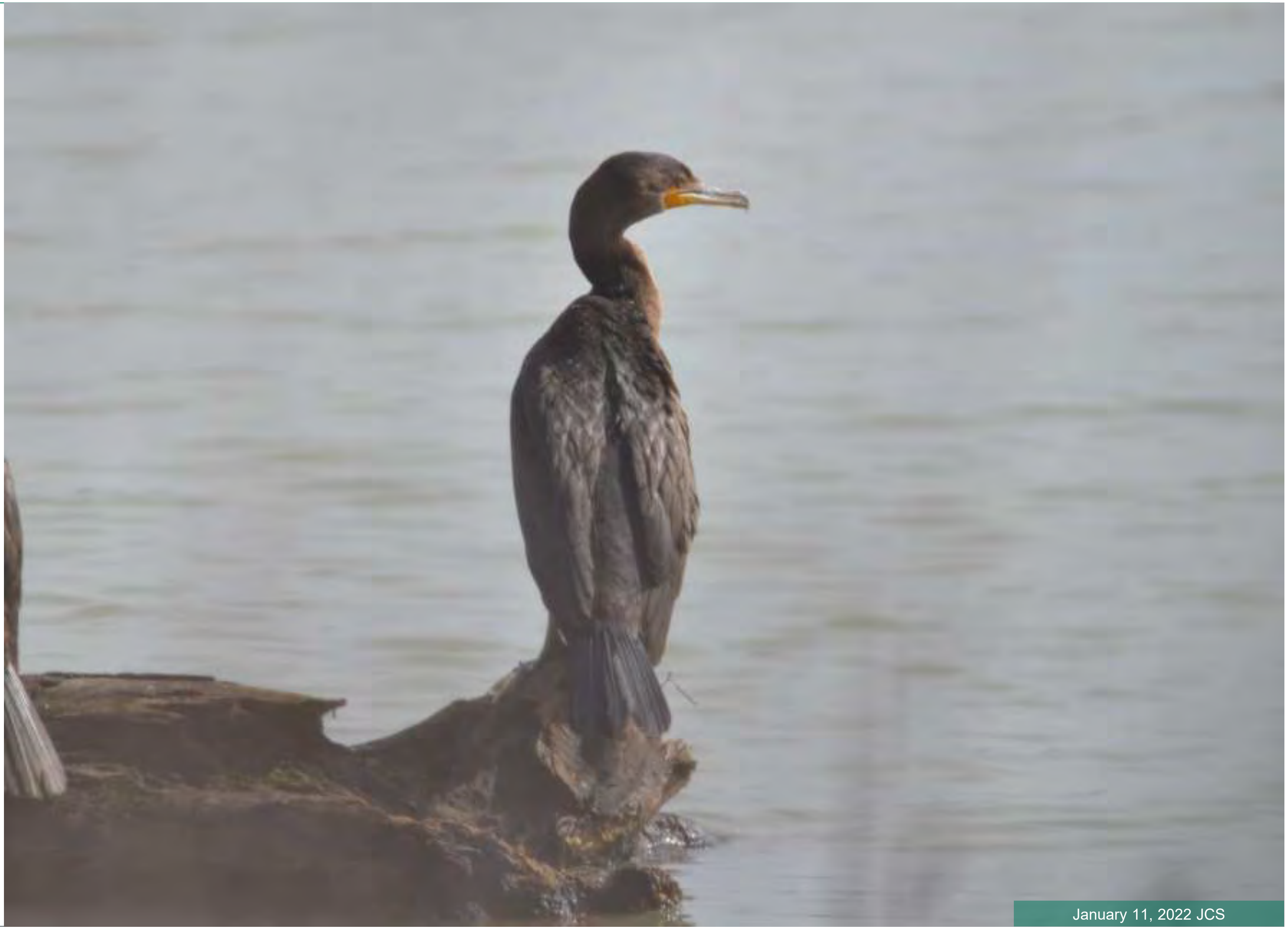
Neotropic Cormorant

Nannopterum brasilianum

Diet

Fish

Area 8: H-3



Neotropic Cormorant

Nannopterum brasilianum

Diet

Fish

Area 8: H-3

Snowy Egret

Egretta thula

Diet

Fish

Area 8: H-3

January 12, 2022 JCS

Great Blue Heron

Ardea herodias

Diet

Fish

East of Area 8

Belted Kingfisher

Megaceryle alcyon

Diet

Fish

Area 8: H-3

Eastern Phoebe

Sayornis phoebe

Diet

Insects

Area 8: H-3

Ibis

Family Threskiornithinae

Diet

Aquatic invertebrates

Area 8: H-3

Ibis

Family Threskiornithinae

Diet

Aquatic invertebrates

Area 8: H-3

Raptor

Order Accipitriformes

Diet

Small mammals

Area 8: H-3

White Ibis

Eudocimus albus

Diet

Aquatic invertebrates

Area 8: H-3

White-Faced Ibis

Plegadis chihi

Diet

Aquatic invertebrates

Area 8: H-3


January 12, 2022 JCS

White-Faced Ibis

Plegadis chihi

Diet

Aquatic invertebrates

Area 8: H-3


January 12, 2022 JCS

Bald Eagle

Haliaeetus leucocephalus

Diet

Fish

Area 8: H-4

American Pipit

Anthus rubescens

Diet

Insects

Area 8: H-4

Killdeer

Charadrius vociferus

Diet

Insects

Area 8: H-4


Checker Butterfly
January 13, 2022 JCS

Appendix B-4

Non-Avian Fauna Observed at the Site

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

American alligator

Alligator mississippiensis

Trophic Level

Apex Predator

Area 2: 12-A

Groundselbush Beetle Grub

Trirhabda bacharidis

Trophic Level

Primary Consumer

Area 2: 12-A

Common Buckeye

Junonia coenia

Trophic Level
Primary Consumer

Area 2: 12-A/H-11

Crawfish Tower

Family Cambaridae

Trophic Level

Primary Consumer

East of Area 5: 8-A

March 24, 2021 PMR

White-Tail Deer Tracks

Odocoileus virginianus

Trophic Level
Primary Consumer

Area 5: 11-A

Cricket

Superfamily Grylloidea

Trophic Level
Secondary Consumer

Area 5: 11-E

Game Trail

Unknown Species

Trophic Level

Varies

East of Area 5: 8-A

Snake Skin

Suborder Serpentine

Trophic Level
Tertiary Consumer

East of Area 5: 11-F

Mammal Tracks

Mammal tracks

Trophic Level

Secondary or Tertiary Consumer

Area 6: H-24

Mammal Tracks

Mammal tracks

Trophic Level

Secondary or Tertiary Consumer

Area 6: H-24

Checker Butterfly

Burnsius communis

Trophic Level
Primary Consumer

Area 8: H-4

American Alligator

Alligator mississippiensis

Trophic Level
Apex Predator

Bayou Lacassine


Unit B
February 24, 2022 JCS

Appendix B-5

Vegetative Communities Observed at Lacassine National Wildlife Refuge

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

Mowed Berm

Unit A

February 24, 2022 JCS

Mowed Berm

Unit A

Fringe Scrub Wetland

Unit A

Open Water and Emergent Marsh

Unit A


February 24, 2022 JCS

Open Water and Emergent Marsh

Unit A

Open Water and Emergent Marsh

Unit A

Open Water and Mowed Roadside

Unit A


February 24, 2022 JCS

Early Successional Grassland

Unit A

Early Successional Grassland

Unit A

Mowed Area

Unit A

Mowed Area

Unit A

Mowed Area

Unit A

Roadside Canal

Unit A

Early Successional Grassland

Unit A

Early Successional Grassland

Unit B

February 24, 2022 JCS

Forested Scrub-Shrub Wetland

Unit B

Early Successional Grassland

Unit B

February 24, 2022 JCS

Early Successional Grassland

Unit B

Emergent Marsh

Unit B


February 24, 2022 JCS

Roadside Forest

Unit B

Observation Deck

Unit B

Early Successional Scrub-Shrub

Unit B

February 24, 2022 JCS


Birdeye Speedwell
February 24, 2022 JCS

Appendix B-6

Flora Observed at Lacassine National Wildlife Refuge

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Carolina Geranium

Geranium carolinianum

Wetland Class

Not Assigned

Unit A

Mousesear

Stachys crenata

Wetland Class

Facultative Upland

Unit A

February 24, 2022 JCS

Spiny Sowthistle

Sonchus asper

Wetland Class

Facultative Upland

Unit A

February 24, 2022 JCS

Virginia Plantain

Plantago virginica

Wetland Class

Facultative Upland

Unit A

Birdeye Speedwell

Veronica persica

Wetland Class

Not Assigned

Unit A

Bald Cypress

Taxodium distichum

Wetland Class

Obligate

Unit A

Black Medick

Medicago lupulina

Wetland Class
Upland

Unit A

Bittercress

Cardamine sp.

Wetland Class

Varies per Species

Unit B

Blue fieldmadder

Sherardia arvensis

Wetland Class
Not Assigned

Unit B

Buttercup

Ranunculus sp.

Wetland Class

Not Assigned

Unit B

February 24, 2022 JCS

California Bulrush

Schoenoplectus californicus

Wetland Class

Obligate

Unit B

Henbit Deadnettle

Lamium amplexicaule

Wetland Class

Not Assigned

Unit B

Appendix B-7

Birds Observed at Lacassine National Wildlife Refuge

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

American Coot

Fulica americana

Diet

Plants

Unit A

Greater White-fronted Goose

Anser albifrons

Diet

Plants

Unit A

February 24, 2022 JCS

Ducks

Anatidae

Diet
Varies per species

Unit A


February 24, 2022 JCS

Neotropic Cormorant

Phalacrocorax brasilianus

Diet

Fish

Unit A

Glossy Ibis

Plegadis falcinellus

Diet

Aquatic Invertebrates

Unit A

White Ibis

Eudocimus albus

Diet

Aquatic Invertebrates

Unit A


February 24, 2022 JCS

Common Gallinule

Gallinula galeata

Diet

Plants

Unit A

Boat-tailed Grackle

Quiscalus major

Diet

Omnivore

Unit A

February 24, 2022 JCS

Great Egret

Ardea alba

Diet

Fish

Unit A

Northern Cardinal

Cardinalis cardinalis

Diet

Seeds

Unit A

Pied-billed Grebe

Podilymbus podiceps

Diet

Aquatic Invertebrates

Unit A

Ibis

Plegadis

Diet

Aquatic Invertebrates

Unit A

Roseate Spoonbill

Platalea ajaja

Diet

Aquatic Invertebrates

Unit A

Snowy Egret

Egretta thula

Diet

Fish

Unit A

Swamp Sparrow

Melospiza georgiana

Diet

Insects

Unit B

Common Yellowthroat

Geothlypis trichas

Diet

Insects

Unit B

American Alligator

February 24, 2022

Appendix B-8

Non-Avian Fauna Observed at Lacassine National Wildlife Refuge

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Alligator

Alligator mississippiensis

Trophic Level

Apex Predator

Unit A

Alligator

Alligator mississippiensis

Trophic Level

Apex Predator

Unit A

February 24, 2022 JCS

River Cooter

Pseudemys concinna

Trophic Level
Secondary Consumer

Unit A

Nutria

Myocastor coypus

Trophic Level
Primary Consumer

Unit A

Pillbug

Family Armadillidiidae

Trophic Level
Primary Consumer

Unit A

APPENDIX C FIELD NOTES

15 March 2022

0430 Depart NOLA - P. Ritchie (ERM)
0745 Arrive on site - front gate, marked location
sent by Walker Wilson
0810 W. Wilson on site - Observations noted are stated by W. Wilson

8-A N 30.081673 W 92.912433

General habitat = Herbaceous Veg - mix of wetland/upland species
2-3" of standing water
Pic 1 Crawfish chimney
Pic 2 Game trail
Pic 3-6 Habitat facing N-W-S-E
Vegetation: Spartina patens, Eleocharis baldwinii, rubus sp, Brazilian Vervain
Andropogon sp, Baccharis halimifolia, Juncus effuses
3 square, Bidens sp., Grasses - Smut? Purple Johnson? Jointed, Thistle
Observation from probing = No sheen - No Odor

8-B N 30.081520° W 92.912396

General habitat = same field - SAA
Pics 7-10 Habitat facing N-W-S-E
Crows, Kill deer, game trail, crawfish
Vegetation - SAA
Grass shrimp, Mosquito fish, crawfish, ramshorn - dipnet HW14 ditch

10-A
Pic 11 Facing W
Texas Gas Valve Site - No probing
Vegetation - Andropogon, Baccharis, Grass -

05 26033 Henning 3-24-2021

0915 11-G N 30.082062 W 92.912417

General habitat = Mix herb + woody, bare ground green moss
2-3" of standing water
Vegetation - Chinese tallow, smutgrass, andropogon, brazilian verbena
rubus, juncus, 3square, johnsongrass, baccharis
Large lancelot leaf herb, Carex sp.
Crawfish - white spotted fishing spider - from dip net
Observation from probing - No sheen No odor

11-F N 30.082113 W 92.912567

General habitat = mix Veg w/ herb, shrub, tree
No water - abandoned motor/debris
Vegetation = Prickly ash, thistle, rubis, andropogon, chinese tallow
Vines - 2 species: opposite leaves reddish stem, hercules club
carex spp., smut grass
Snake skin - rat snake?, Small nest in pipe, ants, bees
Staining - Moderate odor Slight odor - Probing
Potential water well? (Pic) Layne Placard
Common Yellow throat

11-E N 30.082045 W 92.915089

Limestone area on side of entry road
3-4" of water in lower surrounding areas
Vegetation - Yellow clover, andropogon, eleocharis, rubus, golden rod, cyperus sp
(Pics) Facing N - W - S - E
crawfish mayfly? (blue/green) (Pic)

11-A N 30.081937 W 92.913350

Debris - cleared area 1-2" of water,
Vegetation = Bittercress, Cyperus spp, eleocharis, Andropogon, rubis, juncus, whitetail, Vine
Green anole, crawfish - Probing - extensive very slight "sheen" Slight odor
Cricket

0526033 Henning 3-24-2021

11-B N 30.081927 W 92.913131 ⊕

Limestone covered area - water in lower parts of road
Vegetation - small clumps of grass (purple) ✱ good inflorescence
Coyote scat on site

1015 Visitors on-site
John Cook, Clay Kimbrell, Bubba - ROW agent?

11-C

Area between road + well pads
3-4" of standing water
Vegetation - Baccharis, eleocharis, yellow clover, juncus, andropogon
cattail, cyperus spp, coastal bermuda, purple flower 'fern'
Crawfish, native ladybug
Observations from probing - No Odor No sheer

11-D N 30.081173 W 92.913341

(Pics) Facing N - W - S - E
Sparse vegetation, deer + coyote tracks - scatt, mottled ducks
Yellow clover, eleocharis, cyperus spp, andropogon, green algae growing in H2O
Observations from probing No Sheen No Odor

6B N 30.082121 W 92.914660

4-18 well location sedge wren
Habitat - dominated by herb veg - occassional shrub
Vegetation - Eleocharis, andropogon, goldenrod, thistle, grasss, bideas
1-2" of water in lower spots
Observation from probing No Sheen No Odor

[signature] 0526033 3-24-2021

6-D N30.081694 W92.914636

Habitat a mix of herb + occassional shrub
1-2" of water on surface (Pics) N-W-S-E
Vegetation = eleocharis, andropogon, brazillian verbain
large lancelot leaf, Carex spp, grasses
Observations. no odor no sheen

6-C N 30.081690 W92.914933

(Pics) NW-S-E
Vegetation Same as 6-D add rubus
Baccharis has catepillers eating new growth

6-A N30.081708 W92.915481

(Pics) Habitat facing N-W-S-E 1-2" of water
Vegetation = eleocharis, rubis, andropogon, juncus, grasses
Brazilian verbain, Baccharis, purple flower 'Ara'
Observations from probing No Sheen No Odor

~~13-A~~ N 30.082193 W 92.917978

Flowline crossing canal into field ~5"

13A

Ponded ~~[illegible]~~ location - water depth unknown = toodeep to enter
Vegetation = Cattail, maiden cane, juncus, baccharis, hydrocotyl
spartina patens alligator weed, rubis, hairy oppositeleaf vine (no tendrol)
eleocharis, yellowspotflower, thistle, tallow tree, arrowhead vine
On way to site = visual on two white tailed deer (doe), armadillo tracks
eastern meadow lark (call), wren

Location Hennings Date 3/25/21

Project / Client 0526033

8:00 ⊕ JCS on-site
CEI on-site
Walker, Austn, Cora

Site 12-A pond between ICON locations
H-9, 11, & 12
⊕ 8:49 f. NW @ pond. large alligator
cattails, salvinia, black willow, chinese tallow
typha domingensis, alligatorweed, mikania scandens,
louisiana vetch, ludwigia peploides
⊕ 9:01 f. n. east side of pond
juncus effusus, wax myrtle, cirsium horridulum,
bushy bluestem, solidago
⊕ 9:07 f. w. flowline on NE side of pond
nuphar lutea, rubus trivialis, eleocharis sp.
brazillian vervain
⊕ 9:18 f. w, ICON H-12? well
⊕ 9:23 f S, ICON H-9 well
⊕ 9:24 f. E, pond
black medick (lupulina?)
9:27 leaving site 12-A

Location Hennings Date 3/25/21

Project / Client 0526033

Site 12-B, scrubby field @ ICON H-13, 14 locations
wax myrtle, eleocharis, rubus trivialis, brazilian vervain,
⊕ 9:37 f. w.
baccharis, juncus effusus, louisiana vetch, more...

Site 7-M
low, wet spot in field
juncus effusus, bushy bluestem, louisiana vetch,
eleocharis, ~~johnson grass~~ paspalum/vasey grass,
cyperus sp., ludwigia, rumex sp., rubus trivialis
solidago sp.; mikania scandens, baccharis

⊕ 9:58 site f. E
ICON H-10 well on e side

swamp rabbit pellets, eastern pondhawk

Location Hennings Date 3/25/21
Project / Client 0526033

7-C

swamp dogwood, carolina geranium, bedstraw (galium aparine), sonchus aspar, rubus trivialis, pepperwine cirsium horridulum, tallow, sugarberry, butterweed red maple, cyperus sp, eleocharis, solidago sempervirens american pokeweed (photo)
SOM flowlines & values

7-B herbaceous field

bushy bluestem, louisiana vetch, ambrosia sp. (western?), carolina geranium, brazilian vervain, black medick, ~~[illegible]~~ persica veronica, rubus + 3 a, giant ragweed ~~[illegible]~~ johnson grass, solidago altissima, yellow foxtail, (~~[illegible]~~ setaria) raining,
mimosa sp,
⊕ 10:23 f. E 7-B area near ICON H-2 well

Location Hennings Date 3/25/21
Project / Client 0526033

7-E

cyperus sp., brazilian vervain, solidago sempervirens, solidago altissima, rubus trivialis, bushy bluestem mimosa sp, eleocharis sp, carex sp,

7-D low narrow feature

cyperus sp, rubus trivialis, pepperwine western cottonmouth
brazilian vervain, baccharis, solidago altissima pokeweed, sugarberry, red maple

7F scrubby area near ICON H-7 sample location

red swamp crawfish, baccharis, eleocharis rubus trivialis, rubus argutus, ~~[illegible]~~ brazilian vervain, solidago sempervirens, pepperwine, wax myrtle, fire ants, toothache tree, elderberry, purple passionflower, curly dock, bedstraw, dog fennel, sonchus asper, pokeweed, oxalis stricta ranunculus sp, sesbania herbacea, chinese tallow, green hawthorne

Location Hennings Date 3/25/21

Project / Client 0526033

7-J not 32-J

27-A shrubby environment
H-16 well ICON
eleochris, bushy bluestem, solidago sempervirens, solidago altissima, brazilian vervain, baccharis, wax myrtle
rotalla (lowland)
⊕ 14:04 f. N

27-L shrubby location near ICON H-15
soil sample
baccharis, rubus trivialis, solidago sempervirens, bushy bluestem, brazillian vervain
⊕ 14:28 f. N

7-A not 27-A

7-L not 27-L

7-G shrubby area north of road
solidago sempervirens, rubus trivialis, wax myrtle, pepperviney baccharis, rubus argutus, philadelphia fleabane
late-flowering thoroughwort
⊕ 14:41 f. W.

7-H shrubby area just east of 7-G
solidago sempervirens, rubus trivialis, wax myrtle, rubus argutus & trivialis, solidago altissima

Location Hennings Date 3/25/21

Project / Client 0526033

7-G, H, & I overlap, I will record one plant list for all 3.
chinese tallow, juncus effusus, bedstraw, ambrosia psilostachya

32-J
japanese honeysuckle, lyreleaf sage*, corn salad, briza minor, purple passion flower, sonchus aspe[r], rubus trivialis, rubus argutus, butterweed, bushy bluestem, peppervine, sugarberry, baccharis, carolina geranium, galium tinctorium?, solidago sempervirens & altissima, white mulberry*
* technically out of area

7-K large wet ponded area covered in cattails
⊕ 15:N
shield fern, cattails, juncus, rubus argutus

ranunculous sardous, ~~on~~ pinkladies, mouse-eared chickweed, white nymph
on road to sites

Location Hennings Date 3/25/21

Project / Client 0526033

9-B herbaceous area beside limestone road
louisiana vetch, hairy buttercup, cyperus sp., rumex crispus, smilax sp., grass sp, chinese tallow, chocolate?
brazillian vervain, white clover, mock strawberry, rubus argutus, juncus pallidus
⊕ 16:02 N

9-C herbaceous area near cell-phone tower support
cyperus sp, louisiana vetch, brazillian vervain, juncus effusus, hairy buttercup, chinese tallow, white clover
curly, ~~grass sp.~~ bermuda grass, rubus trivialis
few creosote piles (see photo), persian clover
⊕ 16:07 S. E.

9-D/E scrubby area under oak trees
live oaks, chinese tallow, baccharis, juncus effusus, mock strawberry, rubus trivialis, deciduous holly, stinging nettle, dwarf palmetto, timothy canopy grass, giant ragweed, stinging nettle, carolina geranium
few 4" pipes
⊕ 16:13, S. E
louisiana vetch, mouse-eared chickweed, bedstraw
brazilian vervain, butterweed, ... rumex crispus

Location Hennings Date 3/25/21

Project / Client 0526033

cont.
black medick, scarlet pimpernell, rescue grass
⊕ 9E area SE 16:36
sonchus asper, carolina geranium, hairy buttercup
gamochaeta, white clover, persian clover,
rubus argutus, annual rye grass, persicaria hydropiperoides,

9-A several broken-down cattle corrals w/ large concrete silo
⊕ 16:47 NE, E, SE
5-lined skink, baccharis, louisiana vetch, white clover, persian clover, black medic, toxicodendron radicans, rubus trivialis, sesbania sp., peppervine

17:00 off-site

Location Hennings Date 3/26/21
Project / Client OS26033

8:00 JCS on-site
Lance Fontenot (Integra)
Walker, Cara, Austin (CEI)
On Word Line Rd (street sign says Traub Rd)

4-A flooded scrubby area south of Word Line/Traub Rd & levee to south
spartina patens, chinese tallow, pepervine, baccharis??, pickerel weed, smartweed lady's thumb, juncus sp, sugarcane plumegrass, poison ivy, salvinia minima, bald cypress, smilax bona-nox, cornus sp., wolffia g.
bullfrog, green treefrog, green anole, eleocharis, deciduous
⊕ 9:21 f. N
holly, red maple, wax myrtle, rubus argutus

4-B
red maple, chinese tallow, wax myrtle, deciduous holly, cyperus sp, persicaria sp, ludwigia sp,

JM

Location Hennings Date 3/26/21
Project / Client OS26033

10:15
drove east on Word Line & turn north, near well 31298
⊕ 10:20 1-A area f. NE
1-A fallow rice field & berm
old-field toadflax, LA vetch, crow poison, brazilian vervain, oxalis corniculata, purple passion flower, rubus argutus, rubus trivialis
scarlet pimpernell, carolina geranium, western ribbon snake, ludvigia sp., pondweed, sagittaria sp, bacopa monieri, grass

1-C rice field
⊕ 10:39 area f. E
rice, duckweed, unknown 1, 2 see photos

1-D rice field
⊕ 10:44 f. N
rice, duckweed, unknown 1-2, butterweed
ranunculus sp

1-B rice field & berm
⊕ 10:50 f. W aster sp
rice, butterweed, unknown 3, ludwigia sp., ranunculus sp, oldfield toadflax, mouse-ear chickweed
yellow blue-eyed grass, grass sp, scarlet pimpernel

Location Hennings Date 3/26/21
Project / Client 0526033

5-D

roadside pond, partially underwater
near well 195098
⊕11:27 f. W
ludwigia sp. black willow, cyperus sp, dog fennel, eleocharis
pickerelweed

5-C wet part of pond, ~~no veg~~
⊕11:35 f. E
water ≈ 6"
one aquatic species chara?/muskgrass?

5-A cattail patch south of road
⊕11:43 f. S
typha domingensis, black willow, mikania scandens, eleocharis, pepperwort
bronze frog, cyperus sp, azolla, red maple, spotted
lady thumb, sesbania, ludwigia sp.

Location Hennings Date 3/26/21
Project / Client 0526033

5-B scrubby area adjacent to road
⊕11:58 f. S
bushy bluestem, typha domingensis, black willow
louisiana vetch, chinese tallow, butterweed
western ribbonsnake, black medick, tall goldenrod

12:15 off-site

Location Henning Date 1/12/22

Project / Client 05260033

9:30 arrived site with
John Frazier

9:47 Meeting
Shawn Wiggins
Lou Grossman
Victor Gregoire
John Kind
Angela Lavert
Shaun Wenek
Richard Kennedy
John Frazer
Jody Shugart
Emily Martin

Safety Mtg

10:15 Helen, Emily, Jody
begin eco to
H-18 location

Location: Henning Date: 1/12/22
Project / Client: 0526033

add birds 11-A

10:20 Snow geese flying over

10:25 arrived H-18
walked to 11-A
photo no sheen at 11-A

add birds 11-A

overhead sandhill cranes flying
brown rodent 6"
grey catbird
american crow

10:37 water near 11-A saw mosquito fish

photo water 11-A
cricket frog
photo cricket frog

H

Location: Henning Date: 1/12/22
Project / Client: 0526033

10:48
11-A survey
30.081723 °N
92.913814 °W

seaside goldenrod
green flatsedge
black willow
bushy bluestem
goldenrod sp.
baccharis
yellow nutsedge
symphiotricum sp.
clover sp. (burr clover)
sesbania herbatia
eleocharis sp.
photo 11-A vegetation
malabar sprangletop
grass sp.
bushy bluestem
deer prints
typha sp. (1m tall)

H

Location Henning Date 1/12/22
Project / Client 0526033

vetch sp.
rubus sp.
black willow
brazilian vervane
juncus sp.
fall goldenrod
gallium sp.
sedge sp. wren bird
Jody photo'ing grasses
wild rice?
Vasey grass
cricket frog in water
euphorbia sp.
peppervine
Sonchus asper
photo 11-A veget.
blue jay

11:20 at 11-F
We see a stain
photo stain - dark blk
2' diameter brown
no smell

Location Henning Date 1/12/22
Project / Client 0526033

30.082096
92.912585
cardinal (bird)
30' survey

japanese honeysuckle
Ilex decidua (or sp?)
wooly rosette grass
bushy bluestem
tall goldenrod
northern dewberry
brazialin vervane
Chinese privet
photo 11-F veg, Helen
common yellowthroat
giant ragweed
am. crow
cypress sp

H

Location Henning Date 1/12/22
Project / Client 0526033

bacharis
poison ivy
crawfish
chinese tallow
blue grey gnatcatcher
tall goldenrod
japanese climbing fern
Johnson grass
Juncus sp
sugarberry
grape sp.
poison ivy
thistle (yellow)
symphiotricum ~~aster~~ sp.
photo ditch near
TT-F, travels to
bayou, no sheen
smilax sp.
carolina geranium
wax myrtle
lichen

Location Henning Date 1/12/22
Project / Client 0526033

sugar cane plume grass
burr clover
turkey vulture
Eastern phoebe
11:47 Head towards
H-7, H-10, H-15 area
H-11
12:29 Head to H-11
area
common buckeye butterfly

12:36
Walking a path around
water hole, include
H-11 and 12-A
record path, record
vegetation, Emily recording

yellow rumped warbler
ruby crown kinglet
orange crowned warbler

Location: Henning Date: 1/12/22
Project / Client: 0526033

Northern Harrier
photo water hole
near 14-11,12-A
common salvinia
water lily sp
spatterdock
red winged blkbird
cattail sp.
mosquito fish
photo Jody water
dip net hole
duckweed sp.
cricket frogs
juncus
alligator weed
black willow
chinese tallow
baccharus
bushy bluestem
thistle (yellow)

Location: Henning Date: 1/12/22
Project / Client: 0526033

seaside goldenrod
Northen dewberry
wax myrtle
goldenrod sp.
brazilian vervane
eleochous
green flatsedge
Emily photo'd mosquito
-fish - edge water hole
dogfennel
Crawfish
red maple
perisicaria sp
(smartweed)
bacopa monieri
highbush blackberry
Eastern phoebe
King rail
~~fox sedge~~
carex lurida (lookalike)
sedge wren

Location: Henning Date: 1/12/22
Project / Client: 0526033

resurrection fern
climbing hempvine
floating primrose
willow
3 photos Emily
dipnetting
redwinged blk bird

13:48
1:48 at H-3
Jody photo'd
killdeer
white faced ibis
white ibis
great egreat
snowy egret
neotropic cormorant

Spoke to "Henning
guide service"
employee.
He takes
hunters out

Location: Henning Date: 1/12/22
Project / Client: 0526033

for geese + ducks
on the Hennings
property

2:00 Heading to
Lacassine Bayou
photo egrets
east of H-3

2:10 Jody photo'd
ditch that enters
Bayou Lacassine
near water pumps
2:15
red bellied woodpecker
sapsucker
swamp sparrow
chickadee
song sparrow
red tailed hawk

Location: Henning Date: 1/12/22
Project / Client: 05260033

white eyed vireo
alligator
cypress
tupelo
greater white
fronted geese

3 photos Bayou
Lacassine

2:34 Tried to
access ditch
entrance to
Lacassine, but
cypress swamp
was too flotant
duck hunters
2:36
ruby crown kinglet

Location: Henning Date: 1/12/22
Project / Client: 05260033.

Bayou Lacassine location
30.078751 °N
92.88625 °W
giant cutgrass
bald cypress
spider lily
pileated woodpecker
red maple
tupelo
saggitaria latifolia
spanish moss
Am. elm
dwarf palmetto
alligator weed
Salvinia (common)
water hyacinth
apple snail
persicaria maculata
alligator
oak
baccharis

Location Henning Date 1/12/22
Project / Client 05260033

carolina geranium
~~stinging nettle~~ HC
fern sp.
vetch
peppervine
juncus
allium sp.
hibiscus sp.
brazilian vervain
lady's eardrops
chinese tallow
swamp smartweed

3:14
west of Bayou, ricefield
Am Kestral
savannah sparrow
meadowlark
Kestrel
Kingfisher

H

Location Henning Date 1/12/22
Project / Client 05260033

3:34 at H-28
cricket frog
rabbit pellets
30.081513 °N (30.081513)
92.910307 °W

Chinese tallow
cattails
gray catbird
persicaria maculata
red maple
standing water
black willow
climbing hempvine
juncus
oak (willow)
common salvina
duckweed
curly dock
Florida mud midget
leopard frog
alligator weed

H

Location Henning Date 1/12/22
Project / Client 05260033

dog fennel
swamp sparrow

3:59 photo 1+-28
yellow ~~to~~ rumped warbler

4:15 head out

0526033 Henning 1/13/22

08:45 on site safety meeting
Jody + Emily

09:05 Check in w/ Shawn
09:12 Anhinga near A-12
09:20 ⊕ H-13 EM
09:19 ⊕ H-13 JS
09:23 ⊕ snow geese
09:31 H-16 arrive
30.085077° N
92.915516° W
09:34 ⊕ H-16
Bluegray gnat catcher
Savannah sparrow
Carolina wren
ruby crowned Kinglet
eastern towhee
blue jay
red winged black bird
baccharis
wax myrtle
bushy bluestem
yellow thistle
Seaside goldenrod
rabbit's foot grass

EEM

Scale: 1 square = ________

0526033 Henning 1/13/22

H-16 continued ↓

sugarcane plume grass
crawfish mound
eleocharis
gray cat bird
green flat sedge
Brazilian vervain
curly dock
ludwigia repens
tall goldenrod
rabbit pellets
Note H-16 area was bush hogged
sedge wren
cardinal

09:47 ~~hang~~ hand dug soil - no invert. obs

09:49 orange butterfly ⊕

09:52 Arrive H 15
30.084284°N
92.915600°W
⊕ 10:04

blue gray gnat catcher
blue jay
yellow rumped warbler
baccharis
sedge wren
snow geese

ECM

Scale: 1 square = ______

0526033 Henning 1/13/22

H-15 continued

American crow
Seaside goldenrod
tall goldenrod
eleocharis
Brazilian vervain
red wing black birds
greater white fronted geese ⊕ 9:56
bushy bluestem
crow poison
rubus sp.
ruby crowned Kinglet
wax myrtle
juncus sp.
cyperus sp.
crawfish mound
rabbit pellets
highbush blackberry
Savannah sparrow ⊕ 10:05

10:13 H-8 30.084759°N
⊕ 10:13 ECM 92.916089°W

bushy bluestem
baccharis
wax myrtle
⊕ 10:18 JS

ECM

Scale: 1 square = ______

Rite in the Rain

0526033 Henning 1/13/22

H-8 continued

Sedge wren ⊕ 10:18
ruby crowned kinglet
giant cane
fall goldenrod
Southern dewberry
Brazilian vervain
Seaside goldenrod
european honeybee
Carex sp.
eleocharis
Japanese climbing fern
northern dewberry
Juncus sp.
rabbit pellets
curly dock
sesbania herbacea
balloon vine?
giant ragweed
gray catbird
Am. crow
Carolina wren
cardinal
blue gray gnatcatcher

10:32 hand dug soil - no inverts obs
dragonfly

ELM

Scale: 1 square = ______

0526033 Henning 1/13/22

10:44 ⊕ H-7
10:56 H-4 arrive
red bellied woodpecker
red shouldered hawk
Killdeer
checkered butterfly
Am. crow
Savannah sparrow
white ibis
white faced ibis
Snowy egret
Bald Eagle juvenille (2) ⊕11:18
greater yellow legs

30.084759°N
92.916089°W

11:21 ⊕'s
buttercup sp.
Florida mudmidget
rice
sagitaria (grass-leaved)
eleocharis
bacopa monieri
raccoon prints
~~tad~~ elm

ELM

Scale: 1 square = ______

0526033 Henning 1/13/22

H-4 continued

deer tracks
American pipit
crawfish
crawfish tower
rabbits foot grass
vetch
galium sp.
little quaking grass
Brazilian vervain
Bermuda grass
grass sp.
carolina geranium
~~Persian speedwell~~ Em
highbush blackberry
Typha sp.
southern dewberry
smartweed sp.
dragonfly
scarlet pimpernell
clover sp.
Alium sp.

11.53 Arrive H-24
30.081752°N
92.910630°W

EM

0526033 Henning 1/13/22

H-24 continued

⊕ 11:56

1 inch surface water

yellow rumped warbler
Am. crow
Spartina patens
highbush blackberry
sesbania herbacea
sugarcane plume grass
Carex sp.
flies
ludwigia repens
tall goldenrod
dog fennel
baccharis
live oak
small mammal track ⊕ 12:00
Japanese honeysuckle
smilax bona-nox
juncus sp.
black willow
bushy bluestem
Brazilian vervain
~~smartweed sp.~~ - persicaria maculata
curly dock
vetch

EM

Scale 1 square = ______

Scale 1 square = ______

05260033 Henning 1/13/22

H-24 continued

Clover sp.

Typha sp.

Am. crow

Cyperus sp.

burr clover

Carolina geranium

ant tower

Cardinal

12:40 H-26 ⊕

Wilson's Snipe

great blue heron

boat tailed grackle

Phoebe

Red winged blackbird

13:00 Pick up samples from
Shawn and leave site.

Ellen

Scale: 1 square = ________

Location Henning
Project / Client ______ Date 2/24/22

8:40 on-site @ Lacassine NWR HQ
9:00 arrive @ Unit B on Streeter Rd
west side of road has deep ditch w/treed levee before old ag fields.
recording birds on ebird & plants on paper checklist.

⊕10:03 common yellowthroat @ Unit B w. trail parking lot. no GPS

11:10 leaving unit B
12:00 arrive @ Unit F3
stopped by farmer & told I was not allowed to be in this area. There were no "no trespassing" signs posted. Left area w/no survey.
12:35 arrive @ Unit A. Signs say hiking only allowed from Mar 15 - Oct 15. Veg logged on road & trailhead area.
Parts of Unit are very similar to site, but lacks shrubs. Some evidence of controlled burns present

Date 2/24/22
Location Henning
Project / Client ______

14:25 depart NWR.

15:00 arrive @ Bayou Lacassine @ Lorrains Park, small RV park w/campground & boat launch beside Bayou Lacassine.

Measuring Bayou from bridge. Top of bridge ≈ 10' above water. Water 9' 8". Measured using weighted rope & tape measure.
15:40 JCS off-site

Common Name	Scientific Name	Unit A	Unit B				
Red maple	Acer rubrum						
Meadow garlic	Allium canadense						
Alligatorweed	Alternanthera philoxeroides						
Cuman ragweed	Ambrosia psilostachya						
Ragweed	Ambrosia sp.						
Giant ragweed	Ambrosia trifida	X					
False indigo	Amorpha fruticosa						
Scarlet pimpernel	Anagallis arvensis						
Bushy bluestem	Andropogon glomeratus	X	X				
Bluestem	Andropogon sp.						
Giant cane	Arundinaria gigantea		X				
Ebony spleenwort	Asplenium platyneuron						
Carolina mosquitofern	Azolla caroliniana						
Eastern baccharis	Baccharis halimifolia	X	X				
Herb-of-grace	Bacopa monnieri						
Smooth beggartick	Bidens laevis						
Watershield	Brasenia schreberi						
Little quakinggrass	Briza minor						
Rescuegrass	Bromus catharticus						
American buckwheat vine	Brunnichia ovata						
Carolina fanwort	Cabomba caroliniana						
Twoheaded water-starwort	Callitriche heterophylla						
Bittercress	Cardamine sp.		X				
Balloon vine	Cardiospermum halicacabum						
Sedge	Carex sp.						
Sugarberry	Celtis laevigata	X					
Common buttonbush	Cephalanthus occidentalis						
Common mouse-ear chickweed	Cerastium fontanum						
Sticky chickweed	Cerastium glomeratum						
Coon's tail	Ceratophyllum demersum						
Muskgrass	Chara sp.						
Paraguayan windmill grass	Chloris canterai						
Spiny thistle	Cirsium horridulum	X					
Thistle	Cirsium sp.						
Jamaica swamp sawgrass	Cladium jamaicense						
Roughleaf dogwood	Cornus drummondii						
Stiff dogwood	Cornus foemina						
Dogwood	Cornus sp.						
Green hawthorn	Crataegus viridis						
Seven sisters	Crinum americanum						
Bermudagrass	Cynodon dactylon	X	X				
Yellow nutsedge	Cyperus esculentus						
Flatsedge	Cyperus sp.						
Green flatsedge	Cyperus virens						
Woolly rosette grass	Dichanthelium scabriusculum						
Carolina ponysfoot	Dichondra carolinensis						
Common persimmon	Diospyros virginiana						
Shield fern	Dryopteris carthusiana						
Indian strawberry	Duchesnea indica						
Jungle Rice	Echinochloa colona						
Barnyardgrass	Echinochloa crus-galli						
Coast cockspur grass	Echinochloa walteri						
Common water hyacinth	Eichhornia crassipes		X				
Baldwin's spikerush	Eleocharis baldwinii						
Sand spikerush	Eleocharis montevidensis						
Dwarf spikerush	Eleocharis parvula						
Squarestem spikerush	Eleocharis quadrangulata	X					
Spikerush	Eleocharis sp.						
Indian goosegrass	Eleusine indica	X					
Philadelphia fleabane	Erigeron philadelphicus						
Dogfennel	Eupatorium capillifolium						
Lateflowering thoroughwort	Eupatorium serotinum						
Thoroughwort	Eupatorium sp.						
Spurge	Euphorbia sp.						
Fimbry	Fimbristylis miliacea						
Stickywilly	Galium aparine						
Bedstraw	Galium sp.	X					
Stiff marsh bedstraw	Galium tinctorium						
Pennsylvania everlasting	Gamochaeta pensylvanica	X	X				
Carolina geranium	Geranium carolinianum						
Rosemallow	Hibiscus sp.						
Waterthyme	Hydrilla verticillata						
Floating marshpennywort	Hydrocotyle ranunculoides		X				
Hydrocotyle	Hydrocotyle sp.						
Possumhaw	Ilex decidua		X				

Common Name	Scientific Name	Unit A	Unit B	Unit F3	Unit C		
Saltmarsh morning-glory	Ipomoea sagittata						
Virginia iris	Iris virginica						
Annual marsh elder	Iva annua						
Jesuit's bark	Iva frutescens						
Common rush	Juncus effusus		X				
Needlegrass rush	Juncus roemerianus						
Rush	Juncus sp.						
Poverty rush	Juncus tenuis						
Roundhead rush	Juncus validus						
Virginia saltmarsh mallow	Kosteletzkya virginica						
Weedy dwarfdandelion	Krigia caespitosa						
Southern cutgrass	Leersia hexandra						
Common duckweed	Lemna minor						
Little duckweed	Lemna obscura						
Duckweed	Lemna sp.						
Bearded sprangletop	Leptochloa fascicularis						
Malabar sprangletop	Leptochloa fusca						
Japanese privet	Ligustrum japonicum						
Chinese privet	Ligustrum sinense						
American spongeplant	Limnobium spongia						
Sweetgum	Liquidambar styraciflua						
Japanese honeysuckle	Lonicera japonica	X	X				
Floating primrose-willow	Ludwigia peploides		X				
Creeping primrose-willow	Ludwigia repens						
Primrose-willow	Ludwigia sp.						
Japanese climbing fern	Lygodium japonicum						
Winged lythrum	Lythrum alatum var lanceolatum						
Black medick	Medicago lupulina	X	X				
Burclover	Medicago polymorpha	X					
Annual yellow sweetclover	Melilotus indicus						
Chocolateweed	Melochia corchorifolia						
Climbing hempvine	Mikania scandens						
Sensitive plant	Mimosa sp.						
Powderpuff	Mimosa strigillosa						
Wax myrtle	Morella cerifera		X				
White mulberry	Morus alba						
Spring forget-me-not	Myosotis verna						
Parrot feather watermilfoil	Myriophyllum aquaticum	X	X				
Spike watermilfoil	Myriophyllum spicatum						
Southern waternymph	Najas guadalupensis						
Peppervine	Nekemias arborea						
American lotus	Nelumbo lutea		X				
Crowpoison	Nothoscordum bivalve	X	X				
Yellow pond-lily	Nuphar lutea		X				
Canada toadflax	Nuttallanthus canadensis						
Tropical royalblue waterlily	Nymphaea elegans						
Yellow waterlily	Nymphaea mexicana						
American white waterlily	Nymphaea odorata						
Water tupelo	Nyssa aquatica						
Mickey Mouse plant	Ochna serrrulata						
Pinkladies	Oenothera speciosa						
Rice	Oryza sativa						
Ducklettuce	Ottelia alismoides						
Creeping woodsorrel	Oxalis corniculata						
Woodsorrel	Oxalis sp.	X					
Common yellow oxalis	Oxalis stricta						
Butterweed	Packera glabella	X	X				
Fall panicgrass	Panicum dichotomiflorum		X				
Maidencane	Panicum hemitomon						
Brownseed paspalum	Paspalum plicatulum						
Vasey's grass	Paspalum urvillei						
Seashore paspalum	Paspalum vaginatum						
Purple passionflower	Passiflora incarnata						
Knotweed (see Polygonum sp)	Persicaria sp.						
Timothy canarygrass	Phalaris angusta						
Carolina canarygrass	Phalaris caroliniana						
Common reed	Phragmites australis						
Turkey tangle fogfruit	Phyla nodiflora						
American pokeweed	Phytolacca americana						
Water lettuce	Pistia stratiotes						
Narrowleaf plantain	Plantago lanceolata						
Resurrection fern	Pleopeltis polypodioides						
Annual bluegrass	Poa annua	X	X				
Grass	Poaceae						
Swamp smartweed	Polygonum hydropiperoides						

Common Name	Scientific Name	Unit A	Unit B	Unit F3	Unit C		
Spotted lady's-thumb	Polygonum persicaria		X				
Knotweed (see Persicaria sp.)	Polygonum sp.						
Annual rabbitsfoot grass	Polypogon monspeliensis		X				
Pickerelweed	Pontederia cordata						
Waterthread pondweed	Potamogeton diversifolius						
Longleaf pondweed	Potamogeton nodosus						
Ssago pondweed	Potamogeton pectinatus						
Small pondweed	Potamogeton pusillus						
Herbwilliam	Ptilimnium capillaceum						
Water oak	Quercus nigra		X				
Cherrybark oak	Quercus pagoda						
Willow oak	Quercus phellos						
Oak	Quercus sp.						
Live oak	Quercus virginiana		X				
Spinyfruit buttercup	Ranunculus muricatus						
low spearwort	Ranunculus pusillus						
Hairy buttercup	Ranunculus sardous	X	X				
Buttercup	Ranunculus sp.		X				
Starrush whitetop	Rhynchospora colorata						
Shortbristle horned beaksedge	Rhynchospora corniculata		X				
Macartney rose	Rosa bracteata						
Lowland rotala	Rotala ramosior						
Sawtooth blackberry	Rubus argutus	X					
Blackberry	Rubus sp.						
Southern dewberry	Rubus trivialis	X	X				
Curly dock	Rumex crispus	X	X				
Dock	Rumex sp.						
Widgeongrass	Ruppia maritima						
Dwarf palmetto	Sabal minor						
narrow plumegrass	Saccharum baldwinii						
Sugarcane plumegrass	Saccharum giganteum		X				
Sugarcane	Saccharum officinarum						
Grassy arrowhead	Sagittaria graminea						
Bulltongue arrowhead	Sagittaria lancifolia						
Broadleaf arrowhead	Sagittaria latifolia						
Delta arrowhead	Sagittaria platyphylla						
Arrowhead	Sagittaria sp.						
Black willow	Salix nigra	X	X				
Lyreleaf sage	Salvia lyrata						
Water spangles	Salvinia minima		X				
Giant salvinia	Salvinia molesta		X				
Watermoss	Salvinia sp.						
American black elderberry	Sambucus nigra	X	X				
Chairmaker's bulrush	Schoenoplectus californicus	X					
Common threesquare	Schoenoplectus pungens						
California bulrush	Schoenoplectus tabernaemontani						
Softstem bulrush	Scirpus olneyi						
Bulrush	Scirpus spp.						
Poisonbean	Sesbania drummondii						
Bigpod sesbania	Sesbania herbacea						
Bigpod sesbania	Sesbania macrocarpa						
Riverhemp	Sesbania sp.						
Yellow foxtail	Setaria pumila						
Bristlegrass	Setaria sp.						
Annual blue-eyed grass	Sisyrinchium rosulatum		X				
Saw greenbrier	Smilax bona-nox						
Greenbrier	Smilax sp.						
Bristly greenbrier	Smilax tamnoides	X	X				
Canada goldenrod	Solidago altissima	X	X				
Seaside goldenrod	Solidago sempervirens						
Goldenrod	Solidago sp.	X	X				
Spiny sowthistle	Sonchus asper		X				
Johnsongrass	Sorghum halepense	X					
Saltmeadow cordgrass	Spartina patens						
Giant duckweed	Spirodela polyrhiza						
Smut grass	Sporobolus indicus		X				
Aster	Symphyotrichum sp.	X	X				
Bald cypress	Taxodium distichum						
Powdery alligator-flag	Thalia dealbata		X				
Eastern marsh fern	Thelypteris palustris						
Spanish moss	Tillandsia usneoides						
Eastern poison ivy	Toxicodendron radicans						
Whitenymph	Trepocarpus aethusae						
Chinese tallow	Triadica sebifera		X				
White clover	Trifolium repens						

Common Name	Scientific Name	Unit A	Unit B	Unit F3	Unit C		
Persian clover	Trifolium resupinatum						
Eastern gamagrass	Tripsacum dactyloides						
Southern cattail	Typha domingensis	X	X				
Cattail	Typha sp.						
American elm	Ulmus americana						
Heartleaf nettle	Urtica chamaedryoides						
Common bladderwort	Utricularia macrorhiza	X					
Beaked cornsalad	Valerianella radiata	X					
Brazilian vervain	Verbena brasiliensis	X	X				
Birdeye speedwell	Veronica persica	X	X				
Louisiana vetch	Vicia ludoviciana						
Vetch	Vicia sp.						
Grape	Vitis sp.						
Columbian watermeal	Wolffia columbiana						
Watermeal	Wolffia sp.						
Florida mudmidget	Wolffiella gladiata						
Hercules' club	Zanthoxylum clava-herculis						
Annual wildrice	Zizania aquatica	X	X				
Giant cutgrass	Zizaniopsis miliacea		X				
	Ludwigia leptocarpa		X				
	sp.		X				
water/honey locust	panicum sp.		X				
			X				
bullrush sp ⊕ 9:33			X				
apple snails		X	X				
deer tracks			X				
raccoon tracks			X				
ranunculus sp ⊕9:55		X	X				
field madder	sherardia arvensis		X				
"red berries"	smilax walteri?	X	X				
henbit deadnettle ⊕ 1052	lamium		X				
straggler daisy		X					
crowfoot grass	d. aegyptium?	X					
nutria		X					
alligator		X					
turtles		X					
unknown ⊕ 14:05							

APPENDIX D RECAP FORM 18

15 March 2022

APPENDIX D

RECAP FORM 18
ECOLOGICAL CHECKLIST

Section 1 - Facility Information

1. Name of facility: Henning Management L.L.C. property

2. Location of facility: Sections 16, 17, 18, 19, 20, and 21 of Township 11 South, Range 05W, and Section 24 of Township 11 South, Range 06W within the Hayes Oil and Gas Field

   Parish: Calcasieu and Jefferson Davis Parishes, Louisiana

3. Mailing address: NA

4. Type of facility and/or operations associated with AOC:
   Oil and gas exploration and production (E&P) and high pressure gas pipeline right-of-ways (ROWs)

5. Name of AOC or AOI: Site (Chevron former operational areas)

6. If available, attach a USGS topographic map of the facility and/or aerial or other photographs of the release site and surrounding areas.

Section 2 - Land Use Information

1. Describe land use at and in the vicinity of the AOC/AOI: The Site consists of multiple tracts that are located on both sides of Louisiana Highway 14. The approximate area of the Site is 1,262 acres and is primarily used for agriculture (rice and sugar cane farming), oil and gas E&P operations, high pressure gas pipeline ROWs, hunting leases, and undeveloped wetlands along Bayou Lacassine. In the vicinity of the Site, to the west of Highway 14, the land is undeveloped and to the east of Highway 14 the land is currently used for agricultural purposes, specifically rice fields. The US Fish and Wildlife Service (USFWS) has identified the land located to the north and east of the Site as freshwater emergent wetland or freshwater forested/shrub wetland.

2. Describe land use adjacent to the facility:
   Land use in the vicinity of the Site includes oil & gas E&P operations, high pressure gas pipeline ROWs, agriculture, and farther away, residential.

3. Provide the following information regarding the nearest surface water body which has been impacted or has the potential to be impacted by COC migrating from the AOC/AOC:

a) Name of the surface water body: There are several surface water bodies located on Site including shallow field drainage canals that transect the Site, small ponds, and Bayou Lacassine located on the easternmost portion of the Property. One of the small ponds on Site is located at the oil and gas well, SN 25340, and was formed after a blowout that occurred in 1941. Additionally, there are USFWS designated freshwater emergent wetlands or freshwater forested/shrub wetlands in the northern and eastern portions of the Site.

b) Type of surface water body:

   [ ] freshwater river or stream
   [X] freshwater swamp/marsh/wetland
   [ ] saltwater or brackish swamp/marsh/wetland
   [X] lake or pond
   [X] bayou or estuary
   [X] drainage ditch
   [ ] other: ______________________________

c) Designated use of the segment/subsegment of the surface water body (LAC 33:IX): The Site is located within the LDEQ Subsegment #LA050601 (Lacassine Bayou – From headwaters to Grand Lake) and has the following designated uses: primary and secondary contact recreation, fish and wildlife propagation, and agriculture. The LDEQ Subsegment #LA050601 is not designated as a drinking water supply and instead the City of Hayes and nearby communities rely on groundwater for their primary source of drinking water.

d) Distance from the AOC/AOI to nearest surface water body: 0 feet. The nearest named surface water body, Bayou Lacassine, is located on the easternmost portion of the Site. Field drainage canals and ponds are also present on the Site.

4. Do any potentially sensitive environmental areas exist adjacent to or in proximity to the site, e.g., federal and state parks, national and state monuments, wetlands, etc? [X] Yes [ ] No

If yes, explain:
Wetlands are present in portions of the Site, and adjacent to the Site.

Section 3 - Release Information

1. Nature of the release: Investigation of potential releases associated with Chevron former E&P operations.

2. Location of the release (within the facility): Sampling was performed in Areas 1, 2, 4, 5, 6, and 8, associated with Chevron former operational areas. Sampling was also performed in Areas 3 and 7, which are associated with E&P operations unrelated to Chevron, as well as Area 9, considered to be representative of natural conditions at the Site.

3. Location of the release with respect to the facility property boundaries: Potential releases are limited within the Site's boundaries.

4. Constituents known or suspected to have been released: Constituents are associated with oil and gas exploration & production include salts, metals, and total petroleum hydrocarbons (TPH).

5. Indicate which media are known or suspected to be impacted and if sampling data are available:

[X]	soil 0 - 3 feet bgs	[X] yes	[ ] no	*suspected, sampling data available*
[X]	soil 0 - 15 feet bgs	[X] yes	[ ] no	*suspected, sampling data available*
[X]	soil >15 feet bgs	[X] yes	[ ] no	*suspected, sampling data available*
[X]	groundwater	[X] yes	[ ] no	*suspected, sampling data available*
[X]	surface water/sediment	[X] yes	[ ] no	*suspected, sampling data available*

6. Has migration occurred outside the facility property boundaries? [ ] yes [X] no
If yes, describe the designated use of the offsite land impacted:

Section 4 - Criteria for Further Assessment

If the AOI meets **all** of the criteria presented below, then typically no further ecological evaluation shall be required. If the AOI **does not** meet **all** of the criteria, then a screening level ecological risk shall be conducted. The Submitter should make the initial decision regarding whether or not a screening level ecological risk assessment is warranted based on compliance of the AOI with criteria listed below. After review of the ecological checklist and other available site information, the Department will make a final determination on the need for a screening level ecological risk assessment. If site conditions at the AOI change such that one or more of the criteria are not met, then a screening level ecological risk assessment shall be conducted. Answers shall be based on current site conditions (i.e., shall not consider future remedial actions or institutional or engineering controls).

Indicate if the AOI meets the following criteria:

(1) The area of impacted soil is approximately 5 acres or less in size (based on the AOI identified for the human health assessment) and it is not expected that the COC will migrate such that the soil AOI becomes greater than 5 acres in size. [X] yes [ ] no

(2) There is no current release or demonstrable long-term threat of release (via runoff or groundwater discharge) of COC from the AOI to a surface water body. [X] yes [ ] no

(3) Recreational species, commercial species, threatened or endangered species, and/or their habitats are not currently being exposed, or expected to be exposed, to COC present at or migrating from the AOI.
[ ] yes [X] no *Recreational species are present and are included in the risk assessment.*

(4) There are no obvious impacts to ecological receptors or their habitats and none are expected in the future.
[X] yes [ ] no

Is further ecological evaluation required at this AOI? [X] yes [ ] no
An E&P-related ecological evaluation based on the data collected from the Site is being conducted as a part of this investigation.

Section 5 - Site Summary

Section 6 - Submitter Information

Date: January 12, 2022

Name of person submitting this checklist: Helen R. Connelly, Ph.D.

Affiliation: Environmental Resources Management

Signature:__________ Date: January 12, 2022

Additional Preparers: __________

APPENDIX E FLORA AND FAUNA

15 March 2022

APPENDIX E-1

Comparison of Plants Documented on Site and at the Lacassine National Wildlife Refuge Reference Area

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Alligatorweed	*Alternanthera philoxeroides*	✓	
American black elderberry	*Sambucus nigra*	✓	✓
American buckwheat vine	*Brunnichia ovata*	✓	
American elm	*Ulmus americana*	✓	
American lotus	*Nelumbo lutea*		✓
American pokeweed	*Phytolacca americana*	✓	
Anglestem primrose-willow	*Ludwigia leptocarpa*		✓
Annual blue-eyed grass	*Sisyrinchium rosulatum*	✓	
Annual bluegrass	*Poa annua*	✓	✓
Annual marsh elder	*Iva annua*	✓	
Annual rabbitsfoot grass	*Polypogon monspeliensis*	✓	✓
Annual yellow sweetclover	*Melilotus indicus*	✓	
Arrowhead	*Sagittaria sp.*	✓	
Aster	*Symphyotrichum sp.*	✓	✓
Bald cypress	*Taxodium distichum*	✓	✓
Baldwin's spikerush	*Eleocharis baldwinii*	✓	
Balloon vine	*Cardiospermum halicacabum*	✓	✓
Beaked cornsalad	*Valerianella radiata*	✓	✓
Bedstraw	*Galium sp.*	✓	
Bermudagrass	*Cynodon dactylon*	✓	✓
Bigpod sesbania	*Sesbania herbacea*	✓	
Birdeye speedwell	*Veronica persica*	✓	✓
Bittercress	*Cardamine sp.*	✓	
Black medick	*Medicago lupulina*	✓	✓
Black willow	*Salix nigra*	✓	✓
Blackberry	*Rubus sp.*	✓	
Blue fieldmadder	*Sherardia arvensis*		✓
Bluestem	*Andropogon sp.*	✓	
Brazilian vervain	*Verbena brasiliensis*	✓	✓
Bristlegrass	*Setaria sp.*	✓	
Bristly greenbrier	*Smilax tamnoides*	✓	
Broadleaf arrowhead	*Sagittaria latifolia*	✓	
Bulrush	*Scirpus sp.*		✓
Burclover	*Medicago polymorpha*	✓	✓
Bushy bluestem	*Andropogon glomeratus*	✓	✓
Buttercup	*Ranunculus sp.*	✓	✓
Butterweed	*Packera glabella*	✓	✓
Canada goldenrod	*Solidago altissima*	✓	✓
Canada toadflax	*Nuttallanthus canadensis*	✓	
Carolina canarygrass	*Phalaris caroliniana*	✓	
Carolina geranium	*Geranium carolinianum*	✓	✓
Carolina mosquitofern	*Azolla caroliniana*	✓	
Carolina ponysfoot	*Dichondra carolinensis*	✓	
Cattail	*Typha sp.*	✓	✓
Chairmaker's bulrush	*Schoenoplectus californicus*		✓

Notes

Wetland classification and growth habit is provided by the USDA (2022) PLANTS database.

NA : Data not available. Wetland classification, growth habit, and state status data are not always applicable to taxa identified to genus.

Lacassine National Wildlife Refuge species recorded by Mr. Jody Shugart (ERM, February 24, 2022).

References

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service. 2022. PLANTS Database. Available: https://plants.sc.egov.usda.gov/java/. Accessed March 2022.

APPENDIX E-1 (Cont'd)

Comparison of Plants Documented on Site and at the Lacassine National Wildlife Refuge Reference Area

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Cherrybark oak	*Quercus pagoda*	√	
Chinese privet	*Ligustrum sinense*	√	
Chinese tallow	*Triadica sebifera*	√	√
Climbing hempvine	*Mikania scandens*	√	
Columbian watermeal	*Wolffia columbiana*	√	
Common persimmon	*Diospyros virginiana*	√	
Common rush	*Juncus effusus*	√	√
Common threesquare	*Schoenoplectus pungens*	√	
Common water hyacinth	*Eichhornia crassipes*	√	√
Common yellow oxalis	*Oxalis stricta*	√	√
Creeping primrose-willow	*Ludwigia repens*	√	
Creeping woodsorrel	*Oxalis corniculata*	√	√
Crowpoison	*Nothoscordum bivalve*	√	√
Cuman ragweed	*Ambrosia psilostachya*	√	
Curly dock	*Rumex crispus*	√	√
Delta arrowhead	*Sagittaria platyphylla*	√	
Dock	*Rumex sp.*	√	
Dogfennel	*Eupatorium capillifolium*	√	
Dogwood	*Cornus sp.*	√	
Drummond red maple	*Acer rubrum var drummondii*	√	
Ducklettuce	*Ottelia alismoides*	√	
Duckweed	*Lemna sp.*	√	
Dwarf palmetto	*Sabal minor*	√	
Eastern baccharis	*Baccharis halimifolia*	√	√
Eastern marsh fern	*Thelypteris palustris*	√	√
Eastern poison ivy	*Toxicodendron radicans*	√	
Ebony spleenwort	*Asplenium platyneuron*	√	
Egyptian grass	*Dactyloctenium aegyptium*		√
Everlasting	*Gamochaeta sp.*	√	
Flatsedge	*Cyperus sp.*	√	
Floating marshpennywort	*Hydrocotyle ranunculoides*	√	√
Floating primrose-willow	*Ludwigia peploides*	√	√
Florida mudmidget	*Wolffiella gladiata*	√	
Giant cane	*Arundinaria gigantea*	√	√
Giant cutgrass	*Zizaniopsis miliacea*	√	√
Giant duckweed	*Spirodela polyrhiza*	√	
Giant ragweed	*Ambrosia trifida*	√	√
Giant salvinia	*Salvinia molesta*		√
Goldenrod	*Solidago sp.*	√	
Grape	*Vitis sp.*	√	
Grass	*Poaceae*	√	
Grassy arrowhead	*Sagittaria graminea*	√	
Green flatsedge	*Cyperus virens*	√	
Green hawthorn	*Crataegus viridis*	√	
Greenbrier	*Smilax sp.*	√	

Notes

Wetland classification and growth habit is provided by the USDA (2022) PLANTS database.

NA : Data not available. Wetland classification, growth habit, and state status data are not always applicable to taxa identified to genus.

Lacassine National Wildlife Refuge species recorded by Mr. Jody Shugart (ERM, February 24, 2022).

References

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APPENDIX E-1 (Cont'd)
Comparison of Plants Documented on Site and at the Lacassine National Wildlife Refuge Reference Area
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Hairy buttercup	*Ranunculus sardous*	√	√
Heartleaf nettle	*Urtica chamaedryoides*	√	
Henbit deadnettle	*Lamium amplexicaule*		√
Herb-of-grace	*Bacopa monnieri*	√	
Herbwilliam	*Ptilimnium capillaceum*	√	
Hercules' club	*Zanthoxylum clava-herculis*	√	
Honey locust	*Gleditsia triacanthos*		√
Hydrocotyle	*Hydrocotyle sp.*	√	
Indian goosegrass	*Eleusine indica*	√	
Indian strawberry	*Duchesnea indica*	√	
Japanese climbing fern	*Lygodium japonicum*	√	
Japanese honeysuckle	*Lonicera japonica*	√	√
Japanese privet	*Ligustrum japonicum*	√	
Johnsongrass	*Sorghum halepense*	√	√
Jungle Rice	*Echinochloa colona*	√	
Knotweed (see Persicaria sp.)	*Polygonum sp.*	√	
Knotweed (see Polygonum sp)	*Persicaria sp.*	√	
Lanceleaf greenbrier	*Smilax smallii*		√
Lateflowering thoroughwort	*Eupatorium serotinum*	√	
Little duckweed	*Lemna obscura*	√	
Little quakinggrass	*Briza minor*	√	
Live oak	*Quercus virginiana*	√	√
Longleaf pondweed	*Potamogeton nodosus*	√	
Louisiana vetch	*Vicia ludoviciana*	√	√
Low spearwort	*Ranunculus pasillus*	√	
Lowland rotala	*Rotala ramosior*	√	
Lyreleaf sage	*Salvia lyrata*	√	
Maidencane	*Panicum hemitomon*	√	
Malabar sprangletop	*Leptochloa fusca*	√	
Meadow garlic	*Allium canadense*	√	
Mousesear	*Stachys crenata*		√
Muskgrass	*Chara sp.*	√	
Narrow plumegrass	*Saccharum baldwinii*	√	
Narrowleaf plantain	*Plantago lanceolata*	√	
Oak	*Quercus sp.*	√	
Panic grass	*Panicum spp.*		√
Paraguayan windmill grass	*Chloris canterai*	√	
Parrot feather watermilfoil	*Myriophyllum aquaticum*		√
Pennsylvania everlasting	*Gamochaeta pensylvanica*	√	
Peppervine	*Nekemias arborea*	√	
Persian clover	*Trifolium resupinatum*	√	
Philadelphia fleabane	*Erigeron philadelphicus*	√	√
Pickerelweed	*Pontederia cordata*	√	
Pinkladies	*Oenothera speciosa*	√	
Possumhaw	*Ilex decidua*	√	√

Notes
Wetland classification and growth habit is provided by the USDA (2022) PLANTS database.
NA : Data not available. Wetland classification, growth habit, and state status data are not always applicable to taxa identified to genus.
Lacassine National Wildlife Refuge species recorded by Mr. Jody Shugart (ERM, February 24, 2022).

References
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APPENDIX E-1 (Cont'd)
Comparison of Plants Documented on Site and at the Lacassine National Wildlife Refuge Reference Area
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Poverty rush	*Juncus tenuis*	✓	
Powderpuff	*Mimosa strigillosa*	✓	
Primrose-willow	*Ludwigia sp.*	✓	
Purple passionflower	*Passiflora incarnata*	✓	
Ragweed	*Ambrosia sp.*	✓	
Red maple	*Acer rubrum*	✓	
Rescuegrass	*Bromus catharticus*	✓	
Resurrection fern	*Pleopeltis polypodioides*	✓	
Rice	*Oryza sativa*	✓	
Riverhemp	*Sesbania sp.*	✓	
Rosemallow	*Hibiscus sp.*	✓	
Roughleaf dogwood	*Cornus drummondii*	✓	
Roundfruit hedgehyssop	*Gratiola virginiana*	✓	
Roundhead rush	*Juncus validus*	✓	
Rush	*Juncus sp.*	✓	
Saltmeadow cordgrass	*Spartina patens*	✓	✓
Sand spikerush	*Eleocharis montevidensis*	✓	
Saw greenbrier	*Smilax bona-nox*	✓	✓
Sawtooth blackberry	*Rubus argutus*	✓	✓
Scarlet pimpernel	*Anagallis arvensis*	✓	
Seaside goldenrod	*Solidago sempervirens*	✓	✓
Sedge	*Carex sp.*	✓	
Sensitive plant	*Mimosa sp.*	✓	
Seven sisters	*Crinum americanum*	✓	
Shield fern	*Dryopteris carthusiana*	✓	
Smooth beggartick	*Bidens laevis*	✓	
Smut grass	*Sporobolus indicus*	✓	
Southern cattail	*Typha domingensis*	✓	
Southern cutgrass	*Leersia hexandra*	✓	
Southern dewberry	*Rubus trivialis*	✓	✓
Spanish moss	*Tillandsia usneoides*	✓	
Spikerush	*Eleocharis sp.*	✓	✓
Spiny sowthistle	*Sonchus asper*	✓	✓
Spinyfruit buttercup	*Ranunculus muricatus*	✓	
Spotted lady's-thumb	*Polygonum persicaria*	✓	✓
Spring forget-me-not	*Myosotis verna*	✓	
Spurge	*Euphorbia sp.*	✓	
Starrush whitetop	*Rhynchospora colorata*		✓
Sticky chickweed	*Cerastium glomeratum*	✓	
Stickywilly	*Galium aparine*	✓	
Stiff dogwood	*Cornus foemina*	✓	
Stiff marsh bedstraw	*Galium tinctorium*	✓	✓
Straggler daisy	*Calyptocarpus vialis*		✓
Sugarberry	*Celtis laevigata*	✓	✓
Sugarcane	*Saccharum officinarum*	✓	

Notes
Wetland classification and growth habit is provided by the USDA (2022) PLANTS database.
NA : Data not available. Wetland classification, growth habit, and state status data are not always applicable to taxa identified to genus.
Lacassine National Wildlife Refuge species recorded by Mr. Jody Shugart (ERM, February 24, 2022).

References
U.S. Department of Agriculture (USDA) Natural Resources Conservation Service. 2022. PLANTS Database. Available: https://plants.sc.egov.usda.gov/java/. Accessed March 2022.

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Sugarcane plumegrass	*Saccharum giganteum*	√	√
Swamp smartweed	*Polygonum hydropiperoides*	√	
Sweetgum	*Liquidambar styraciflua*	√	
Thistle	*Cirsium sp.*	√	
Thoroughwort	*Eupatorium sp.*	√	
Timothy canarygrass	*Phalaris angusta*	√	
Twoheaded water-starwort	*Callitriche heterophylla*	√	
Vasey's grass	*Paspalum urvillei*	√	
Vetch	*Vicia sp.*	√	
Water oak	*Quercus nigra*	√	√
Water spangles	*Salvinia minima*	√	√
Water tupelo	*Nyssa aquatica*	√	
Watermeal	*Wolffia sp.*	√	
Watermoss	*Salvinia sp.*	√	
Waterthread pondweed	*Potamogeton diversifolius*	√	
Wax myrtle	*Morella cerifera*	√	√
Weedy dwarfdandelion	*Krigia caespitosa*	√	
White clover	*Trifolium repens*	√	
White mulberry	*Morus alba*	√	
Whitenymph	*Trepocarpus aethusae*	√	
Willow oak	*Quercus phellos*	√	
Winged lythrum	*Lythrum alatum var lanceolatum*	√	
Woodsorrel	*Oxalis sp.*	√	
Woolly rosette grass	*Dichanthelium scabriusculum*	√	
Yellow foxtail	*Setaria pumila*	√	
Yellow nutsedge	*Cyperus esculentus*	√	
Yellow pond-lily	*Nuphar lutea*	√	√
Yellow thistle	*Cirsium horridulum*	√	√
Total Documented	256	193	71

Notes

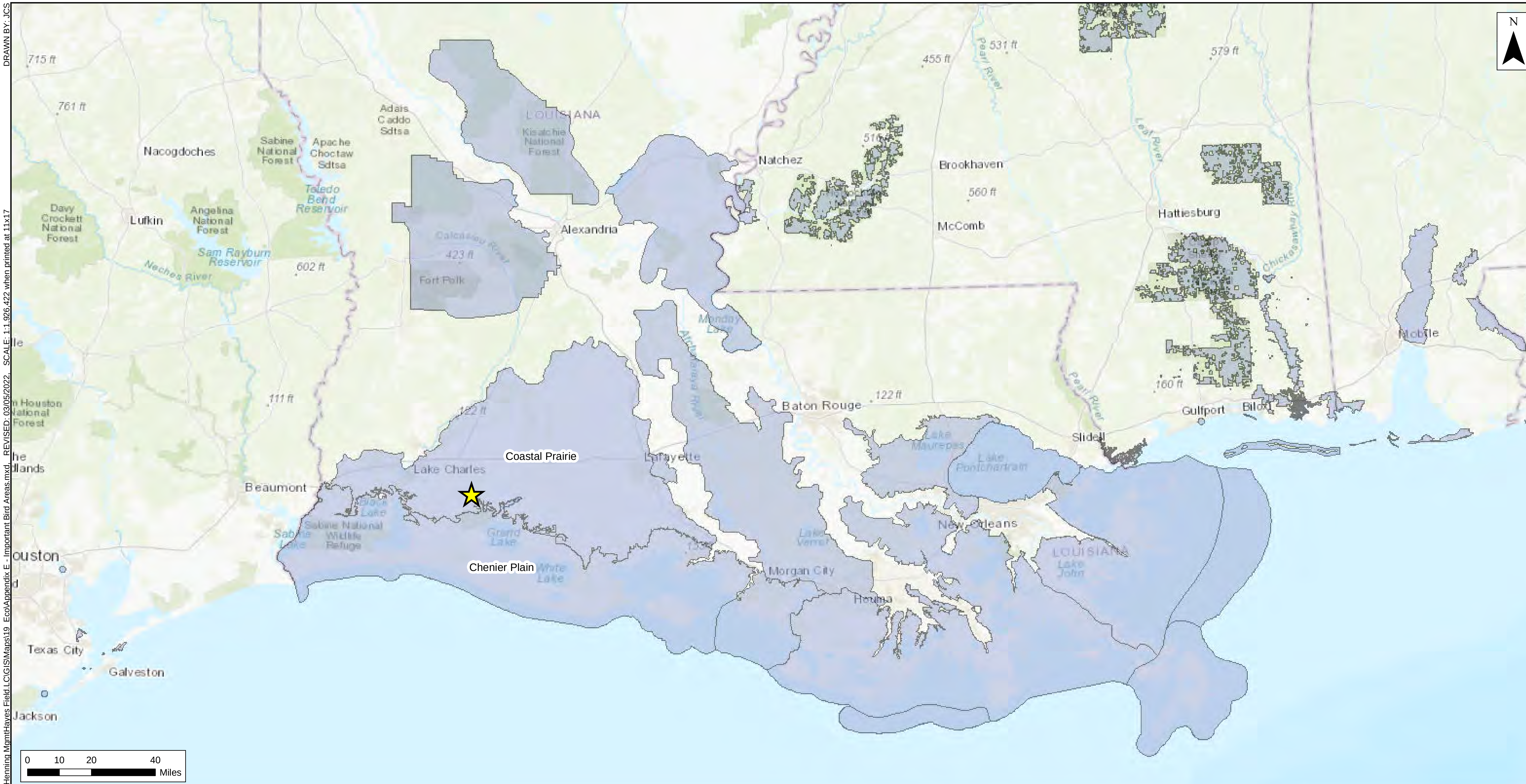
Wetland classification and growth habit is provided by the USDA (2022) PLANTS database.

NA : Data not available. Wetland classification, growth habit, and state status data are not always applicable to taxa identified to genus.

Lacassine National Wildlife Refuge species recorded by Mr. Jody Shugart (ERM, February 24, 2022).

References

U.S. Department of Agriculture (USDA) Natural Resources Conservation Service. 2022. PLANTS Database. Available: https://plants.sc.egov.usda.gov/java/. Accessed March 2022.



Henning Site Location

Important Bird Areas

Appendix E-2
Important Bird Areas
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Notes:
Aerial Imagery Basemap via ESRI
Important Bird Areas from US Audubon (2022).

Environmental Resources Management
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X:\Houston\Projects\0526033 Kean Miller LLP (CVX) Henning Mgmt\Hayes Field.LC\GIS\Maps\19_Eco\Appendix E - Important Bird Areas.mxd, REVISED: 03/05/2022, SCALE: 1:1,926,422 when printed at 11x17 DRAWN BY: JCS

Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

APPENDIX E-3

Comparison of Birds Documented on Site and at the Lacassine National Wildlife Refuge Reference Area

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
American Avocet	*Recurvirostra americana*		✓
American Coot	*Fulica americana*		✓
American Crow	*Corvus brachyrhynchos*	✓	
American Golden-Plover	*Pluvialis dominica*		✓
American Goldfinch	*Spinus tristis*	✓	
American Kestrel	*Falco sparverius*	✓	
American Pipit	*Anthus rubescens*	✓	✓
American White Pelican	*Pelecanus erythrorhynchos*		✓
American Woodcock	*Scolopax minor*		✓
Anhinga	*Anhinga anhinga*	✓	
Bald Eagle	*Haliaeetus leucocephalus*	✓	
Barred Owl	*Strix varia*	✓	✓
Belted Kingfisher	*Megaceryle alcyon*	✓	✓
Black Rail	*Laterallus jamaicensis*		✓
Black Tern	*Chlidonias niger*		✓
Black Vulture	*Coragyps atratus*	✓	
Black-necked Stilt	*Himantopus mexicanus*		✓
Blue Jay	*Cyanocitta cristata*	✓	✓
Blue-gray Gnatcatcher	*Polioptila caerulea*	✓	✓
Boat-tailed Grackle	*Quiscalus major*	✓	✓
Brown-headed Cowbird	*Molothrus ater*	✓	
Buff-breasted Sandpiper	*Calidris subruficollis*		✓
Carolina Chickadee	*Poecile carolinensis*	✓	✓
Carolina Wren	*Thryothorus ludovicianus*	✓	✓
Caspian Tern	*Hydropogne caspia*		✓
Cedar Waxwing	*Bombycilla cedrorum*	✓	
Clapper Rail	*Rallus crepitans*		✓
Common Gallinule	*Gallinula galeata*	✓	
Common Grackle	*Quiscalus quiscula*	✓	
Common Moorhen	*Gallinula chloropus*		✓
Common Yellowthroat	*Geothlypis trichas*	✓	✓
Cooper's Hawk	*Accipiter cooperii*	✓	
Crested Caracara	*Caracara plancus*	✓	
Double-crested Cormorant	*Nannopterum auritum*		✓
Downy Woodpecker	*Dryobates pubescens*	✓	
Dunlin	*Calidris alpina*		✓
Eastern Meadowlark	*Sturnella magna*	✓	
Eastern Phoebe	*Sayornis phoebe*	✓	✓
Eastern Towhee	*Pipilo erythrophthalmus*	✓	
Fish Crow	*Corvus ossifragus*	✓	
Forster's Tern	*Sterna forsteri*		✓
Glossy Ibis	*Plegadis falcinellus*		✓
Gray Catbird	*Dumetella carolinensis*	✓	✓

Notes

Diet data provided by the The Cornell Lab (2022).

Lacassine NWR checklist combines field data from Mr. Jody Shugarts reference area survey (ERM, Feburary 24, 2022) with habitat-specific data from the USFWS (2011) Refuge Habitat Management Plan (moist soil, unimpounded marsh, and agricultural).

References

The Cornell Lab. 2022. All About Birds. Available: https://www.allaboutbirds.org/news/. Accessed February 2022.

U.S. Fish and Wildlife Service. 2011. Lacassine National Wildlife Refuge Habitat Management Plan. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region.

APPENDIX E-3 (Cont'd)
Comparison of Birds Documented on Site and at the Lacassine National Wildlife Refuge Reference Area
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Great Blue Heron	*Ardea herodias*	√	√
Great Egret	*Ardea alba*	√	√
Greater White-fronted Goose	*Anser albifrons*	√	
Greater Yellowlegs	*Tringa melanoleuca*	√	√
Green Heron	*Butorides virescens*	√	
Gull-billed Tern	*Gelochelidon nilotica*		√
Herring Gull	*Larus argentatus*		√
House Wren	*Troglodytes aedon*	√	
Killdeer	*Charadrius vociferous*	√	√
King Rail	*Rallus elegans*	√	√
Laughing Gull	*Leucophaeus atricilla*	√	√
Least Sandpiper	*Calidris minutilla*		√
Lesser Yellowlegs	*Tringa flavipes*		√
Limpkin	*Aramus guarauna*		√
Little Blue Heron	*Egretta caerulea*	√	
Long-billed Dowitcher	*Limnodromus scolopaceus*		√
Mottled duck	*Anas fulvigula*	√	
Mourning Dove	*Zenaida macroura*	√	
Neotropic Cormorant	*Phalacrocorax brasilianus*	√	√
Northern Bobwhite	*Colinus virginianus*	√	
Northern Cardinal	*Cardinalis cardinalis*	√	√
Northern Harrier	*Circus hudsonius*	√	√
Northern Mockingbird	*Mimus polyglottos*	√	
Orange-crowned Warbler	*Leiothlypis celata*	√	
Pectoral Sandpiper	*Calidris melanotos*		√
Peregrine Falcon	*Falco peregrinus*	√	
Pied-billed Grebe	*Podilymbus podiceps*		√
Pileated Woodpecker	*Dryocopus pileatus*	√	
Purple Gallinule	*Porphyrio porphyrio*		√
Purple Martin	*Progne subis*	√	
Red-bellied Woodpecker	*Melanerpes carolinus*	√	√
Red-shouldered Hawk	*Buteo lineatus*	√	√
Red-tailed Hawk	*Buteo jamaicensis*	√	
Red-winged Blackbird	*Agelaius phoeniceus*	√	√
Ring-billed Gull	*Larus delawarensis*		√
Ring-necked Duck	*Aythya collaris*		√
Roseate Spoonbill	*Platalea ajaja*		√
Royal Tern	*Thalasseus maximus*		√
Ruby-crowned Kinglet	*Regulus calendula*	√	√
Ruddy Turnstone	*Arenaria interpres*		√
Sandhill Crane	*Antigone canadensis*	√	
Savannah Sparrow	*Passerculus sandwichensis*	√	√
Sedge Wren	*Cistothorus platensis*	√	

Notes

Diet data provided by the The Cornell Lab (2022).

Lacassine NWR checklist combines field data from Mr. Jody Shugarts reference area survey (ERM, Feburary 24, 2022) with habitat-specific data from the USFWS (2011) Refuge Habitat Management Plan (moist soil, unimpounded marsh, and agricultural).

References

The Cornell Lab. 2022. All About Birds. Available: https://www.allaboutbirds.org/news/. Accessed February 2022.

U.S. Fish and Wildlife Service. 2011. Lacassine National Wildlife Refuge Habitat Management Plan. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region.

APPENDIX E-3 (Cont'd)

Comparison of Birds Documented on Site and at the Lacassine National Wildlife Refuge Reference Area

Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.

Hayes Oil & Gas Field

Calcasieu and Jefferson Davis Parishes, Louisiana

Common Name	*Scientific Name*	Site Checklist	Lacassine NWR Checklist
Semipalmated Plover	*Charadrius semipalmatus*		✓
Semipalmated Sandpiper	*Calidris pusilla*		✓
Short-billed Dowitcher	*Limnodromus griseus*		✓
Snow Goose	*Anser caerulescens*	✓	
Snowy Egret	*Egretta thula*	✓	✓
Solitary Sandpiper	*Tringa solitaria*		✓
Song Sparrow	*Melospiza melodia*	✓	
Sora	*Porzana carolina*		✓
Spotted Sandpiper	*Actitis macularius*		✓
Stilt Sandpiper	*Calidris himantopus*		✓
Swamp Sparrow	*Melospiza georgiana*	✓	✓
Tree Swallow	*Tachycineta bicolor*	✓	✓
Turkey Vulture	*Cathartes aura*	✓	
Virginia Rail	*Rallus limicola*	✓	✓
Western Sandpiper	*Calidris mauri*		✓
Whimbrel	*Numenius hudsonicus*		✓
White Ibis	*Eudocimus albus*	✓	✓
White-eyed Vireo	*Vireo griseus*	✓	
White-faced Ibis	*Plegadis chihi*	✓	✓
White-throated Sparrow	*Zonotrichia albicollis*		✓
Willet	*Tringa semipalmata*		✓
Wilson's Plover	*Charadrius wilsonia*		✓
Wilson's Snipe	*Gallinago delicata*	✓	✓
Wood duck	*Aix sponsa*	✓	
Yellow Rail	*Coturnicops noveboracensis*		✓
Yellow-bellied Sapsucker	*Sphyrapicus varius*	✓	
Yellow-rumped Warbler	*Setophaga coronata*	✓	✓
Total Species	115	72	78

Notes

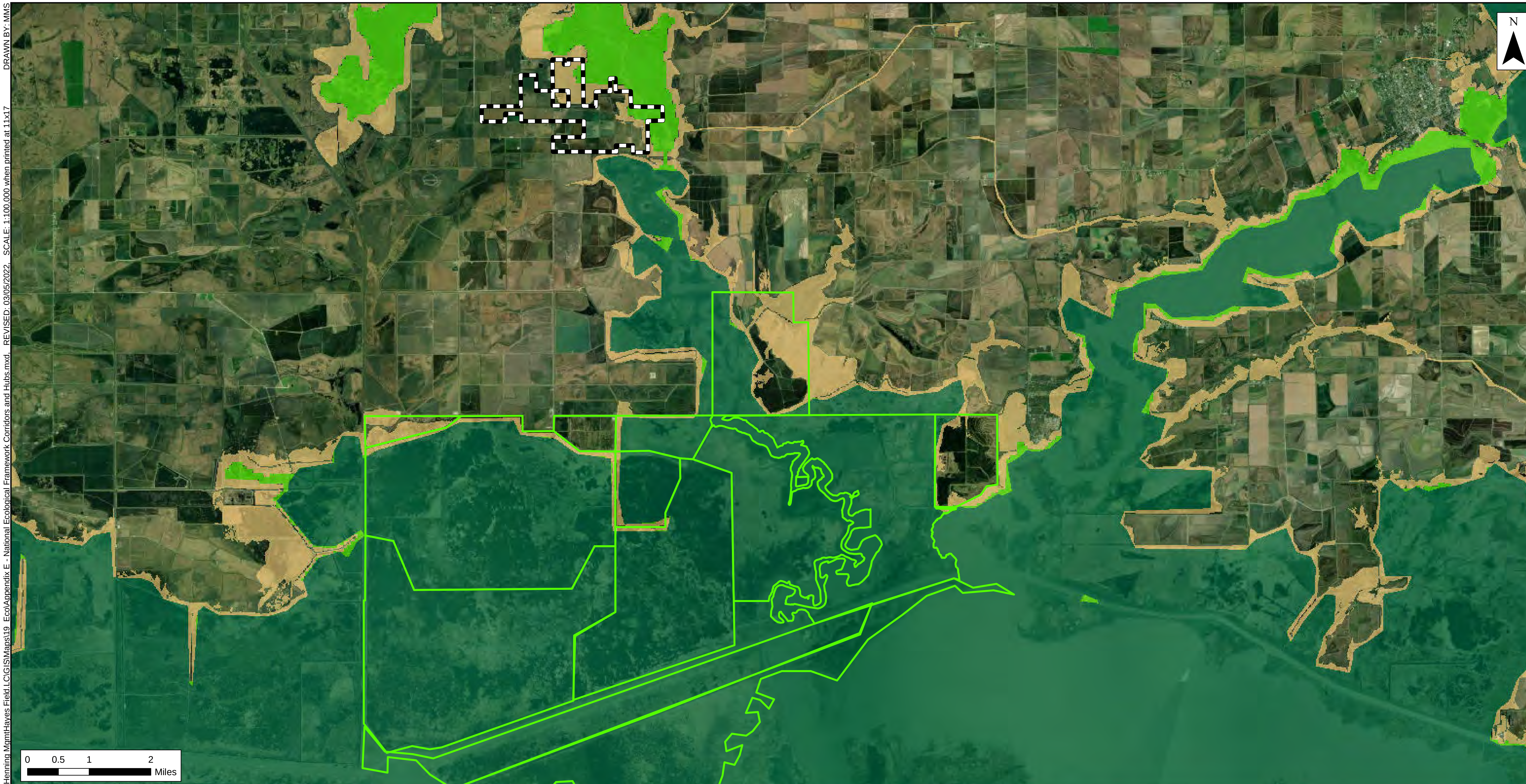
Diet data provided by the The Cornell Lab (2022).

Lacassine NWR checklist combines field data from Mr. Jody Shugarts reference area survey (ERM, Feburary 24, 2022) with habitat-specific data from the USFWS (2011) Refuge Habitat Management Plan (moist soil, unimpounded marsh, and agricultural).

References

The Cornell Lab. 2022. All About Birds. Available: https://www.allaboutbirds.org/news/. Accessed February 2022.

U.S. Fish and Wildlife Service. 2011. Lacassine National Wildlife Refuge Habitat Management Plan. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region.



Henning Property

Lacassine NWR Management Units

NEF Hubs

NEF Corridors

Auxiliary connections

Notes:
Aerial Imagery Basemap via ESRI
NEF: National Ecological Framework from US EPA.

Appendix E-4

National Ecological Framework Corridors, Hubs, and Connectivity

Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Environmental Resources Management
www.erm.com
ERM

X:\Houston\Projects\0526033 Kean Miller LLP (CVX) Henning Mgmt\Hayes Field.LCG\GIS\Maps\19_Eco\Appendix E - National Ecological Framework Corridors and Hubs.mxd REVISED: 03/05/2022 SCALE: 1:100,000 when printed at 11x17 DRAWN BY: MMS

Source: Esri - World Imagery Map; NAD 1983 UTM Zone 15N

APPENDIX F BARIUM SOIL SCREENING VALUE

15 March 2022

TABLE F-1
Barium Invertebrate NOEC for Barite
Henning Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Organism Age/Weight	Organism Lifestage	Chemical Concentration	Total Barium/ Barium Sulfate	Media Type	Test Location	Observed Duration (Days)	Observed Duration Units (Days)	Endpoint	Effect	Effect Measure-ment	NOEC/LOEC	Concentration	Concentration Units (dw)	pH	Authors	Title	Source	Publication Year
Barium sulfate	*Eisenia fetida*	Earthworm	Invertebrate	Adult	NR	Acid Digestion, ICP/MS	Barium	Soil	Lab	NR	NR	Growth	Weight loss	No effect	NOEC	2,033	mg/kg	6.1 - 8.3	Lamb, D., Matanitobua, V., Palanisami, T., Megharaj, M. and Naidu, R.	Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite	Environmental Science and Technology, No. 47, pp. 4670-4676	2013
Barium sulfate	*Eisenia fetida*	Earthworm	Invertebrate	Adult	NR	Acid Digestion, ICP/MS	Barium	Soil	Lab	NR	NR	Survival	Mortality	No effect	NOEC	3,367	mg/kg	6.1 - 8.3	Lamb, D., Matanitobua, V., Palanisami, T., Megharaj, M. and Naidu, R.	Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite	Environmental Science and Technology, No. 47, pp. 4670-4676	2013
Barium sulfate	*Eisenia andrei*	Earthworm	Invertebrate	Adult	NR	E3073A aqua regia digest	Barium	Soil	Lab	14	Days	Survival	Mortality	No Effect	NOEC	2,080	mg/kg	8.01-8.48	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003

TABLE F-2
Barium Plant NOEC for Barite
Henning Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Organism Age/Weight	Organism Lifestage	Chemical Concentration	Total Barium/ Barium Sulfate	Media Type	Test Location	Observed Duration (Days)	Observed Duration Units (Days)	Endpoint	Effect	Effect Measure-ment	NOEC/LOEC	Concentration	Concentration Units (dw)	pH	Authors	Title	Source	Publication Year
Barium sulfate	*Lactuca sativa L.*	Great Lakes lettuce	Plant	Seed	Juvenile	Acid Digestion, ICP/MS	Barium	Soil	Lab	56	Days	Growth	Shoot Biomass	Lowest Effect	**LOEC**	**483**	mg/kg	6.5	Lamb, D., Matanitobua, V., Palanisami, T., Megharaj, M. and Naidu, R.	Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite	Environmental Science and Technology, No. 47, pp. 4670-4676	2013
Barium sulfate	*Lolium perenne*	Ryegrass	Plant	Seed	Juvenile	E3073A aqua regia digest	Barium	Soil	Lab	14	Days	Growth	Root length	No Effect	**NOEC**	**1,910**	mg/kg	7.98-8.65	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003

TABLE F-3
Nominally Measured Barium Sulfate Invertebrate Effects Due to Barite
Henning Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Organism Age/Weight	Organism Lifestage	Chemical Concentration	Total Barium/ Barium Sulfate	Media Type	Test Location	Observed Duration (Days)	Observed Duration Units (Days)	Endpoint	Effect	Effect Measure-ment	NOEC/LOEC	Concentration	Concentrati on Units (dw)	pH	Authors	Title	Source	Publication Year
Barium sulfate	*Onychiurus folsomi*	Springtail insect	Invertebrate	Adult	NR	Nominal	Barium sulfate	Soil	Lab	7	Days	Survival	Mortality	No Effect	NOEC	1,000,000	mg/kg	7.8-8.01	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003
Barium sulfate	*Eisenia andrei*	Earthworm	Invertebrate	Adult	NR	Nominal	Barium sulfate	Soil	Lab	14	Days	Survival	Mortality	No Effect	NOEC	1,000,000	mg/kg	8.01-8.48	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003

TABLE F-4
Nominally Measured Barium Sulfate Plant Effects Due to Barite
Henning Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Organism Age/Weight	Organism Lifestage	Chemical Concentration	Total Barium/ Barium Sulfate	Media Type	Test Location	Observed Duration (Days)	Observed Duration Units (Days)	Endpoint	Effect	Effect Measure-ment	NOEC/LOEC	Concentration	Concentrati on Units (dw)	pH	Authors	Title	Source	Publication Year
Barium sulfate	*Phaseolus vulgaris*	Green beans	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	56	Days	Growth	Biomass	No effect	NOEC	795,833	mg/kg	6.0 - 6.2	Honarvar, S. Miller, R., Honarvar, S., and Hunsaker, B.	Effect of Drilling Fluid Components and Mixtures on Plants and Soils Effects of Drilling Fluids on Soils and Plants: I. Individual Fluid Components	Utah State University DigitalCommons, Masters Degree J. Environ. Quai., Vol. 9, no. 4	1975 1980
Barium sulfate	*Phaseolus vulgaris*	Green beans	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	56	Days	Growth	Biomass	No effect	NOEC	227,500	mg/kg	6.0 - 6.2	Honarvar, S. Miller, R., Honarvar, S., and Hunsaker, B.	Effect of Drilling Fluid Components and Mixtures on Plants and Soils Effects of Drilling Fluids on Soils and Plants: I. Individual Fluid Components	Utah State University DigitalCommons, Masters Degree J. Environ. Quai., Vol. 9, no. 5	1975 1980
Barium sulfate	*Zea mays succharate*	Sweet corn	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	56	Days	Growth	Biomass	No effect	NOEC	227,500	mg/kg	6.0 - 6.2	Honarvar, S. Miller, R., Honarvar, S., and Hunsaker, B.	Effect of Drilling Fluid Components and Mixtures on Plants and Soils Effects of Drilling Fluids on Soils and Plants: I. Individual Fluid Components	Utah State University DigitalCommons, Masters Degree J. Environ. Quai., Vol. 9, no. 5	1975 1980
Barium sulfate	*Trifolium hybridum*	Alsike Clover	Plant	Seed	Juvenile	Nominal	Barium Sulfate	Soil	Lab	21	Days	Growth	Root Biomass	No Effect	NOEC	30,000	mg/kg	7.98-9.06	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003
Barium sulfate	*Dactylis glomerata*	Orchardgrass	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	14	Days	Growth	Shoot Biomass	No Effect	NOEC	1,000	mg/kg	7.86-8.58	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003
Barium sulfate	*Dactylis glomerata*	Orchardgrass	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	14	Days	Survival	Emergence	No Effect	NOEC	1,000,000	mg/kg	7.86-8.58	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003
Barium sulfate	*Lolium perenne*	Ryegrass	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	14	Days	Growth	Root length	No Effect	NOEC	300,000	mg/kg	7.98-8.65	ESG International, Guelph, Ontario	Ecotoxicity Evaluation of Referenc Site Soils Amended with Barium Sulphate	Technical Appendices for Barite Soil Remediation Guidelines, Alberta, Canada	2003
Barium sulfate	*Zea mays succharate*	Sweet corn	Plant	Seed	Juvenile	Nominal	Barium sulfate	Soil	Lab	56	Days	Growth	Biomass	20% Reduction in weight	**LOEC**	**795,833**	mg/kg	6.0 - 6.2	Honarvar, S. Miller, R., Honarvar, S., and Hunsaker, B.	Effect of Drilling Fluid Components and Mixtures on Plants and Soils Effects of Drilling Fluids on Soils and Plants: I. Individual Fluid Components	Utah State University DigitalCommons, Masters Degree J. Environ. Quai., Vol. 9, no. 4	1975 1980

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Organism Age/Weight	Organism Lifestage	Chemical Concentration	Total Barium/ Barium Sulfate	Media Type	Test Location	Observed Duration (Days)	Observed Duration Units (Days)	Endpoint	Effect	Effect Measure-ment	NOEC/LOEC	Concentration	Concentrati on Units (dw)	pH	Authors	Title	Source	Publication Year
Barium sulfate	*Eisenia fetida*	Earthworm	Invertebrate	0.3 - 0.6 gms	Adult	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	21	Days	Reproduction	Cocoons	70% Reduction in number	LOEC	100 - 1,000	mg/kg	5.0	Simini, M. Checkai, R., Kuperman, R., and Phillips, C. Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (ECO-SSL) Using Earthworm (*Eisenia fetida*) Benchmark Values Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	U.S. Army Soldier and Biological Chemical Command Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2002 2006
Barium sulfate	*Enchytraeus crypticus*	Potworm	Invertebrate	Adult	Adult 1 cm long, with eggs	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	28	Days	Reproduction	No. of offspring	EC20	LOEC	5,000	mg/kg	5.0	Kuperman, R., Simini, M., Checkai, R., and Phillips, C. Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Screening Levels (ECO-SSL) Using Enchytraeid Reproduction Benchmark Values Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	U.S. Army Soldier and Biological Chemical Command Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2002 2006
Barium sulfate	*Enchytraeus crypticus*	Potworm	Invertebrate	Adult	Adult 1 cm long, with eggs	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	28	Days	Reproduction	No. of offspring	Lowest Effect	LOEC	500 - 1,000	mg/kg	5.0	Kuperman, R., Simini, M., Checkai, R., and Phillips, C. Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Screening Levels (ECO-SSL) Using Enchytraeid Reproduction Benchmark Values Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	U.S. Army Soldier and Biological Chemical Command Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2002 2006
Barium sulfate	*Eisenia fetida*	Earthworm	Invertebrate	0.3 - 0.6 gms	Adult	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	21	Days	Reproduction	Cocoons	10% Reduction in number	NOEC	500 - 5000	mg/kg	5.0	Simini, M., Checkai, R., Kuperman, R., and Phillips, C. Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Soil Screening Levels (ECO-SSL) Using Earthworm (*Eisenia fetida*) Benchmark Values Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	U.S. Army Soldier and Biological Chemical Command Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2002 2006
Barium sulfate	*Enchytraeus crypticus*	Potworm	Invertebrate	Adult	Adult 1 cm long, with eggs	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	14	Days	Survival	Mortality	No effect	NOEC	10,000	mg/kg	5.0	Kuperman, R., Simini, M., Checkai, R., and Phillips, C. Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Assessments of Antimony, Barium, Beryllium, and Manganese for Development of Ecological Screening Levels (ECO-SSL) Using Enchytraeid Reproduction Benchmark Values Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	U.S. Army Soldier and Biological Chemical Command Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2002 2006
Barium sulfate	*Folsomia candida*	Springtail insect	Invertebrate	Adult	NR	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	14	Days	Survival	Mortality	No effect	NOEC	10,000	mg/kg	5.29	Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2006
Barium sulfate	*Folsomia candida*	Springtail insect	Invertebrate	Adult	NR	USEPA Method 200.8, ICP-MS	Total barium	Soil	Lab	28	Days	Reproduction	No. of offspring	No effect	NOEC	10,000	mg/kg	5.29	Kuperman, R., Simini, M., Checkai, R., Phillips, C., Speicher, J., and Barclift, D.	Toxicity Benchmarks for Antimony, Barium, and Beryllium Determined Using Reproduction Endpoints for *Folsomia candida* , *Eisenia fetida* , and *Enchytraeus crypticus*	Environmental Toxicology and Chemistry, Vol. 25, No. 3, pp. 754-762	2006
Barium sulfate	*Eisenia fetida*	Earthworm	Invertebrate	Adult	NR	XRF	Total Barium	Soil	Lab	NR	NR	Survival	Mortality	No effect	NOEC	29,200	mg/kg	6.1 - 8.3	Lamb, D., Matanitobua, V., Palanisami, T., Megharaj, M. and Naidu, R.	Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite	Environmental Science and Technology, No. 47, pp. 4670-4676	2013
Barium sulfate	*Eisenia fetida*	Earthworm	Invertebrate	Adult	NR	XRF	Total Barium	Soil	Lab	NR	NR	Growth	Weight loss	No effect	NOEC	5,700	mg/kg	6.1 - 8.3	Lamb, D., Matanitobua, V., Palanisami, T., Megharaj, M. and Naidu, R.	Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite	Environmental Science and Technology, No. 47, pp. 4670-4676	2013

TABLE F-6
Total Barium Plant Effects Due to Barite
Henning Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Chemical Name	Species Scientific Name	Species Common Name	Species Group	Organism Age/Weight	Organism Lifestage	Chemical Concentration	Total Barium/ Barium Sulfate	Media Type	Test Location	Observed Duration (Days)	Observed Duration Units (Days)	Endpoint	Effect	Effect Measure-ment	NOEC/LOEC	Concentration	Concentration Units (dw)	pH	Authors	Title	Source	Publication Year
Barium sulfate	*Lactuca sativa L.*	Great Lakes lettuce	Plant	Seed	Juvenile	XRF	Total Barium	Soil	Lab	56	Days	Growth	Shoot Biomass	Lowest Effect	**LOEC**	**1300**	mg/kg	6.5	Lamb, D., Matanitobua, V., Palanisami, T., Megharaj, M. and Naidu, R.	Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite	Environmental Science and Technology, No. 47, pp. 4670-4676	2013

APPENDIX G BACKGROUND CALCULATIONS

15 March 2022

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

SiteID	StateID	CollDate	Depth (cm)	Ag (mg/kg)	D_Ag (mg/kg)	As (mg/kg)	D_As (mg/kg)	Ba (mg/kg)	D_Ba (mg/kg)
120	LA	7/30/2008	0-5	1	0	4.9	1	514	1
140	LA	8/6/2008	0-5	1	0	2	1	111	1
204	LA	7/26/2008	0-5	1	0	5.7	1	296	1
332	LA	8/2/2008	0-5	1	0	2.5	1	187	1
460	LA	7/26/2008	0-5	1	0	3	1	210	1
588	LA	8/6/2008	0-5	1	0	4.8	1	138	1
824	LA	7/30/2008	0-5	1	0	4.2	1	448	1
1072	LA	7/28/2008	0-5	1	0	10	1	652	1
1144	LA	7/30/2008	0-5	1	0	11.4	1	654	1
1356	LA	8/2/2008	0-5	1	0	2.1	1	232	1
1612	LA	8/5/2008	0-5	1	0	5.1	1	520	1
1740	LA	8/3/2008	0-5	1	0	5.4	1	641	1
1848	LA	7/28/2008	0-5	1	0	5.5	1	542	1
2168	LA	7/29/2008	0-5	1	0	10.7	1	765	1
2380	LA	8/4/2008	0-5	1	0	1.9	1	236	1
2636	LA	8/6/2008	0-5	1	0	1.7	1	304	1
2872	LA	7/28/2008	0-5	1	0	7.4	1	712	1
2892	LA	8/6/2008	0-5	1	0	3.2	1	231	1
3404	LA	8/4/2008	0-5	1	0	2.9	1	425	1
3640	LA	7/31/2008	0-5	1	0	6.9	1	576	1
3896	LA	7/27/2008	0-5	1	0	1.3	1	104	1
3980	LA	8/1/2008	0-5	1	0	9.4	1	514	1
4216	LA	7/30/2008	0-5	1	0	5.4	1	648	1
4236	LA	8/6/2008	0-5	1	0	3.6	1	180	1
4300	LA	8/1/2008	0-5	1	0	4.3	1	624	1
4428	LA	8/2/2008	0-5	1	0	3.3	1	102	1
4492	LA	8/6/2008	0-5	1	0	5.6	1	342	1
4664	LA	7/31/2008	0-5	1	0	3.9	1	471	1
4684	LA	8/6/2008	0-5	1	0	2.6	1	75	1
4920	LA	7/31/2008	0-5	1	0	1	1	283	1
5240	LA	8/1/2008	0-5	1	0	10.1	1	2690	1
5452	LA	8/2/2008	0-5	1	0	4	1	363	1
5688	LA	7/31/2008	0-5	1	0	1.5	1	228	1
5708	LA	8/6/2008	0-5	1	0	6.8	1	378	1
5836	LA	8/4/2008	0-5	1	0	10.8	1	603	1
5944	LA	7/26/2008	0-5	1	0	3.8	1	264	1
6264	LA	7/29/2008	0-5	1	0	7	1	842	1
6476	LA	8/2/2008	0-5	1	0	2.8	1	103	1
6712	LA	7/31/2008	0-5	1	0	5.9	1	376	1
6968	LA	7/28/2008	0-5	1	0	5.8	1	728	1
7500	LA	8/4/2008	0-5	1	0	2.9	1	196	1
7736	LA	7/31/2008	0-5	1	0	5.6	1	269	1
7992	LA	7/28/2008	0-5	1	0	11.5	1	632	1
8012	LA	8/6/2008	0-5	1	0	3.8	1	368	1
8076	LA	8/1/2008	0-5	1	0	6.9	1	688	1
8312	LA	7/30/2008	0-5	1	0	7.6	1	692	1
8332	LA	8/6/2008	0-5	1	0	10.1	1	471	1
8396	LA	8/3/2008	0-5	1	0	9.3	1	606	1
8524	LA	8/4/2008	0-5	1	0	4.4	1	348	1
8780	LA	8/6/2008	0-5	1	0	3.2	1	273	1
8908	LA	8/4/2008	0-5	1	0	8.7	1	484	1
9016	LA	7/30/2008	0-5	1	0	3.3	1	687	1
9336	LA	7/30/2008	0-5	1	0	5.4	1	599	1
9548	LA	8/3/2008	0-5	1	0	1.6	1	408	1
9804	LA	8/6/2008	0-5	1	0	1.9	1	88	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

SiteID	StateID	CollDate	Depth (cm)	Ag (mg/kg)	D_Ag (mg/kg)	As (mg/kg)	D_As (mg/kg)	Ba (mg/kg)	D_Ba (mg/kg)
9932	LA	8/4/2008	0-5	1	0	12.7	1	649	1
10040	LA	7/29/2008	0-5	1	0	8.2	1	638	1
10060	LA	8/6/2008	0-5	1	0	1.2	1	64	1
10572	LA	7/31/2008	0-5	1	0	6.3	1	185	1
10808	LA	7/31/2008	0-5	1	0	4.4	1	203	1
11064	LA	7/28/2008	0-5	1	0	14.5	1	606	1
11148	LA	8/1/2008	0-5	1	0	4.3	1	634	1
11340	LA	8/4/2008	0-5	1	0	5.6	1	452	1
11468	LA	7/26/2008	0-5	1	0	3.4	1	206	1
11596	LA	8/4/2008	0-5	1	0	1.1	1	156	1
11724	LA	8/4/2008	0-5	1	0	17.4	1	710	1
11832	LA	7/30/2008	0-5	1	0	5.1	1	217	1
11852	LA	8/2/2008	0-5	1	0	32.6	1	198	1
12088	LA	7/29/2008	0-5	1	0	8.4	1	703	1
12408	LA	7/30/2008	0-5	1	0	8.7	1	710	1
12620	LA	8/2/2008	0-5	1	0	2	1	149	1
12856	LA	7/31/2008	0-5	1	0	2	1	144	1
12876	LA	8/6/2008	0-5	1	0	4.1	1	211	1
13004	LA	8/3/2008	0-5	1	0	6.5	1	731	1
13112	LA	7/31/2008	0-5	1	0	3.7	1	163	1
120	LA	7/30/2008	0-15	1	0	4.8	1	448	1
140	LA	8/6/2008	0-30	1	0	1.8	1	132	1
204	LA	7/26/2008	0-5	1	0	6.1	1	271	1
332	LA	8/2/2008	0-15	1	0	1	1	147	1
460	LA	7/26/2008	0-10	1	0	3.1	1	199	1
588	LA	8/6/2008	0-20	1	0	5.3	1	168	1
824	LA	7/30/2008	0-20	1	0	4	1	353	1
1072	LA	7/28/2008	0-20	1	0	6.8	1	474	1
1144	LA	7/30/2008	0-20	1	0	11	1	667	1
1356	LA	8/2/2008	0-20	1	0	1.4	1	226	1
1612	LA	8/5/2008	0-30	1	0	6.8	1	503	1
1740	LA	8/3/2008	0-20	1	0	7.9	1	624	1
1848	LA	7/28/2008	0-10	1	0	5	1	607	1
2168	LA	7/29/2008	0-8	1	0	9.6	1	775	1
2380	LA	8/4/2008	0-20	1	0	2.5	1	254	1
2636	LA	8/6/2008	0-15	1	0	1.4	1	267	1
2872	LA	7/28/2008	0-10	1	0	5.7	1	565	1
2892	LA	8/6/2008	0-20	1	0	3	1	234	1
3404	LA	8/4/2008	0-30	1	0	3.2	1	447	1
3640	LA	7/31/2008	0-30	1	0	6.9	1	468	1
3896	LA	7/27/2008	0-20	1	0	2.3	1	111	1
3980	LA	8/1/2008	0-10	1	0	8.7	1	535	1
4216	LA	7/30/2008	0-20	1	0	5.7	1	629	1
4236	LA	8/6/2008	0-20	1	0	3.8	1	154	1
4300	LA	8/1/2008	0-5	1	0	5.6	1	592	1
4428	LA	8/2/2008	0-20	1	0	1.8	1	86	1
4492	LA	8/6/2008	0-10	1	0	5.3	1	291	1
4664	LA	7/31/2008	0-15	1	0	3.9	1	432	1
4684	LA	8/6/2008	0-30	1	0	5.7	1	68	1
4920	LA	7/31/2008	0-5	1	0	1.4	1	364	1
5240	LA	8/1/2008	0-15	1	0	14	1	2530	1
5452	LA	8/2/2008	0-20	1	0	4	1	339	1
5688	LA	7/31/2008	0-30	1	0	2.7	1	242	1
5708	LA	8/6/2008	0-20	1	0	6.6	1	318	1
5836	LA	8/4/2008	0-20	1	0	13.7	1	686	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

SiteID	StateID	CollDate	Depth (cm)	Ag (mg/kg)	D_Ag (mg/kg)	As (mg/kg)	D_As (mg/kg)	Ba (mg/kg)	D_Ba (mg/kg)
5944	LA	7/26/2008	0-20	1	0	4.5	1	304	1
6264	LA	7/29/2008	0-20	1	0	7.5	1	847	1
6476	LA	8/2/2008	0-20	1	0	2.9	1	97	1
6712	LA	7/31/2008	0-25	1	0	6.7	1	354	1
6968	LA	7/28/2008	0-25	1	0	8.4	1	667	1
7500	LA	8/4/2008	0-15	1	0	3	1	205	1
7736	LA	7/31/2008	0-15	1	0	5.6	1	287	1
7992	LA	7/28/2008	0-8	1	0	11.4	1	647	1
8012	LA	8/6/2008	0-20	1	0	3.9	1	370	1
8076	LA	8/1/2008	0-20	1	0	7.3	1	694	1
8312	LA	7/30/2008	0-30	1	0	4.9	1	657	1
8332	LA	8/6/2008	0-70	1	0	10.4	1	536	1
8396	LA	8/3/2008	0-30	1	0	8.9	1	597	1
8524	LA	8/4/2008	0-20	1	0	3.9	1	387	1
8780	LA	8/6/2008	0-10	1	0	3.8	1	232	1
8908	LA	8/4/2008	0-20	1	0	8.8	1	479	1
9016	LA	7/30/2008	0-30	1	0	3.3	1	238	1
9336	LA	7/30/2008	0-20	1	0	6.9	1	646	1
9548	LA	8/3/2008	0-20	1	0	5.8	1	403	1
9804	LA	8/6/2008	0-15	1	0	2	1	74	1
9932	LA	8/4/2008	0-30	1	0	11.1	1	648	1
10040	LA	7/29/2008	0-30	1	0	9.6	1	708	1
10060	LA	8/6/2008	0-25	1	0	1.2	1	74	1
10572	LA	7/31/2008	0-10	1	0	6.3	1	187	1
10808	LA	7/31/2008	0-10	1	0	3.4	1	162	1
11064	LA	7/28/2008	0-8	1	0	13.9	1	654	1
11148	LA	8/1/2008	0-20	1	0	4.8	1	575	1
11340	LA	8/4/2008	0-30	1	0	6.4	1	402	1
11468	LA	7/26/2008	0-30	1	0	3.4	1	223	1
11596	LA	8/4/2008	0-30	1	0	1.9	1	170	1
11724	LA	8/4/2008	0-50	1	0	18	1	617	1
11832	LA	7/30/2008	0-20	1	0	4.9	1	243	1
11852	LA	8/2/2008	0-20	1	0	38.2	1	180	1
12088	LA	7/29/2008	0-30	1	0	8	1	638	1
12408	LA	7/30/2008	0-30	1	0	8.6	1	749	1
12620	LA	8/2/2008	0-25	1	0	1.8	1	159	1
12856	LA	7/31/2008	0-20	1	0	1.9	1	141	1
12876	LA	8/6/2008	0-10	1	0	3.3	1	218	1
13004	LA	8/3/2008	0-20	1	0	6.7	1	701	1
13112	LA	7/31/2008	0-20	1	0	3.8	1	169	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevro
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishe

SiteID	StateID	CollDate	Depth (cm)	Cd (mg/kg)	D_Cd (mg/kg)	Cr (mg/kg)	D_Cr (mg/kg)	Pb (mg/kg)	D_Pb (mg/kg)
120	LA	7/30/2008	0-5	0.3	1	66	1	90.8	1
140	LA	8/6/2008	0-5	0.1	0	19	1	6.7	1
204	LA	7/26/2008	0-5	0.3	1	35	1	18.7	1
332	LA	8/2/2008	0-5	0.1	0	20	1	10.7	1
460	LA	7/26/2008	0-5	0.1	0	27	1	15.3	1
588	LA	8/6/2008	0-5	0.1	0	31	1	10.1	1
824	LA	7/30/2008	0-5	0.1	0	39	1	18.3	1
1072	LA	7/28/2008	0-5	0.6	1	70	1	47.2	1
1144	LA	7/30/2008	0-5	0.4	1	71	1	20.9	1
1356	LA	8/2/2008	0-5	0.1	0	18	1	10.9	1
1612	LA	8/5/2008	0-5	0.3	1	62	1	35	1
1740	LA	8/3/2008	0-5	1.1	1	65	1	25.4	1
1848	LA	7/28/2008	0-5	0.4	1	38	1	26	1
2168	LA	7/29/2008	0-5	0.3	1	40	1	19.6	1
2380	LA	8/4/2008	0-5	0.1	0	30	1	14.1	1
2636	LA	8/6/2008	0-5	0.1	0	23	1	11.3	1
2872	LA	7/28/2008	0-5	0.3	1	52	1	24.1	1
2892	LA	8/6/2008	0-5	0.1	0	34	1	9.8	1
3404	LA	8/4/2008	0-5	0.1	0	24	1	17.5	1
3640	LA	7/31/2008	0-5	0.2	1	48	1	24.8	1
3896	LA	7/27/2008	0-5	0.1	1	12	1	25.7	1
3980	LA	8/1/2008	0-5	0.4	1	80	1	41.7	1
4216	LA	7/30/2008	0-5	0.2	1	39	1	18.9	1
4236	LA	8/6/2008	0-5	0.2	1	28	1	26.3	1
4300	LA	8/1/2008	0-5	0.2	1	58	1	19.2	1
4428	LA	8/2/2008	0-5	0.1	0	21	1	11.1	1
4492	LA	8/6/2008	0-5	0.1	0	32	1	21.3	1
4664	LA	7/31/2008	0-5	0.1	0	20	1	13.9	1
4684	LA	8/6/2008	0-5	0.1	0	22	1	7.6	1
4920	LA	7/31/2008	0-5	0.1	0	5	1	9.3	1
5240	LA	8/1/2008	0-5	0.3	1	23	1	31.8	1
5452	LA	8/2/2008	0-5	0.1	1	34	1	19.2	1
5688	LA	7/31/2008	0-5	0.1	0	25	1	13.6	1
5708	LA	8/6/2008	0-5	0.1	1	66	1	27.6	1
5836	LA	8/4/2008	0-5	1	1	67	1	30.5	1
5944	LA	7/26/2008	0-5	0.2	1	15	1	26.2	1
6264	LA	7/29/2008	0-5	0.2	1	38	1	13.6	1
6476	LA	8/2/2008	0-5	0.1	0	18	1	11.3	1
6712	LA	7/31/2008	0-5	0.2	1	19	1	12.7	1
6968	LA	7/28/2008	0-5	0.4	1	60	1	27.9	1
7500	LA	8/4/2008	0-5	0.1	0	15	1	10.8	1
7736	LA	7/31/2008	0-5	0.1	0	30	1	16.4	1
7992	LA	7/28/2008	0-5	0.5	1	47	1	46.7	1
8012	LA	8/6/2008	0-5	0.1	0	28	1	17.8	1
8076	LA	8/1/2008	0-5	0.5	1	57	1	22.2	1
8312	LA	7/30/2008	0-5	0.3	1	54	1	17.5	1
8332	LA	8/6/2008	0-5	0.1	1	72	1	19.6	1
8396	LA	8/3/2008	0-5	0.4	1	75	1	25.9	1
8524	LA	8/4/2008	0-5	0.1	0	31	1	18.9	1
8780	LA	8/6/2008	0-5	0.1	1	19	1	14.6	1
8908	LA	8/4/2008	0-5	0.1	1	39	1	19.7	1
9016	LA	7/30/2008	0-5	0.1	0	27	1	17.2	1
9336	LA	7/30/2008	0-5	0.1	1	37	1	31.3	1
9548	LA	8/3/2008	0-5	0.1	0	22	1	22.2	1
9804	LA	8/6/2008	0-5	0.1	0	25	1	10	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevro
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishe

SiteID	StateID	CollDate	Depth (cm)	Cd (mg/kg)	D_Cd (mg/kg)	Cr (mg/kg)	D_Cr (mg/kg)	Pb (mg/kg)	D_Pb (mg/kg)
9932	LA	8/4/2008	0-5	0.2	1	46	1	17.5	1
10040	LA	7/29/2008	0-5	1.1	1	55	1	80.6	1
10060	LA	8/6/2008	0-5	0.1	0	10	1	8.1	1
10572	LA	7/31/2008	0-5	0.1	0	38	1	16	1
10808	LA	7/31/2008	0-5	0.1	0	31	1	22.4	1
11064	LA	7/28/2008	0-5	0.8	1	61	1	34.1	1
11148	LA	8/1/2008	0-5	0.2	1	55	1	32.1	1
11340	LA	8/4/2008	0-5	0.1	0	22	1	11.8	1
11468	LA	7/26/2008	0-5	0.1	0	35	1	19.8	1
11596	LA	8/4/2008	0-5	0.1	0	19	1	9.3	1
11724	LA	8/4/2008	0-5	0.1	1	32	1	11.8	1
11832	LA	7/30/2008	0-5	0.1	0	33	1	13.3	1
11852	LA	8/2/2008	0-5	0.1	0	77	1	36.2	1
12088	LA	7/29/2008	0-5	0.3	1	60	1	19.8	1
12408	LA	7/30/2008	0-5	0.5	1	59	1	23.2	1
12620	LA	8/2/2008	0-5	0.1	0	18	1	9.3	1
12856	LA	7/31/2008	0-5	0.1	0	24	1	8.8	1
12876	LA	8/6/2008	0-5	0.1	0	27	1	11.4	1
13004	LA	8/3/2008	0-5	0.1	0	44	1	13.3	1
13112	LA	7/31/2008	0-5	0.1	0	23	1	16.2	1
120	LA	7/30/2008	0-15	0.2	1	67	1	35.2	1
140	LA	8/6/2008	0-30	0.1	0	11	1	8.1	1
204	LA	7/26/2008	0-5	0.3	1	37	1	22.5	1
332	LA	8/2/2008	0-15	0.1	0	16	1	9.3	1
460	LA	7/26/2008	0-10	0.1	0	33	1	13.4	1
588	LA	8/6/2008	0-20	0.1	0	25	1	11.5	1
824	LA	7/30/2008	0-20	0.1	0	32	1	16.8	1
1072	LA	7/28/2008	0-20	0.6	1	57	1	35.7	1
1144	LA	7/30/2008	0-20	0.4	1	61	1	22.5	1
1356	LA	8/2/2008	0-20	0.1	0	21	1	11.1	1
1612	LA	8/5/2008	0-30	0.2	1	84	1	31	1
1740	LA	8/3/2008	0-20	0.8	1	62	1	28	1
1848	LA	7/28/2008	0-10	0.3	1	45	1	26.8	1
2168	LA	7/29/2008	0-8	0.3	1	53	1	15.5	1
2380	LA	8/4/2008	0-20	0.1	0	23	1	13.6	1
2636	LA	8/6/2008	0-15	0.1	0	19	1	9.4	1
2872	LA	7/28/2008	0-10	0.3	1	37	1	23.4	1
2892	LA	8/6/2008	0-20	0.1	0	19	1	11.2	1
3404	LA	8/4/2008	0-30	0.1	0	29	1	16	1
3640	LA	7/31/2008	0-30	0.2	1	37	1	20.8	1
3896	LA	7/27/2008	0-20	0.1	1	19	1	23.6	1
3980	LA	8/1/2008	0-10	0.4	1	79	1	33.3	1
4216	LA	7/30/2008	0-20	0.2	1	51	1	18.4	1
4236	LA	8/6/2008	0-20	0.2	1	30	1	25.5	1
4300	LA	8/1/2008	0-5	0.2	1	60	1	20	1
4428	LA	8/2/2008	0-20	0.1	0	18	1	9.7	1
4492	LA	8/6/2008	0-10	0.1	0	31	1	20.3	1
4664	LA	7/31/2008	0-15	0.1	0	6	1	16.4	1
4684	LA	8/6/2008	0-30	0.1	0	13	1	8.2	1
4920	LA	7/31/2008	0-5	0.1	0	7	1	10.9	1
5240	LA	8/1/2008	0-15	0.3	1	35	1	18.4	1
5452	LA	8/2/2008	0-20	0.1	1	31	1	17.5	1
5688	LA	7/31/2008	0-30	0.1	0	22	1	16.3	1
5708	LA	8/6/2008	0-20	0.1	0	69	1	24.6	1
5836	LA	8/4/2008	0-20	0.8	1	78	1	31.4	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevro
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishe

SiteID	StateID	CollDate	Depth (cm)	Cd (mg/kg)	D_Cd (mg/kg)	Cr (mg/kg)	D_Cr (mg/kg)	Pb (mg/kg)	D_Pb (mg/kg)
5944	LA	7/26/2008	0-20	0.2	1	28	1	31.9	1
6264	LA	7/29/2008	0-20	0.3	1	37	1	18.5	1
6476	LA	8/2/2008	0-20	0.1	0	24	1	10.4	1
6712	LA	7/31/2008	0-25	0.2	1	35	1	12.1	1
6968	LA	7/28/2008	0-25	0.3	1	47	1	27	1
7500	LA	8/4/2008	0-15	0.1	0	17	1	11.6	1
7736	LA	7/31/2008	0-15	0.1	0	26	1	18	1
7992	LA	7/28/2008	0-8	0.4	1	53	1	44.2	1
8012	LA	8/6/2008	0-20	0.1	0	39	1	19.6	1
8076	LA	8/1/2008	0-20	0.4	1	47	1	22.2	1
8312	LA	7/30/2008	0-30	0.3	1	52	1	16	1
8332	LA	8/6/2008	0-70	0.1	1	84	1	20.5	1
8396	LA	8/3/2008	0-30	0.3	1	60	1	24.5	1
8524	LA	8/4/2008	0-20	0.1	0	22	1	16.2	1
8780	LA	8/6/2008	0-10	0.1	1	24	1	12.8	1
8908	LA	8/4/2008	0-20	0.1	0	35	1	16.1	1
9016	LA	7/30/2008	0-30	0.1	0	25	1	10.9	1
9336	LA	7/30/2008	0-20	0.1	0	51	1	19	1
9548	LA	8/3/2008	0-20	0.1	0	21	1	14	1
9804	LA	8/6/2008	0-15	0.1	0	19	1	7.2	1
9932	LA	8/4/2008	0-30	0.2	1	39	1	20.1	1
10040	LA	7/29/2008	0-30	1	1	78	1	41.6	1
10060	LA	8/6/2008	0-25	0.1	0	16	1	4.4	1
10572	LA	7/31/2008	0-10	0.1	0	38	1	17.4	1
10808	LA	7/31/2008	0-10	0.1	0	26	1	20.3	1
11064	LA	7/28/2008	0-8	0.8	1	56	1	38	1
11148	LA	8/1/2008	0-20	0.2	1	65	1	20.9	1
11340	LA	8/4/2008	0-30	0.1	0	23	1	14.1	1
11468	LA	7/26/2008	0-30	0.1	0	24	1	19.7	1
11596	LA	8/4/2008	0-30	0.1	0	13	1	10.5	1
11724	LA	8/4/2008	0-50	0.2	1	22	1	13.2	1
11832	LA	7/30/2008	0-20	0.1	0	32	1	15.2	1
11852	LA	8/2/2008	0-20	0.1	0	75	1	37.4	1
12088	LA	7/29/2008	0-30	0.3	1	41	1	19	1
12408	LA	7/30/2008	0-30	0.5	1	63	1	23.9	1
12620	LA	8/2/2008	0-25	0.1	0	17	1	8.8	1
12856	LA	7/31/2008	0-20	0.1	0	17	1	9.6	1
12876	LA	8/6/2008	0-10	0.1	0	22	1	13.2	1
13004	LA	8/3/2008	0-20	0.1	0	47	1	13.8	1
13112	LA	7/31/2008	0-20	0.1	0	33	1	15.2	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevro
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishe

SiteID	StateID	CollDate	Depth (cm)	Se (mg/kg)	D_Se (mg/kg)	Sr (mg/kg)	D_Sr (mg/kg)	Zn (mg/kg)	D_Zn (mg/kg)
120	LA	7/30/2008	0-5	1	1	87.3	1	87	1
140	LA	8/6/2008	0-5	0.2	0	11	1	8	1
204	LA	7/26/2008	0-5	0.7	1	45	1	38	1
332	LA	8/2/2008	0-5	0.2	0	15.6	1	10	1
460	LA	7/26/2008	0-5	0.3	1	22.8	1	21	1
588	LA	8/6/2008	0-5	0.2	0	14.2	1	24	1
824	LA	7/30/2008	0-5	0.4	1	82.8	1	28	1
1072	LA	7/28/2008	0-5	0.7	1	122	1	135	1
1144	LA	7/30/2008	0-5	0.5	1	121	1	98	1
1356	LA	8/2/2008	0-5	0.2	0	21.2	1	15	1
1612	LA	8/5/2008	0-5	0.7	1	95.5	1	119	1
1740	LA	8/3/2008	0-5	1	1	96.4	1	111	1
1848	LA	7/28/2008	0-5	0.4	1	149	1	90	1
2168	LA	7/29/2008	0-5	0.2	1	167	1	70	1
2380	LA	8/4/2008	0-5	0.2	0	25.7	1	9	1
2636	LA	8/6/2008	0-5	0.2	0	32.4	1	9	1
2872	LA	7/28/2008	0-5	0.3	1	177	1	77	1
2892	LA	8/6/2008	0-5	0.2	0	30.8	1	11	1
3404	LA	8/4/2008	0-5	0.3	1	52	1	38	1
3640	LA	7/31/2008	0-5	0.5	1	142	1	140	1
3896	LA	7/27/2008	0-5	0.5	1	112	1	19	1
3980	LA	8/1/2008	0-5	0.7	1	96.3	1	112	1
4216	LA	7/30/2008	0-5	0.5	1	150	1	71	1
4236	LA	8/6/2008	0-5	0.2	0	24.6	1	98	1
4300	LA	8/1/2008	0-5	0.4	1	114	1	73	1
4428	LA	8/2/2008	0-5	0.2	0	12.9	1	25	1
4492	LA	8/6/2008	0-5	0.4	1	48	1	18	1
4664	LA	7/31/2008	0-5	0.2	0	203	1	55	1
4684	LA	8/6/2008	0-5	0.2	0	9.1	1	16	1
4920	LA	7/31/2008	0-5	0.2	0	31.2	1	8	1
5240	LA	8/1/2008	0-5	0.2	0	160	1	54	1
5452	LA	8/2/2008	0-5	0.2	0	75.5	1	33	1
5688	LA	7/31/2008	0-5	0.4	1	34.7	1	15	1
5708	LA	8/6/2008	0-5	0.9	1	78.3	1	75	1
5836	LA	8/4/2008	0-5	1.2	1	92.3	1	121	1
5944	LA	7/26/2008	0-5	0.3	1	104	1	37	1
6264	LA	7/29/2008	0-5	0.2	0	182	1	45	1
6476	LA	8/2/2008	0-5	0.2	0	11.3	1	10	1
6712	LA	7/31/2008	0-5	0.2	1	275	1	53	1
6968	LA	7/28/2008	0-5	0.6	1	124	1	95	1
7500	LA	8/4/2008	0-5	0.2	0	21.6	1	17	1
7736	LA	7/31/2008	0-5	0.3	1	37.2	1	21	1
7992	LA	7/28/2008	0-5	0.7	1	127	1	119	1
8012	LA	8/6/2008	0-5	0.4	1	44.7	1	32	1
8076	LA	8/1/2008	0-5	0.8	1	135	1	87	1
8312	LA	7/30/2008	0-5	0.4	1	160	1	75	1
8332	LA	8/6/2008	0-5	0.3	1	98	1	76	1
8396	LA	8/3/2008	0-5	0.9	1	104	1	118	1
8524	LA	8/4/2008	0-5	0.2	0	69.9	1	34	1
8780	LA	8/6/2008	0-5	0.2	0	30.6	1	76	1
8908	LA	8/4/2008	0-5	0.3	1	70.7	1	51	1
9016	LA	7/30/2008	0-5	0.3	1	27.9	1	14	1
9336	LA	7/30/2008	0-5	0.4	1	143	1	55	1
9548	LA	8/3/2008	0-5	0.2	0	74.9	1	17	1
9804	LA	8/6/2008	0-5	0.2	0	11.9	1	7	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevro
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishe

SiteID	StateID	CollDate	Depth (cm)	Se (mg/kg)	D_Se (mg/kg)	Sr (mg/kg)	D_Sr (mg/kg)	Zn (mg/kg)	D_Zn (mg/kg)
9932	LA	8/4/2008	0-5	0.4	1	136	1	56	1
10040	LA	7/29/2008	0-5	1.1	1	124	1	148	1
10060	LA	8/6/2008	0-5	0.2	0	7	1	4	1
10572	LA	7/31/2008	0-5	0.3	1	20.1	1	13	1
10808	LA	7/31/2008	0-5	0.4	1	32.7	1	65	1
11064	LA	7/28/2008	0-5	0.7	1	152	1	385	1
11148	LA	8/1/2008	0-5	0.5	1	131	1	88	1
11340	LA	8/4/2008	0-5	0.2	0	83.5	1	19	1
11468	LA	7/26/2008	0-5	0.6	1	20.5	1	24	1
11596	LA	8/4/2008	0-5	0.2	0	15.4	1	8	1
11724	LA	8/4/2008	0-5	0.2	0	213	1	30	1
11832	LA	7/30/2008	0-5	0.3	1	27.4	1	20	1
11852	LA	8/2/2008	0-5	1	1	28.1	1	55	1
12088	LA	7/29/2008	0-5	0.4	1	145	1	79	1
12408	LA	7/30/2008	0-5	0.7	1	143	1	86	1
12620	LA	8/2/2008	0-5	0.2	0	12.6	1	5	1
12856	LA	7/31/2008	0-5	0.2	0	16	1	11	1
12876	LA	8/6/2008	0-5	0.2	0	30.5	1	73	1
13004	LA	8/3/2008	0-5	0.2	0	136	1	40	1
13112	LA	7/31/2008	0-5	0.4	1	19.3	1	15	1
120	LA	7/30/2008	0-15	0.8	1	98.8	1	92	1
140	LA	8/6/2008	0-30	0.2	0	13	1	10	1
204	LA	7/26/2008	0-5	0.7	1	49.6	1	38	1
332	LA	8/2/2008	0-15	0.2	0	18	1	10	1
460	LA	7/26/2008	0-10	0.3	1	23.4	1	15	1
588	LA	8/6/2008	0-20	0.2	0	16.8	1	27	1
824	LA	7/30/2008	0-20	0.4	1	65.5	1	23	1
1072	LA	7/28/2008	0-20	0.4	1	82.5	1	228	1
1144	LA	7/30/2008	0-20	0.4	1	114	1	105	1
1356	LA	8/2/2008	0-20	0.2	1	26.1	1	10	1
1612	LA	8/5/2008	0-30	0.7	1	96.4	1	121	1
1740	LA	8/3/2008	0-20	1	1	104	1	123	1
1848	LA	7/28/2008	0-10	0.3	1	181	1	70	1
2168	LA	7/29/2008	0-8	0.2	0	173	1	71	1
2380	LA	8/4/2008	0-20	0.2	0	26.3	1	9	1
2636	LA	8/6/2008	0-15	0.2	0	28.1	1	7	1
2872	LA	7/28/2008	0-10	0.4	1	172	1	72	1
2892	LA	8/6/2008	0-20	0.2	0	31.5	1	11	1
3404	LA	8/4/2008	0-30	0.3	1	53.1	1	36	1
3640	LA	7/31/2008	0-30	0.3	1	139	1	127	1
3896	LA	7/27/2008	0-20	0.5	1	128	1	18	1
3980	LA	8/1/2008	0-10	0.6	1	101	1	114	1
4216	LA	7/30/2008	0-20	0.4	1	144	1	65	1
4236	LA	8/6/2008	0-20	0.3	1	21.2	1	88	1
4300	LA	8/1/2008	0-5	0.4	1	124	1	72	1
4428	LA	8/2/2008	0-20	0.2	0	16.3	1	13	1
4492	LA	8/6/2008	0-10	0.6	1	52	1	19	1
4664	LA	7/31/2008	0-15	0.2	0	225	1	60	1
4684	LA	8/6/2008	0-30	0.2	0	8.9	1	18	1
4920	LA	7/31/2008	0-5	0.2	1	32.4	1	9	1
5240	LA	8/1/2008	0-15	0.2	0	156	1	52	1
5452	LA	8/2/2008	0-20	0.2	1	82.9	1	37	1
5688	LA	7/31/2008	0-30	0.4	1	40.3	1	15	1
5708	LA	8/6/2008	0-20	0.6	1	78.7	1	67	1
5836	LA	8/4/2008	0-20	1.1	1	115	1	134	1

APPENDIX G-1
Background Data Collected by USGS
Henning Management, L.L.C. v. Chevro
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishe

SiteID	StateID	CollDate	Depth (cm)	Se (mg/kg)	D_Se (mg/kg)	Sr (mg/kg)	D_Sr (mg/kg)	Zn (mg/kg)	D_Zn (mg/kg)
5944	LA	7/26/2008	0-20	0.3	1	100	1	31	1
6264	LA	7/29/2008	0-20	0.3	1	159	1	63	1
6476	LA	8/2/2008	0-20	0.2	0	10	1	6	1
6712	LA	7/31/2008	0-25	0.3	1	290	1	46	1
6968	LA	7/28/2008	0-25	0.7	1	133	1	93	1
7500	LA	8/4/2008	0-15	0.2	0	21.4	1	14	1
7736	LA	7/31/2008	0-15	0.3	1	38	1	21	1
7992	LA	7/28/2008	0-8	0.7	1	117	1	123	1
8012	LA	8/6/2008	0-20	0.4	1	47	1	31	1
8076	LA	8/1/2008	0-20	0.9	1	133	1	90	1
8312	LA	7/30/2008	0-30	0.4	1	174	1	74	1
8332	LA	8/6/2008	0-70	0.2	1	113	1	86	1
8396	LA	8/3/2008	0-30	1	1	93.9	1	117	1
8524	LA	8/4/2008	0-20	0.2	0	75.2	1	34	1
8780	LA	8/6/2008	0-10	0.2	0	29.1	1	80	1
8908	LA	8/4/2008	0-20	0.3	1	68.2	1	32	1
9016	LA	7/30/2008	0-30	0.2	0	26	1	12	1
9336	LA	7/30/2008	0-20	0.5	1	139	1	71	1
9548	LA	8/3/2008	0-20	0.2	0	85.7	1	23	1
9804	LA	8/6/2008	0-15	0.2	0	10.3	1	6	1
9932	LA	8/4/2008	0-30	0.3	1	134	1	68	1
10040	LA	7/29/2008	0-30	1	1	132	1	140	1
10060	LA	8/6/2008	0-25	0.2	0	8.1	1	4	1
10572	LA	7/31/2008	0-10	0.3	1	20.4	1	14	1
10808	LA	7/31/2008	0-10	0.4	1	31.7	1	57	1
11064	LA	7/28/2008	0-8	0.6	1	143	1	220	1
11148	LA	8/1/2008	0-20	0.5	1	115	1	80	1
11340	LA	8/4/2008	0-30	0.2	0	87.1	1	22	1
11468	LA	7/26/2008	0-30	0.5	1	21.5	1	23	1
11596	LA	8/4/2008	0-30	0.2	0	18.9	1	8	1
11724	LA	8/4/2008	0-50	0.2	0	196	1	36	1
11832	LA	7/30/2008	0-20	0.4	1	28.9	1	14	1
11852	LA	8/2/2008	0-20	1.2	1	31.6	1	61	1
12088	LA	7/29/2008	0-30	0.4	1	152	1	78	1
12408	LA	7/30/2008	0-30	0.6	1	151	1	93	1
12620	LA	8/2/2008	0-25	0.2	0	12.2	1	5	1
12856	LA	7/31/2008	0-20	0.2	1	14.3	1	9	1
12876	LA	8/6/2008	0-10	0.3	1	27	1	50	1
13004	LA	8/3/2008	0-20	0.2	0	132	1	49	1
13112	LA	7/31/2008	0-20	0.4	1	19.9	1	17	1

APPENDIX G-2
ProUCL Output: Outlier Test
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Outlier Tests

Outlier Tests for Selected Variables excluding nondetects

User Selected Options

Date/Time of Computation	ProUCL 5.17/14/2020 1:20:12 PM
From File	ProUCL data_USGS Bkg_Top 5 cm and A horizon_LA.xls
Full Precision	OFF

Rosner's Outlier Test for 5 Outliers in As (mg/kg)

Total N	**150**
Number NDs	**0**
Number Detects	**150**
Mean of Detects	**5.988**
SD of Detects	**4.832**
Number of data	**150**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	5.988	4.816	38.2	143	6.689	3.52	3.89
2	5.772	4.056	32.6	68	6.615	3.51	3.89
3	5.591	3.41	18	141	3.639	3.51	3.89
4	5.506	3.263	17.4	66	3.645	3.51	3.88
5	5.425	3.121	14.5	61	2.908	3.51	3.88

For 5% significance level, there are 4 Potential Outliers
38.2, 32.6, 18, 17.4

For 1% Significance Level, there are 2 Potential Outliers
38.2, 32.6

Outlier Tests

Rosner's Outlier Test for 5 Outliers in Ba (mg/kg)

Total N	**150**
Number NDs	**0**
Number Detects	**150**
Mean of Detects	**429.3**
SD of Detects	**333.7**
Number of data	**150**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	429.3	332.6	2690	31	6.798	3.52	3.89
2	414.1	278.1	2530	106	7.609	3.51	3.89
3	399.8	217.2	847	112	2.059	3.51	3.89
4	396.8	214.8	842	37	2.073	3.51	3.88
5	393.7	212.3	775	89	1.796	3.51	3.88

For 5% significance level, there are 2 Potential Outliers
2690, 2530

For 1% Significance Level, there are 2 Potential Outliers
2690, 2530

Rosner's Outlier Test for 5 Outliers in Cd (mg/kg)

Total N	**150**
Number NDs	**77**
Number Detects	**73**
Mean of Detects	**0.34**
SD of Detects	**0.243**
Number of data	**73**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.34	0.241	1.1	6	3.149	3.275	3.635
2	0.329	0.227	1.1	33	3.391	3.265	3.635
3	0.318	0.209	1	19	3.257	3.265	3.625
4	0.309	0.194	1	68	3.565	3.255	3.618
5	0.299	0.176	0.8	34	2.847	3.255	3.615

For 5% significance level, there are 4 Potential Outliers
1.1, 1.1, 1, 1

For 1% Significance Level, there is no Potential Outlier

Outlier Tests

Rosner's Outlier Test for 5 Outliers in Cr (mg/kg)

Total N	**150**
Number NDs	**0**
Number Detects	**150**
Mean of Detects	**37.67**
SD of Detects	**19.3**
Number of data	**150**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	37.67	19.24	84	86	2.408	3.52	3.89
2	37.36	18.99	84	122	2.456	3.51	3.89
3	37.05	18.66	80	22	2.302	3.51	3.89
4	36.76	18.38	79	97	2.298	3.51	3.88
5	36.47	18.1	78	110	2.294	3.51	3.88

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Rosner's Outlier Test for 5 Outliers in Pb (mg/kg)

Total N	**150**
Number NDs	**0**
Number Detects	**150**
Mean of Detects	**20.12**
SD of Detects	**11.61**
Number of data	**150**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	20.12	11.57	90.8	1	6.107	3.52	3.89
2	19.64	10.09	80.6	57	6.042	3.51	3.89
3	19.23	8.776	47.2	8	3.187	3.51	3.89
4	19.04	8.495	46.7	43	3.256	3.51	3.88
5	18.85	8.206	44.2	118	3.089	3.51	3.88

For 5% significance level, there are 2 Potential Outliers
90.8, 80.6

For 1% Significance Level, there are 2 Potential Outliers
90.8, 80.6

Outlier Tests

Rosner's Outlier Test for 5 Outliers in Hg (mg/kg)

Total N	**150**
Number NDs	**7**
Number Detects	**143**
Mean of Detects	**0.114**
SD of Detects	**0.634**
Number of data	**143**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.114	0.631	6.24	103	9.702	3.5	3.87
2	0.0708	0.369	4.43	30	11.81	3.492	3.87
3	0.0399	0.0242	0.13	24	3.719	3.492	3.87
4	0.0393	0.0231	0.11	42	3.066	3.49	3.86
5	0.0388	0.0223	0.11	96	3.188	3.49	3.86

For 5% significance level, there are 3 Potential Outliers
6.24, 4.43, 0.13

For 1% Significance Level, there are 2 Potential Outliers
6.24, 4.43

Rosner's Outlier Test for 5 Outliers in Se (mg/kg)

Total N	**150**
Number NDs	**53**
Number Detects	**97**
Mean of Detects	**0.511**
SD of Detects	**0.253**
Number of data	**97**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.511	0.252	1.2	21	2.733	3.371	3.741
2	0.504	0.244	1.2	92	2.846	3.368	3.738
3	0.497	0.235	1.1	36	2.567	3.368	3.738
4	0.49	0.228	1.1	70	2.677	3.361	3.728
5	0.484	0.22	1	1	2.348	3.358	3.728

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Outlier Tests

Rosner's Outlier Test for 5 Outliers in Sr (mg/kg)

Total N	**150**
Number NDs	**0**
Number Detects	**150**
Mean of Detects	**81.84**
SD of Detects	**61.29**
Number of data	**150**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	81.84	61.08	290	114	3.408	3.52	3.89
2	80.44	59.05	275	39	3.295	3.51	3.89
3	79.13	57.02	225	103	2.558	3.51	3.89
4	78.13	55.92	213	66	2.412	3.51	3.88
5	77.21	54.97	203	28	2.288	3.51	3.88

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Rosner's Outlier Test for 5 Outliers in Zn (mg/kg)

Total N	**150**
Number NDs	**0**
Number Detects	**150**
Mean of Detects	**55.21**
SD of Detects	**51.06**
Number of data	**150**
Number of suspected outliers	**5**
NDs not included in the following:	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	55.21	50.89	385	61	6.481	3.52	3.89
2	52.99	43.42	228	83	4.031	3.51	3.89
3	51.81	41.08	220	136	4.094	3.51	3.89
4	50.67	38.79	148	57	2.509	3.51	3.88
5	50	38.07	140	20	2.364	3.51	3.88

For 5% significance level, there are 3 Potential Outliers
385, 228, 220

For 1% Significance Level, there are 3 Potential Outliers
385, 228, 220

Background Threshold Values

Background Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.17/14/2020 1:22:06 PM
From File	ProUCL data_USGS Bkg_Top 5 cm and A horizon_LA.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	95%
ent or Future K Observations	1
ber of Bootstrap Operations	2000

As (mg/kg)

General Statistics

Total Number of Observations	150	Number of Distinct Observations	86
Minimum	1	First Quartile	3.2
Second Largest	32.6	Median	5.05
Maximum	38.2	Third Quartile	7.375
Mean	5.988	SD	4.832
Coefficient of Variation	0.807	Skewness	3.415
Mean of logged Data	1.557	SD of logged Data	0.683

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test

Shapiro Wilk Test Statistic	0.738	**Normal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	15.01	90% Percentile (z)	12.18
95% UPL (t)	14.01	95% Percentile (z)	13.94
95% USL	22.14	99% Percentile (z)	17.23

Gamma GOF Test

A-D Test Statistic	0.659	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.764	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0636	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0774	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.302	k star (bias corrected MLE)	2.261
Theta hat (MLE)	2.601	Theta star (bias corrected MLE)	2.649
nu hat (MLE)	690.7	nu star (bias corrected)	678.2
MLE Mean (bias corrected)	5.988	MLE Sd (bias corrected)	3.983

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	13.56	90% Percentile	11.32
95% Hawkins Wixley (HW) Approx. Gamma UPL	13.73	95% Percentile	13.67
95% WH Approx. Gamma UTL with 95% Coverage	15.02	99% Percentile	18.85
95% HW Approx. Gamma UTL with 95% Coverage	15.31		
95% WH USL	28.48	95% HW USL	30.91

Background Threshold Values

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.334	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0534	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0727	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	17	90% Percentile (z)	11.39
95% UPL (t)	14.76	95% Percentile (z)	14.6
95% USL	46.59	99% Percentile (z)	23.26

Nonparametric Distribution Free Background Statistics
Data appear Gamma Distributed at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	146	95% UTL with 95% Coverage	14.5
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
		Approximate Sample Size needed to achieve specified CC	181
95% Percentile Bootstrap UTL with 95% Coverage	14.5	95% BCA Bootstrap UTL with 95% Coverage	14.5
95% UPL	13.79	90% Percentile	10.71
90% Chebyshev UPL	20.53	95% Percentile	13.25
95% Chebyshev UPL	27.12	99% Percentile	25.45
95% USL	38.2		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Ba (mg/kg)

General Statistics

Total Number of Observations	150	Number of Distinct Observations	134
Minimum	64	First Quartile	207
Second Largest	2530	Median	373
Maximum	2690	Third Quartile	624
Mean	429.3	SD	333.7
Coefficient of Variation	0.777	Skewness	3.749
Mean of logged Data	5.832	SD of logged Data	0.697

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test

Shapiro Wilk Test Statistic	0.704	**Normal GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.138	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0727	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	1053	90% Percentile (z)	856.9
95% UPL (t)	983.4	95% Percentile (z)	978.1
95% USL	1545	99% Percentile (z)	1206

Background Threshold Values

Gamma GOF Test

A-D Test Statistic	1.966	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0888	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0774	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.328	k star (bias corrected MLE)	2.285
Theta hat (MLE)	184.4	Theta star (bias corrected MLE)	187.8
nu hat (MLE)	698.3	nu star (bias corrected)	685.6
MLE Mean (bias corrected)	429.3	MLE Sd (bias corrected)	284

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	971	90% Percentile	809.4
95% Hawkins Wixley (HW) Approx. Gamma UPL	988.3	95% Percentile	976.8
95% WH Approx. Gamma UTL with 95% Coverage	1075	99% Percentile	1345
95% HW Approx. Gamma UTL with 95% Coverage	1102		
95% WH USL	2032	95% HW USL	2225

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.944	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	6.1525E-6	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0997	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0727	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	1254	90% Percentile (z)	833.5
95% UPL (t)	1086	95% Percentile (z)	1074
95% USL	3508	99% Percentile (z)	1727

Nonparametric Distribution Free Background Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	146	95% UTL with 95% Coverage	775
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
		Approximate Sample Size needed to achieve specified CC	181
95% Percentile Bootstrap UTL with 95% Coverage	775	95% BCA Bootstrap UTL with 95% Coverage	775
95% UPL	739.1	90% Percentile	694.7
90% Chebyshev UPL	1434	95% Percentile	729.7
95% Chebyshev UPL	1889	99% Percentile	1705
95% USL	2690		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Background Threshold Values

Cd (mg/kg)

General Statistics

Total Number of Observations	150	Number of Missing Observations	0
Number of Distinct Observations	9		
Number of Detects	73	Number of Non-Detects	77
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	1.1	Maximum Non-Detect	0.1
Variance Detected	0.0591	Percent Non-Detects	51.33%
Mean Detected	0.34	SD Detected	0.243
Mean of Detected Logged Data	-1.291	SD of Detected Logged Data	0.646

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.786	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	1.266E-14	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.217	KM SD	0.207
95% UTL95% Coverage	0.603	95% KM UPL (t)	0.56
90% KM Percentile (z)	0.482	95% KM Percentile (z)	0.557
99% KM Percentile (z)	0.698	95% KM USL	0.908

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.191	SD	0.223
95% UTL95% Coverage	0.607	95% UPL (t)	0.561
90% Percentile (z)	0.477	95% Percentile (z)	0.558
99% Percentile (z)	0.709	95% USL	0.936

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.18	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.177	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.105	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.521	k star (bias corrected MLE)	2.426
Theta hat (MLE)	0.135	Theta star (bias corrected MLE)	0.14
nu hat (MLE)	368.1	nu star (bias corrected)	354.3
MLE Mean (bias corrected)	0.34		
MLE Sd (bias corrected)	0.218	95% Percentile of Chisquare (2kstar)	10.84

Background Threshold Values

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.173
Maximum	1.1	Median	0.0531
SD	0.235	CV	1.363
k hat (MLE)	0.548	k star (bias corrected MLE)	0.542
Theta hat (MLE)	0.315	Theta star (bias corrected MLE)	0.318
nu hat (MLE)	164.5	nu star (bias corrected)	162.6
MLE Mean (bias corrected)	0.173	MLE Sd (bias corrected)	0.234
95% Percentile of Chisquare (2kstar)	4.045	90% Percentile	0.459
95% Percentile	0.644	99% Percentile	1.096

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.718	0.777	95% Approx. Gamma UPL	0.604	0.637
95% Gamma USL	1.968	2.548			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.217	SD (KM)	0.207
Variance (KM)	0.0427	SE of Mean (KM)	0.017
k hat (KM)	1.099	k star (KM)	1.081
nu hat (KM)	329.6	nu star (KM)	324.4
theta hat (KM)	0.197	theta star (KM)	0.2
80% gamma percentile (KM)	0.346	90% gamma percentile (KM)	0.489
95% gamma percentile (KM)	0.631	99% gamma percentile (KM)	0.96

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.572	0.571	95% Approx. Gamma UPL	0.512	0.509
95% KM Gamma Percentile	0.508	0.504	95% Gamma USL	1.129	1.197

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.915	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	4.3261E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.195	Mean in Log Scale	-2.171
SD in Original Scale	0.221	SD in Log Scale	1.071
95% UTL95% Coverage	0.843	95% BCA UTL95% Coverage	0.8
95% Bootstrap (%) UTL95% Coverage	0.8	95% UPL (t)	0.675
90% Percentile (z)	0.45	95% Percentile (z)	0.664
99% Percentile (z)	1.377	95% USL	4.089

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-1.81	95% KM UTL (Lognormal)95% Coverage	0.578
KM SD of Logged Data	0.676	95% KM UPL (Lognormal)	0.502
95% KM Percentile Lognormal (z)	0.497	95% KM USL (Lognormal)	1.565

Background Threshold Values

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.191	Mean in Log Scale	-2.166
SD in Original Scale	0.223	SD in Log Scale	0.966
95% UTL95% Coverage	0.696	95% UPL (t)	0.57
90% Percentile (z)	0.395	95% Percentile (z)	0.561
99% Percentile (z)	1.084	95% USL	2.895

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	146	95% UTL with95% Coverage	0.8
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
Approximate Sample Size needed to achieve specified CC	181	95% UPL	0.8
95% USL	1.1	95% KM Chebyshev UPL	1.121

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Cr (mg/kg)

General Statistics

Total Number of Observations	150	Number of Distinct Observations	64
Minimum	5	First Quartile	22
Second Largest	84	Median	33
Maximum	84	Third Quartile	52.75
Mean	37.67	SD	19.3
Coefficient of Variation	0.512	Skewness	0.637
Mean of logged Data	3.488	SD of logged Data	0.557

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test

Shapiro Wilk Test Statistic	0.918	**Normal GOF Test**
5% Shapiro Wilk P Value	5.049E-11	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	73.73	90% Percentile (z)	62.41
95% UPL (t)	69.73	95% Percentile (z)	69.43
95% USL	102.2	99% Percentile (z)	82.58

Gamma GOF Test

A-D Test Statistic	1.034	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0655	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0769	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Background Threshold Values

Gamma Statistics

k hat (MLE)	3.707	k star (bias corrected MLE)	3.637
Theta hat (MLE)	10.16	Theta star (bias corrected MLE)	10.36
nu hat (MLE)	1112	nu star (bias corrected)	1091
MLE Mean (bias corrected)	37.67	MLE Sd (bias corrected)	19.75

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	75.05	90% Percentile	64.16
95% Hawkins Wixley (HW) Approx. Gamma UPL	76.4	95% Percentile	74.92
95% WH Approx. Gamma UTL with 95% Coverage	81.67	99% Percentile	98
95% HW Approx. Gamma UTL with 95% Coverage	83.64		
95% WH USL	140.4	95% HW USL	151

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	9.2132E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0673	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0727	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	92.55	90% Percentile (z)	66.78
95% UPL (t)	82.47	95% Percentile (z)	81.75
95% USL	210.4	99% Percentile (z)	119.5

Nonparametric Distribution Free Background Statistics

Data appear Approximate Gamma Distribution at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	146	95% UTL with 95% Coverage	78
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
		Approximate Sample Size needed to achieve specified CC	181
95% Percentile Bootstrap UTL with 95% Coverage	78	95% BCA Bootstrap UTL with 95% Coverage	78
95% UPL	75.9	90% Percentile	66.1
90% Chebyshev UPL	95.78	95% Percentile	75
95% Chebyshev UPL	122.1	99% Percentile	82.04
95% USL	84		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Pb (mg/kg)

General Statistics

Total Number of Observations	150	Number of Distinct Observations	114
Minimum	4.4	First Quartile	12.73
Second Largest	80.6	Median	18.15
Maximum	90.8	Third Quartile	24.05
Mean	20.12	SD	11.61
Coefficient of Variation	0.577	Skewness	2.792
Mean of logged Data	2.878	SD of logged Data	0.484

Background Threshold Values

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test

Shapiro Wilk Test Statistic	0.794	**Normal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	41.81	90% Percentile (z)	35
95% UPL (t)	39.4	95% Percentile (z)	39.22
95% USL	58.94	99% Percentile (z)	47.13

Gamma GOF Test

A-D Test Statistic	1.111	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0779	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0768	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.217	k star (bias corrected MLE)	4.137
Theta hat (MLE)	4.771	Theta star (bias corrected MLE)	4.863
nu hat (MLE)	1265	nu star (bias corrected)	1241
MLE Mean (bias corrected)	20.12	MLE Sd (bias corrected)	9.891

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	38.55	90% Percentile	33.37
95% Hawkins Wixley (HW) Approx. Gamma UPL	38.71	95% Percentile	38.65
95% WH Approx. Gamma UTL with 95% Coverage	41.77	99% Percentile	49.91
95% HW Approx. Gamma UTL with 95% Coverage	42.12		
95% WH USL	69.98	95% HW USL	73.25

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.873	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0427	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0727	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	43.92	90% Percentile (z)	33.07
95% UPL (t)	39.73	95% Percentile (z)	39.43
95% USL	89.68	99% Percentile (z)	54.83

Nonparametric Distribution Free Background Statistics

Data appear Lognormal at 5% Significance Level

Background Threshold Values

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	146	95% UTL with 95% Coverage	44.2
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
		Approximate Sample Size needed to achieve specified CC	181
95% Percentile Bootstrap UTL with 95% Coverage	44.2	95% BCA Bootstrap UTL with 95% Coverage	44.2
95% UPL	39.62	90% Percentile	32.22
90% Chebyshev UPL	55.07	95% Percentile	37.73
95% Chebyshev UPL	70.9	99% Percentile	64.23
95% USL	90.8		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Hg (mg/kg)

General Statistics

Total Number of Observations	150	Number of Missing Observations	0
Number of Distinct Observations	14		
Number of Detects	143	Number of Non-Detects	7
Number of Distinct Detects	14	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	6.24	Maximum Non-Detect	0.01
Variance Detected	0.401	Percent Non-Detects	4.667%
Mean Detected	0.114	SD Detected	0.634
Mean of Detected Logged Data	-3.34	SD of Detected Logged Data	0.874

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.143	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.482	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0745	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.109	KM SD	0.617
95% UTL95% Coverage	1.261	95% KM UPL (t)	1.134
90% KM Percentile (z)	0.9	95% KM Percentile (z)	1.124
99% KM Percentile (z)	1.544	95% KM USL	2.171

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.109	SD	0.619
95% UTL95% Coverage	1.265	95% UPL (t)	1.137
90% Percentile (z)	0.902	95% Percentile (z)	1.127
99% Percentile (z)	1.549	95% USL	2.178

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Background Threshold Values

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	26.29	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.816	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.347	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.0827	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.538	k star (bias corrected MLE)	0.531
Theta hat (MLE)	0.212	Theta star (bias corrected MLE)	0.215
nu hat (MLE)	153.8	nu star (bias corrected)	151.9
MLE Mean (bias corrected)	0.114		
MLE Sd (bias corrected)	0.156	95% Percentile of Chisquare (2kstar)	3.994

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.109
Maximum	6.24	Median	0.03
SD	0.619	CV	5.672
k hat (MLE)	0.532	k star (bias corrected MLE)	0.525
Theta hat (MLE)	0.205	Theta star (bias corrected MLE)	0.208
nu hat (MLE)	159.5	nu star (bias corrected)	157.6
MLE Mean (bias corrected)	0.109	MLE Sd (bias corrected)	0.151
95% Percentile of Chisquare (2kstar)	3.966	90% Percentile	0.292
95% Percentile	0.412	99% Percentile	0.705

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.307	0.253	95% Approx. Gamma UPL	0.259	0.213
95% Gamma USL	0.824	0.722			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.109	SD (KM)	0.617
Variance (KM)	0.381	SE of Mean (KM)	0.0505
k hat (KM)	0.0313	k star (KM)	0.0351
nu hat (KM)	9.389	nu star (KM)	10.53
theta hat (KM)	3.487	theta star (KM)	3.108
80% gamma percentile (KM)	0.00312	90% gamma percentile (KM)	0.0919
95% gamma percentile (KM)	0.481	99% gamma percentile (KM)	2.692

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.305	0.252	95% Approx. Gamma UPL	0.258	0.212
95% KM Gamma Percentile	0.255	0.21	95% Gamma USL	0.819	0.717

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.803	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0745	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Threshold Values

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.109	Mean in Log Scale	-3.427
SD in Original Scale	0.619	SD in Log Scale	0.942
95% UTL95% Coverage	0.189	95% BCA UTL95% Coverage	0.0955
95% Bootstrap (%) UTL95% Coverage	0.11	95% UPL (t)	0.155
90% Percentile (z)	0.109	95% Percentile (z)	0.153
99% Percentile (z)	0.291	95% USL	0.757

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-3.399	95% KM UTL (Lognormal)95% Coverage	0.177
KM SD of Logged Data	0.891	95% KM UPL (Lognormal)	0.147
95% KM Percentile Lognormal (z)	0.145	95% KM USL (Lognormal)	0.657

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.109	Mean in Log Scale	-3.431
SD in Original Scale	0.619	SD in Log Scale	0.948
95% UTL95% Coverage	0.19	95% UPL (t)	0.156
90% Percentile (z)	0.109	95% Percentile (z)	0.154
99% Percentile (z)	0.294	95% USL	0.77

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	146	95% UTL with95% Coverage	0.11
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
Approximate Sample Size needed to achieve specified CC	181	95% UPL	0.09
95% USL	6.24	95% KM Chebyshev UPL	2.807

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Se (mg/kg)

General Statistics

Total Number of Observations	150	Number of Missing Observations	0
Number of Distinct Observations	11		
Number of Detects	97	Number of Non-Detects	53
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	0.2
Maximum Detect	1.2	Maximum Non-Detect	0.2
Variance Detected	0.0641	Percent Non-Detects	35.33%
Mean Detected	0.511	SD Detected	0.253
Mean of Detected Logged Data	-0.782	SD of Detected Logged Data	0.467

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.857	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	1.499E-13	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0902	Data Not Normal at 5% Significance Level

Background Threshold Values

Data Not Normal at 5% Significance Level

Background Threshold Values

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.401	KM SD	0.251
95% UTL95% Coverage	0.871	95% KM UPL (t)	0.819
90% KM Percentile (z)	0.724	95% KM Percentile (z)	0.815
99% KM Percentile (z)	0.986	95% KM USL	1.242

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.366	SD	0.283
95% UTL95% Coverage	0.895	95% UPL (t)	0.836
90% Percentile (z)	0.729	95% Percentile (z)	0.832
99% Percentile (z)	1.025	95% USL	1.313

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.705	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.205	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.0911	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.672	k star (bias corrected MLE)	4.534
Theta hat (MLE)	0.109	Theta star (bias corrected MLE)	0.113
nu hat (MLE)	906.4	nu star (bias corrected)	879.7
MLE Mean (bias corrected)	0.511		
MLE Sd (bias corrected)	0.24	95% Percentile of Chisquare (2kstar)	17.02

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.358
Maximum	1.2	Median	0.3
SD	0.293	CV	0.82
k hat (MLE)	1.007	k star (bias corrected MLE)	0.991
Theta hat (MLE)	0.356	Theta star (bias corrected MLE)	0.361
nu hat (MLE)	302	nu star (bias corrected)	297.3
MLE Mean (bias corrected)	0.358	MLE Sd (bias corrected)	0.36
95% Percentile of Chisquare (2kstar)	5.956	90% Percentile	0.826
95% Percentile	1.076	99% Percentile	1.656

The following statistics are computed using Gamma ROS Statistics on Imputed Data
Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	1.223	1.361	95% Approx. Gamma UPL	1.066	1.163
95% Gamma USL	2.796	3.588			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.401	SD (KM)	0.251
Variance (KM)	0.0632	SE of Mean (KM)	0.0206
k hat (KM)	2.549	k star (KM)	2.502
nu hat (KM)	764.6	nu star (KM)	750.6
theta hat (KM)	0.157	theta star (KM)	0.16
80% gamma percentile (KM)	0.585	90% gamma percentile (KM)	0.741
95% gamma percentile (KM)	0.888	99% gamma percentile (KM)	1.211

Background Threshold Values

The following statistics are computed using gamma distribution and KM estimates
Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.9	0.909	95% Approx. Gamma UPL	0.824	0.827
95% KM Gamma Percentile	0.818	0.821	95% Gamma USL	1.587	1.676

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.924	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	7.3138E-6	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0902	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.386	Mean in Log Scale	-1.177
SD in Original Scale	0.266	SD in Log Scale	0.688
95% UTL95% Coverage	1.113	95% BCA UTL95% Coverage	1
95% Bootstrap (%) UTL95% Coverage	1	95% UPL (t)	0.965
90% Percentile (z)	0.744	95% Percentile (z)	0.955
99% Percentile (z)	1.526	95% USL	3.071

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-1.074	95% KM UTL (Lognormal)95% Coverage	0.945
KM SD of Logged Data	0.545	95% KM UPL (Lognormal)	0.844
95% KM Percentile Lognormal (z)	0.837	95% KM USL (Lognormal)	2.109

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.366	Mean in Log Scale	-1.319
SD in Original Scale	0.283	SD in Log Scale	0.82
95% UTL95% Coverage	1.238	95% UPL (t)	1.044
90% Percentile (z)	0.765	95% Percentile (z)	1.031
99% Percentile (z)	1.803	95% USL	4.151

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	146	95% UTL with95% Coverage	1
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
Approximate Sample Size needed to achieve specified CC	181	95% UPL	1
95% USL	1.2	95% KM Chebyshev UPL	1.501

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Background Threshold Values

Sr (mg/kg)

General Statistics

Total Number of Observations	150	Number of Distinct Observations	131
Minimum	7	First Quartile	26.15
Second Largest	275	Median	76.9
Maximum	290	Third Quartile	131.8
Mean	81.84	SD	61.29
Coefficient of Variation	0.749	Skewness	0.706
Mean of logged Data	4.039	SD of logged Data	0.939

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test

Shapiro Wilk Test Statistic	0.898	**Normal GOF Test**
5% Shapiro Wilk P Value	1.332E-15	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	196.3	90% Percentile (z)	160.4
95% UPL (t)	183.6	95% Percentile (z)	182.6
95% USL	286.7	99% Percentile (z)	224.4

Gamma GOF Test

A-D Test Statistic	3.313	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.77	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.078	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.514	k star (bias corrected MLE)	1.488
Theta hat (MLE)	54.05	Theta star (bias corrected MLE)	54.99
nu hat (MLE)	454.2	nu star (bias corrected)	446.4
MLE Mean (bias corrected)	81.84	MLE Sd (bias corrected)	67.09

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	214	90% Percentile	170.9
95% Hawkins Wixley (HW) Approx. Gamma UPL	223	95% Percentile	213.7
95% WH Approx. Gamma UTL with 95% Coverage	241.3	99% Percentile	310.6
95% HW Approx. Gamma UTL with 95% Coverage	254.7		
95% WH USL	504.7	95% HW USL	587.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.240E-12	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	328.1	90% Percentile (z)	189.2
95% UPL (t)	270.1	95% Percentile (z)	266.1
95% USL	1311	99% Percentile (z)	504.6

Background Threshold Values

Nonparametric Distribution Free Background Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	146	95% UTL with 95% Coverage	203
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
		Approximate Sample Size needed to achieve specified CC	181
95% Percentile Bootstrap UTL with 95% Coverage	203	95% BCA Bootstrap UTL with 95% Coverage	203
95% UPL	181.5	90% Percentile	159.1
90% Chebyshev UPL	266.3	95% Percentile	179.2
95% Chebyshev UPL	349.9	99% Percentile	250.5
95% USL	290		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers
and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data
represents a background data set and when many onsite observations need to be compared with the BTV.

Zn (mg/kg)

General Statistics

Total Number of Observations	150	Number of Distinct Observations	86
Minimum	4	First Quartile	16.25
Second Largest	228	Median	39
Maximum	385	Third Quartile	78.75
Mean	55.21	SD	51.06
Coefficient of Variation	0.925	Skewness	2.454
Mean of logged Data	3.589	SD of logged Data	0.985

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.868	d2max (for USL)	3.343

Normal GOF Test

Shapiro Wilk Test Statistic	0.811	**Normal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	150.6	90% Percentile (z)	120.6
95% UPL (t)	140	95% Percentile (z)	139.2
95% USL	225.9	99% Percentile (z)	174

Gamma GOF Test

A-D Test Statistic	1.524	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.775	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0841	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.0783	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.328	k star (bias corrected MLE)	1.306
Theta hat (MLE)	41.58	Theta star (bias corrected MLE)	42.28
nu hat (MLE)	398.3	nu star (bias corrected)	391.7

Background Threshold Values

MLE Mean (bias corrected)	55.21	MLE Sd (bias corrected)	48.31

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	149.4	90% Percentile	119
95% Hawkins Wixley (HW) Approx. Gamma UPL	154.8	95% Percentile	150.7
95% WH Approx. Gamma UTL with 95% Coverage	169.4	99% Percentile	223
95% HW Approx. Gamma UTL with 95% Coverage	177.9		
95% WH USL	365.8	95% HW USL	425.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	5.4134E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0727	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	228.1	90% Percentile (z)	128
95% UPL (t)	186	95% Percentile (z)	183.1
95% USL	976	99% Percentile (z)	358.4

Nonparametric Distribution Free Background Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	146	95% UTL with 95% Coverage	140
Approx, f used to compute achieved CC	1.537	Approximate Actual Confidence Coefficient achieved by UTL	0.874
		Approximate Sample Size needed to achieve specified CC	181
95% Percentile Bootstrap UTL with 95% Coverage	140	95% BCA Bootstrap UTL with 95% Coverage	140
95% UPL	134.5	90% Percentile	118.1
90% Chebyshev UPL	208.9	95% Percentile	130.9
95% Chebyshev UPL	278.5	99% Percentile	224.1
95% USL	385		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.
Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

APPENDIX H 95% UCL CALCULATIONS

15 March 2022

APPENDIX H-1
ProUCL Data for 95% UCL Calculations
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Sampling Area	Preliminary AOI	Sample ID	Depth (ft)	Date	Sampler	Barium (mg/kg-dry)	D_Barium (mg/kg-dry)
Area 4	Area 4 Prelim AOI	H-8	0-2	11/5/2019	ICON	7000	1
Area 4	Area 4 Prelim AOI	H-8R	0-2	11/11/2021	ERM	NA	NA
Area 4	Area 4 Prelim AOI	H-8N	0-2	11/11/2021	ERM	1890	1
Area 4	Area 4 Prelim AOI	H-8N	0-2	11/11/2021	ICON	3330	1
Area 4	Area 4 Prelim AOI	H-8N2	0-2	1/11/2022	ERM	2520	1
Area 4	Area 4 Prelim AOI	H-8N2	0-2	1/11/2022	ICON	3000	1
Area 4	Area 4 Prelim AOI	H-8S	0-2	11/11/2021	ERM	2680	1
Area 4	Area 4 Prelim AOI	H-8S	0-2	11/11/2021	ICON	2530	1
Area 4	Area 4 Prelim AOI	H-8W	0-2	11/11/2021	ERM	649	1
Area 6	Area 4 Prelim AOI	H-8W	0-2	11/11/2021	ICON	2540	1
Area 4	Area 4 Prelim AOI	H-16	0-2	11/20/2019	ERM	221	1
Area 4	Area 4 Prelim AOI	H-16	0-2	11/20/2019	ICON	4390	1
Area 4	Area 4 Prelim AOI	H-16R	0-2	11/15/2021	ERM	71.1	1
Area 4	Area 4 Prelim AOI	H-16R	0-2	11/15/2021	ICON	2160	1
Area 5	Area 5 Prelim AOI	H-1	0-2	10/29/2019	ICON	2940	1
Area 5	Area 5 Prelim AOI	H-1R	0-2	12/13/2021	ERM	NA	NA
Area 5	Area 5 Prelim AOI	H-1R	0-2	12/13/2021	ICON	1940	1
Area 5	Area 5 Prelim AOI	H-18	0-4	11/21/2019	ICON	6390	1
Area 5	Area 5 Prelim AOI	H-18R	0-1	12/3/2021	ERM	NA	NA
Area 5	Area 5 Prelim AOI	H-18R	0-1	12/3/2021	ICON	NA	NA
Area 5	Area 5 Prelim AOI	H-18R	0-4	12/3/2021	ERM	NA	NA
Area 5	Area 5 Prelim AOI	H-18R	0-4	12/3/2021	ICON	472	1
Area 5	Area 5 Prelim AOI	H-18R	1-2	12/3/2021	ERM	NA	NA
Area 5	Area 5 Prelim AOI	H-18R	1-2	12/3/2021	ICON	NA	NA
Area 5	Area 5 Prelim AOI	H-18R	2-3	12/3/2021	ERM	NA	NA
Area 5	Area 5 Prelim AOI	H-18R	2-3	12/3/2021	ICON	NA	NA
Area 5	Area 5 Prelim AOI	H-19	0-2	11/22/2019	ICON	3750	1
Area 5	Area 5 Prelim AOI	H-19R	0-2	12/14/2021	ERM	NA	NA
Area 5	Area 5 Prelim AOI	H-19R	0-2	12/14/2021	ICON	4530	1
Area 5	Area 5 Prelim AOI	H-19SW	0-2	12/14/2021	ERM	702	1
Area 5	Area 5 Prelim AOI	H-19SW	0-2	12/14/2021	ICON	3950	1
Area 6	Area 6 Prelim AOI	H-24	0-2	4/6/2021	ERM	355	1
Area 6	Area 6 Prelim AOI	H-24	0-2	4/6/2021	ICON	4180	1
Area 6	Area 6 Prelim AOI	H-24R	0-2	11/12/2021	ERM	NA	NA
Area 6	Area 6 Prelim AOI	H-24E	0-2	11/12/2021	ERM	1900	1
Area 6	Area 6 Prelim AOI	H-24E	0-2	11/12/2021	ICON	5890	1
Area 6	Area 6 Prelim AOI	H-24N	0-2	11/12/2021	ERM	3230	1
Area 6	Area 6 Prelim AOI	H-24N	0-2	11/12/2021	ICON	3130	1
Area 6	Area 6 Prelim AOI	H-24S	0-2	11/11/2021	ERM	4660	1
Area 6	Area 6 Prelim AOI	H-24S	0-2	11/11/2021	ICON	5900	1
Area 6	Area 6 Prelim AOI	H-24W	0-2	11/12/2021	ERM	2860	1
Area 6	Area 6 Prelim AOI	H-24W	0-2	11/12/2021	ICON	4550	1
Area 6	Area 6 Prelim AOI	H-24NW	0-2	1/11/2022	ERM	2320	1
Area 6	Area 6 Prelim AOI	H-24NW	0-2	1/11/2022	ICON	3940	1
Area 6	Area 6 Prelim AOI	H-24NE	0-2	1/11/2022	ERM	3990	1
Area 6	Area 6 Prelim AOI	H-24NE	0-2	1/11/2022	ICON	7410	1
Area 6	Area 6 Prelim AOI	H-28	0-2	4/12/2021	ERM	1210	1
Area 6	Area 6 Prelim AOI	H-28	0-2	4/12/2021	ICON	7080	1
Area 6	Area 6 Prelim AOI	H-28R	0-2	11/11/2021	ERM	NA	NA
Area 6	Area 6 Prelim AOI	H-28S	0-2	11/11/2021	ERM	1280	1
Area 6	Area 6 Prelim AOI	H-28S	0-2	11/11/2021	ICON	4240	1
Area 8	Area 8 Prelim AOI	H-4	0-2	11/4/2019	ICON	4540	1
Area 8	Area 8 Prelim AOI	H-4R	0-2	11/12/2021	ERM	NA	NA
Area 8	Area 8 Prelim AOI	H-4E	0-2	11/12/2021	ERM	2860	1
Area 8	Area 8 Prelim AOI	H-4E	0-2	11/12/2021	ICON	3700	1
Area 8	Area 8 Prelim AOI	H-4E2	0-2	1/10/2022	ERM	4920	1
Area 8	Area 8 Prelim AOI	H-4E2	0-2	1/10/2022	ICON	7290	1
Area 8	Area 8 Prelim AOI	H-4N	0-2	11/12/2021	ERM	2890	1
Area 8	Area 8 Prelim AOI	H-4N	0-2	11/12/2021	ICON	2170	1
Area 8	Area 8 Prelim AOI	H-4N2	0-2	1/10/2022	ERM	3730	1
Area 8	Area 8 Prelim AOI	H-4N2	0-2	1/10/2022	ICON	4020	1
Area 8	Area 8 Prelim AOI	H-4W	0-2	11/12/2021	ERM	1290	1
Area 8	Area 8 Prelim AOI	H-4W	0-2	11/12/2021	ICON	6620	1
Area 8	Area 8 Prelim AOI	H-4W2	0-2	1/10/2022	ERM	668	1
Area 8	Area 8 Prelim AOI	H-4W2	0-2	1/10/2022	ICON	4270	1

APPENDIX H-2
ProUCL Output for 95% UCL Calculatons
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.13/9/2022 1:05:44 PM
From File	ProUCL data_Soil 0-4ft_preliminary AOI.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Barium (mg/kg-dry) (area 4 prelim aoi 1)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	1
Minimum	71.1	Mean	2537
Maximum	7000	Median	2530
SD	1821	Std. Error of Mean	505
Coefficient of Variation	0.718	Skewness	1.001

Normal GOF Test

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3437	95% Adjusted-CLT UCL (Chen-1995)	3518
		95% Modified-t UCL (Johnson-1978)	3460

Gamma GOF Test

A-D Test Statistic	0.827	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.242	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.264	k star (bias corrected MLE)	1.024
Theta hat (MLE)	2007	Theta star (bias corrected MLE)	2478
nu hat (MLE)	32.87	nu star (bias corrected)	26.62
MLE Mean (bias corrected)	2537	MLE Sd (bias corrected)	2507
		Approximate Chi Square Value (0.05)	15.86
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	14.68

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4259	95% Adjusted Gamma UCL (use when n<50)	4599

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.798	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.316	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.234	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.264	Mean of logged Data	7.394
Maximum of Logged Data	8.854	SD of logged Data	1.277

Assuming Lognormal Distribution

95% H-UCL	12636	90% Chebyshev (MVUE) UCL	7223
95% Chebyshev (MVUE) UCL	8987	97.5% Chebyshev (MVUE) UCL	11435
99% Chebyshev (MVUE) UCL	16244		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3368	95% Jackknife UCL	3437
95% Standard Bootstrap UCL	3324	95% Bootstrap-t UCL	3658
95% Hall's Bootstrap UCL	4359	95% Percentile Bootstrap UCL	3329
95% BCA Bootstrap UCL	3512		
90% Chebyshev(Mean, Sd) UCL	4052	95% Chebyshev(Mean, Sd) UCL	4738
97.5% Chebyshev(Mean, Sd) UCL	5691	99% Chebyshev(Mean, Sd) UCL	7562

Suggested UCL to Use

95% Student's-t UCL	3437

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium (mg/kg-dry) (area 5 prelim aoi)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	9
Minimum	472	Mean	3084
Maximum	6390	Median	3345
SD	2001	Std. Error of Mean	707.6
Coefficient of Variation	0.649	Skewness	0.172

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4425	95% Adjusted-CLT UCL (Chen-1995)	4294
		95% Modified-t UCL (Johnson-1978)	4432

Gamma GOF Test

A-D Test Statistic	0.385	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.198	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.298	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.879	k star (bias corrected MLE)	1.258
Theta hat (MLE)	1642	Theta star (bias corrected MLE)	2452
nu hat (MLE)	30.06	nu star (bias corrected)	20.12
MLE Mean (bias corrected)	3084	MLE Sd (bias corrected)	2750
		Approximate Chi Square Value (0.05)	10.94
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	9.277

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5672	95% Adjusted Gamma UCL (use when n<50)	6689

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.879	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.157	Mean of logged Data	7.745
Maximum of Logged Data	8.762	SD of logged Data	0.929

Assuming Lognormal Distribution

95% H-UCL	11143	90% Chebyshev (MVUE) UCL	6660
95% Chebyshev (MVUE) UCL	8173	97.5% Chebyshev (MVUE) UCL	10273
99% Chebyshev (MVUE) UCL	14397		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4248	95% Jackknife UCL	4425
95% Standard Bootstrap UCL	4171	95% Bootstrap-t UCL	4461
95% Hall's Bootstrap UCL	4316	95% Percentile Bootstrap UCL	4198
95% BCA Bootstrap UCL	4125		
90% Chebyshev(Mean, Sd) UCL	5207	95% Chebyshev(Mean, Sd) UCL	6169
97.5% Chebyshev(Mean, Sd) UCL	7503	99% Chebyshev(Mean, Sd) UCL	10125

Suggested UCL to Use

95% Student's-t UCL	4425

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium (mg/kg-dry) (area 6 prelim aoi)

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
		Number of Missing Observations	2
Minimum	355	Mean	3785
Maximum	7410	Median	3965
SD	1980	Std. Error of Mean	466.7
Coefficient of Variation	0.523	Skewness	0.165

Normal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.107	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4597	95% Adjusted-CLT UCL (Chen-1995)	4572
		95% Modified-t UCL (Johnson-1978)	4600

Gamma GOF Test

A-D Test Statistic	0.415	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.162	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.715	k star (bias corrected MLE)	2.3
Theta hat (MLE)	1394	Theta star (bias corrected MLE)	1646
nu hat (MLE)	97.75	nu star (bias corrected)	82.79
MLE Mean (bias corrected)	3785	MLE Sd (bias corrected)	2496
		Approximate Chi Square Value (0.05)	62.82
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	61.15

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4988	95% Adjusted Gamma UCL (use when n<50)	5124

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.179	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.202	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.872	Mean of logged Data	8.043
Maximum of Logged Data	8.911	SD of logged Data	0.751

Assuming Lognormal Distribution

95% H-UCL	6274	90% Chebyshev (MVUE) UCL	6349
95% Chebyshev (MVUE) UCL	7391	97.5% Chebyshev (MVUE) UCL	8837
99% Chebyshev (MVUE) UCL	11679		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4552	95% Jackknife UCL	4597
95% Standard Bootstrap UCL	4534	95% Bootstrap-t UCL	4662
95% Hall's Bootstrap UCL	4594	95% Percentile Bootstrap UCL	4543
95% BCA Bootstrap UCL	4539		
90% Chebyshev(Mean, Sd) UCL	5185	95% Chebyshev(Mean, Sd) UCL	5819
97.5% Chebyshev(Mean, Sd) UCL	6699	99% Chebyshev(Mean, Sd) UCL	8428

Suggested UCL to Use

95% Student's-t UCL	4597

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium (mg/kg-dry) (area 8 prelim aoi)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	1
Minimum	668	Mean	3767
Maximum	7290	Median	3730
SD	1886	Std. Error of Mean	523.1
Coefficient of Variation	0.501	Skewness	0.274

Normal GOF Test

Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4699	95% Adjusted-CLT UCL (Chen-1995)	4670
		95% Modified-t UCL (Johnson-1978)	4706

Gamma GOF Test

A-D Test Statistic	0.339	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.176	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.238	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.324	k star (bias corrected MLE)	2.609
Theta hat (MLE)	1133	Theta star (bias corrected MLE)	1444
nu hat (MLE)	86.44	nu star (bias corrected)	67.82
MLE Mean (bias corrected)	3767	MLE Sd (bias corrected)	2332
		Approximate Chi Square Value (0.05)	49.87
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	47.68

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5123	95% Adjusted Gamma UCL (use when n<50)	5358

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.897	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.2	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.504	Mean of logged Data	8.076
Maximum of Logged Data	8.894	SD of logged Data	0.655

Assuming Lognormal Distribution

95% H-UCL	6167	90% Chebyshev (MVUE) UCL	6130
95% Chebyshev (MVUE) UCL	7135	97.5% Chebyshev (MVUE) UCL	8530
99% Chebyshev (MVUE) UCL	11271		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4627	95% Jackknife UCL	4699
95% Standard Bootstrap UCL	4581	95% Bootstrap-t UCL	4817
95% Hall's Bootstrap UCL	4794	95% Percentile Bootstrap UCL	4592
95% BCA Bootstrap UCL	4618		
90% Chebyshev(Mean, Sd) UCL	5336	95% Chebyshev(Mean, Sd) UCL	6047
97.5% Chebyshev(Mean, Sd) UCL	7033	99% Chebyshev(Mean, Sd) UCL	8971

Suggested UCL to Use

95% Student's-t UCL	4699

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX I HQ INPUT FACTORS CALCULATIONS

15 March 2022

TABLE 1. Summary: Barium Soil/Sediment to Plant Bioconcentration Factors

Plant	Geometric Mean Soil/Sediment to Plant Bioconcentration Factor conc. in plant ÷ conc. in sediment	Reference
Swiss Chard	0.0041	Nelson et al., 1984
Rye Grass	0.0043	Nelson et al., 1984
Plant Shoots	0.0056	Lamb et al., 2013
Geometric Mean Ba Soil/Sediment to Plant BCF	0.0046	

Notes:

Ba=Barium

BCF=Bioconcentration Factor

References:

Nelson et al. 1984. Extractability and Plant Uptake of Trace Elements from Drilling Fluids. Journal of Environmental Quality, Vol. 13, No. 4.

Lamb, D. et al. 2013. Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite. Environ. Sci. Technol. 47: 4670 - 4676.

TABLE 2. Barium in Soils and Plants and Bioconcentration Factor Calculations (Nelson et al., 1984)

Treatment	Barium in Swiss Chard (mg/kg)	Barium in Soil (mg/kg)	Soil to Plant BCF (Ba in Swiss Chard ÷Total Ba in Soil)
Control	206	350	0.59
BM1	196	101000	0.0019
BM2	226	252000	0.00090
NS2	165	215000	0.00077
MX1	464	91000	0.0051
MX2	262	227000	0.0012
		Geometric Mean Ba Plant BCF	0.0041

Treatment	Barium in Rye Grass (mg/kg)	Barium in Soil (mg/kg)	Soil to Plant BCF (Ba in Rye Grass÷Total Ba in Soil)
Control	188	350	0.54
BM1	172	101000	0.0017
BM2	275	252000	0.0011
NS2	-	215000	NA
MX1	142	91000	0.0016
MX2	216	227000	0.0010
		Geometric Mean Barium Soil to Plant BCF	0.0043

Notes:
The controls are not included in BCF calculations, because they represent the Ba in plants at background.
Ba=Barium
BCF=Bioconcentration Factor

Reference:
Nelson et al. 1984. Extractability and Plant Uptake of Trace Elements from Drilling Fluids. Journal of Environmental Quality, Vol. 13, No. 4.

TABLE 3. Barium in Soils and Plants and Bioconcentration Factor Calculations (Lamb et al., 2013)

Total Barium[a] Soil **mg/kg**	**Barium Shoot Concentration** **mg/kg**	**Barium Soil to Plant BCF** **(conc. in plant ÷ conc. in soil)**
700	18	0.026
1300	122	0.094
5300	87	0.016
7700	79	0.010
5700	65	0.011
10100	79	0.0078
10100	133	0.013
6700	132	0.020
269000	92	0.00034
292000	68	0.00023
265000	65	0.00025
Geometric Mean Barium Soil to Plant BCF		0.0056

Notes:
BCF=Bioconcentration Factor
[a]Analyzed by XRF (X-ray diffraction analysis)

Reference:
Lamb, D. et al. 2013. Bioavailability of Barium to Plants and Invertebrates in Soils Contaminated by Barite. Environ. Sci. Technol. 47: 4670 - 4676.

TABLE 4. Summary: Barium Sediment to Benthic Invertebrate Bioconcentration Factors

Location	Barium Geometric Mean Sediment to Benthic Invertebrate BCF	Reference
South Louisiana (Abdominal)	0.0013	Finerty et al., 1990
South Louisiana (Hepatopancreas)	0.012	Finerty et al., 1990
EWL, LA (EWL Site)	0.091	ERM, 2019
EWL, LA (EWL Reference)	0.21	ERM, 2019
Total Means: Barium Sediment to Benthic Invertebrate BCF	0.023	

Notes:
BCF=Bioconcentration Factor
EWL, LA=East White Lake, Louisiana

References:

Finerty, M.W., Madden, J.D., Feagley, and Grodner, R.M. 1990. Tissues of Wild and Pond-raised Crayfish in Southern Louisiana, Effect of Environs and Seasonality on Metal Residues. Arch. Environ. Contam. Toxicol. 19: 94-100.

ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 5. Barium in Sediments and Invertebrates and Bioconcentration Factor Calculations (Finerty et al., 1990)

Sample ID	Crawfish Mean Abdominal Barium (mg/kg)	Crawfish Mean Hepatopancreas Barium (mg/kg)	Mean Sediment Barium (mg/kg)	Abdominal BCF (conc. in crawfish ÷ conc. in sed.)	Hepatopancreas BCF (conc. in crawfish ÷ conc. in sed.)
VER	0.782	8.223	333.5	0.0023	0.025
AP	-	4.84	556.4	-	0.0087
CRS	0.532	6.869	519.3	0.0010	0.013
LB	1.288	6.177	297.6	0.0043	0.021
STM	0.043	2.193	945.9	0.000045	0.0023
UB	2.383	6.558	282.2	0.0084	0.023
Geometric Mean Barium Sediment to Benthic Invertebrate BCF				0.0013	0.012

Notes:
Outlier removed: Barium soil outlier significantly below background (13.39 mg/kg).
BCF=Bioconcentration Factor

Reference:

Finerty, M.W., Madden, J.D., Feagley, and Grodner, R.M. 1990. Tissues of Wild and Pond-raised Crayfish in Southern Louisiana, Effect of Environs and Seasonality on Metal Residues. Arch. Environ. Contam. Toxicol. 19: 94-100.

TABLE 6. Barium in Sediments and Crabs and Bioconcentration Factor Calculations (ERM, 2019)

Area	Sample ID	Barium Concentration in Crab Tissue	Barium Concentration in Sediment	Barium Sediment to Crab BCF (conc. in crab tissue ÷ conc. in sediment)
EWL Site	EWL-T-01A-C	13.1		
EWL Site	EWL-T-01-C	22.6		
EWL Site	EWL-T-02-C	16.5		
EWL Site	EWL-T-03-C	34.1		
EWL Site	EWL-T-04-C	20.7		
EWL Site	EWL-T-05-C	19.5		
EWL Site	EWL-T-06-C	22.9		
EWL Site	EWL-T-07-C	20.4		
EWL Site	EWL-T-08-C	23.5		
EWL Site	EWL-T-09-C	16.1		
EWL Site	EWL-T-10-C	37.7		
EWL Site	EWL-T-11-C	24.3		
EWL Site	EWL-T-12-C	24.9		
EWL Site Geometric Mean		**21.9**	**241**	**0.091**
EWL Reference	EWL-TR-01-C	16.8		
EWL Reference	EWL-TR-02-C	20.8		
EWL Reference	EWL-TR-03A-C	25.8		
EWL Reference	EWL-TR-03-C	20.4		
EWL Reference	EWL-TR-04-C	22.4		
EWL Reference	EWL-TR-05-C	21.1		
EWL Reference	EWL-TR-06-C	29.3		
EWL Reference	EWL-TR-07-C	14.3		
EWL Reference	EWL-TR-08-C	21.8		
EWL Reference	EWL-TR-09-C	23.6		
EWL Reference Geometric Mean		**21.3**	**101**	**0.21**

Notes:
Concentrations are in mg/kg wet weight.
Concentrations for crab are for tissue.
Crab sampling was performed in December 2010/January 2011.
Sediment data are from 0-2 feet and collected in 2010 at EWL.
BCF=Bioconcentration Factor
EWL=East White Lake

Reference:
ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 7. Summary: Bariumn Sediment to Fish Bioconcentration Factors

Location	Geometric Mean Barium Sediment to Fish BCF	Reference
Ottawa River, Ten Mile Creek, Ohio	0.012	Ohio EPA, 1991
Upper Columbia River, Washington	0.0068	Teck American, Inc. 2010
EWL, LA (EWL Site)	0.071	ERM, 2019
EWL, LA (EWL Reference)	0.11	ERM, 2019
Barium Sediment to Fish BCF	**0.028**	

Notes:
BCF=Bioconcentration Factor
EWL, LA= East White Lake, Louisiana

References:

Ohio EPA. 1991. Fish Tissue Bottom Sediment Surface Water Organic & Metal Chemical Evaluation, Ottawa River, Ten Mile Creek, Toledo, Ohio, Division Of Water Quality Planning And Assessment. US Geological Survey. Pearl, Mississippi.

Teck American, Inc. 2010. Upper Columbia River Screening-Level Ecological Risk Assessment (SLERA) Teck American, Inc., Spokane, WA.

ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 8. Barium in Fish and Sediments in Rivers in Ohio and Washington and Bioconcentration Factor Calculations (Ohio EPA, 1991; Teck American, Inc., 2010)

Ottawa River / Ten Mile Creek[a]	Site Location	Detroit Ave	Adj. Dura Landfill	Suder Ave	Dst Summit St	Sylvania Ave	Highland Meadows Golf
Whole body common carp conc.	mg/kg	1.94	0.843	0.79	1.38	1.22	1.34
Sediment composite conc.	mg/kg	96.9	126	143	175	55	72.6
BCF	fish conc.÷ sed. conc.	0.020	0.0067	0.0055	0.0079	0.022	0.018
Geometric Mean Barium Sediment to Fish BCF							**0.012**

Upper Columbia River[b]	Reach #	6b	6a	5	4a	3	2	1
Mean fish tissue conc. in reach	mg/kg-dry	10.6	10.6	10.4	9.2	8.0	6.7	7.6
Avg. sediment conc. by location	mg/kg-dry	1517	798	1067	1190	1382	1543	2008
BCF	fish conc.÷ sed. conc.	0.0070	0.013	0.010	0.0077	0.0058	0.0043	0.0038
Geometric Mean Barium Sediment to Fish BCF								**0.0068**

Note:
BCF=Bioconcentration Factor

References:

[a]Ohio EPA. 1991. Fish Tissue Bottom Sediment Surface Water Organic & Metal Chemical Evaluation, Ottawa River, Ten Mile Creek, Toledo, Ohio, Division Of Water Quality Planning And Assessment. US Geological Survey. Pearl, Mississippi.

[b]Teck American, Inc. 2010. Upper Columbia River Screening-Level Ecological Risk Assessment (SLERA) Teck American, Inc., Spokane, WA.

TABLE 9. Barium in EWL Fish and Sediments and Bioconcentration Factor Calculations (ERM, 2019)

Area	Sample ID	Barium Concentration in Fish Tissue	Barium Concentration in Sediment	Barium Sediment to Fish BCF Conc. in Fish Tissue ÷ Conc. in Sediment
EWL Site	EWL-T-01A-F	NA		
EWL Site	EWL-T-01-F	16.4		
EWL Site	EWL-T-02-F	17.0		
EWL Site	EWL-T-03-F	15.9		
EWL Site	EWL-T-04-F	17.1		
EWL Site	EWL-T-05-F	19.1		
EWL Site	EWL-T-06-F	16.4		
EWL Site	EWL-T-07-F	17.0		
EWL Site	EWL-T-08-F	17.1		
EWL Site	EWL-T-09-F	16.7		
EWL Site	EWL-T-10-F	20.1		
EWL Site	EWL-T-11-F	18.0		
EWL Site	EWL-T-12-F	14.7		
EWL Site Geometric Mean		**17.1**	**241**	**0.071**
EWL Reference	EWL-TR-01-F	NA		
EWL Reference	EWL-TR-02-F	9.1		
EWL Reference	EWL-TR-03A-F	NA		
EWL Reference	EWL-TR-03-F	9.5		
EWL Reference	EWL-TR-04-F	13.4		
EWL Reference	EWL-TR-05-F	13.0		
EWL Reference	EWL-TR-06-F	10.8		
EWL Reference	EWL-TR-07-F	11.5		
EWL Reference	EWL-TR-08-F	11.9		
EWL Reference	EWL-TR-09-F	12.1		
EWL Reference Geometric Mean		**11.3**	**101**	**0.11**

Notes:
Concentrations are in mg/kg wet weight.
Concentrations for shad fish are for tissue.
Fish sampling was performed in December 2010/January 2011.
Sediment data are from 0-2 feet and collected in 2010 at EWL.
BCF=Bioconcentration Factor
EWL=East White Lake

Reference:
ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 10. Summary: Soil/Sediment Barium Bioavailability Factors

Geometric Mean Barium Soil/Sediment Bioavailability Factor	Reference
0.00072	Engdahl, A. et al., 2008
0.00013	Environment International Ltd, 2010
0.000086	USGS, 2002
0.00020	**Geometric Mean Barium Soil Bioavailability Factor**

Note:
Soil bioavailability factors in each study are based on mean soil and porewater concentrations.

References:

Engdahl, A. et al. 2008. Oskarshamm and Forsmark site investigation, Chemical composition of suspended material, sediment and pore water in lakes and sea bays. Swedish Nuclear Fuel and Waste Management Co., P-08-81: 80 pgs.

Environment International Ltd. 2010. Upper Columbia River in-Situ Porewater Assessment Sampling and Quality Assurance Plan, Washington State Attorney General's Office.

USGS. 2002. Vertical Distribution of Trace-Element Concentrations and Occurrence of Metallurgical Slag Particles in Accumulated Bed Sediments of Lake Roosevelt, Washington. Scientific Investigations Report 2004-5090.

TABLE 11. Barium in Soils/Sediments/Porewaters and Soil Bioavailability Calculations (Engdahl et al., 2008)

Barium Sediment Concentration

	Sample ID	Eck	Eck	Lab	Lab	Bol	Bol	Geometric Mean Ba Sediment Concentration
Sample Depth	*cm*	0-5	25-30	0-5	25-30	0-5	25-30	86
Concentration	mg/kg-dry	40	46	59	59	220	280	

Barium Porewater Concentration

	Sample ID	Eck	Eck	Lab	Lab	Bol	Bol	Geometric Mean Ba Porewater Concentration
Sample Depth	*cm*	0-5	25-30	0-5	25-30	0-5	25-30	0.062
Concentration	mg/L	0.03	0.06	0.06	0.08	0.04	0.17	

Barium Soil Bioavailability

	Sample ID	Eck	Eck	Lab	Lab	Bol	Bol	**Geometric Mean Barium Soil/Sed. Bioavailability Factor**
Porewater conc. ÷ Sediment conc.	unitless	0.0008	0.0013	0.0009	0.0013	0.0002	0.0006	**0.00072**

Note:
Ba=Barium

Reference:
Engdahl, A. et al. 2008. Oskarshamm and Forsmark site investigation, Chemical composition of suspended material, sediment and pore water in lakes and sea bays. Swedish Nuclear Fuel and Waste Management Co., P-08-81: 80 pgs.

TABLE 12. Barium in Soils/Sediments/Porewaters and Soil Bioavailability Calculations (Environment International Ltd, 2010)

	Barium Soil Concentrations (mg/kg)							
Sample ID	UDE 2 SED	BSB 2 SED	BSB 1 SED	DE 2 SED	DE 1 SED	MSB 1 SED	MSB 2 SED	UDE 1 SED
	347	1010	1250	845	415	268	468	678
	Barium Porewater Concentrations (mg/L)							
Collected AM	0.109	0.058	0.154	0.129	0.115	0.040	0.047	0.029
Collected PM	0.129	0.055	0.146	0.173	0.117	0.039	0.044	0.029
Mean of AM and PM	0.119	0.057	0.150	0.151	0.116	0.0392	0.046	0.029
	Barium Soil/Sediment Bioavailability Factor							
porewater conc.÷ soil conc.	0.00034	0.000056	0.00012	0.00018	0.00028	0.00015	0.00010	0.000042
	Geometric Mean Soil/Sediment Barium Bioavailability Factor							**0.00013**

Reference:
Environment International Ltd. 2010. Upper Columbia River in-Situ Porewater Assessment Sampling and Quality Assurance Plan, Washington State Attorney General's Office.

TABLE 13. Barium in Lake Roosevelt in Soils/Sediments/Porewaters and Soil Bioavailability Calculations

Sample ID	Depth cm	Barium Porewater mg/L	Barium Sediment mg/kg	Barium Soil/Sediment Bioavailability Factor (porewater conc. ÷ sediment conc.)
1	1-2	0.091	1100	0.000083
	9-11	0.14	1100	0.00013
2	1-2	0.11	1200	0.000092
	9-11	0.18	1500	0.00012
3	1-2	0.068	1200	0.000057
	9-11	0.08	1300	0.000062
Geometric Mean Barium Soil/Sediment Bioavailability Factor				**0.000086**

Reference:
USGS. 2002. Vertical Distribution of Trace-Element Concentrations and Occurrence of Metallurgical Slag Particles in Accumulated Bed Sediments of Lake Roosevelt, Washington. Scientific Investigations Report 2004-5090.

TABLE 14. Barium Sulfate Toxicity Studies

Endpoint	Result	Units	Exposure	Duration	Media	Salinity	Organism Scientific Name	Common Name	Life Stage	Effect	Reference
AQUATIC STUDIES											
Freshwater											
EC50	32	mg/L	direct contact	48 hrs	water	freshwater	*Daphnia magna Straus*	water flea	not reported	immobility	1. Khangarot,B.S., and P.K. Ray, 1989
EC50	33.65	mg/L	direct contact	48 hrs	water	freshwater	*Tubifex tubifex*	Tubificid Worm	not reported	immobility	2. Khangarot,B.S., 1991
EC50	33.65	mg/L	direct contact	96 hrs	water	freshwater	*Tubifex tubifex*	Tubificid Worm	not reported	immobility	2. Khangarot,B.S., 1991
EC50	44.98	mg/L	direct contact	24 hrs	water	freshwater	*Tubifex tubifex*	Tubificid Worm	not reported	immobility	2. Khangarot,B.S., 1991
EC50	52.82	mg/L	direct contact	24 hrs	water	freshwater	*Daphnia magna Straus*	water flea	not reported	immobility	1. Khangarot,B.S., and P.K. Ray, 1989
EC50	634-798	mg/L	direct contact	48 hr	water	freshwater	*C. subglobosa Sowerby*	freshwater ostracod	various	immobility	3. Khangarot, B.S. and Das, S., 2009
LC50	> 7500	mg/L	direct contact	96 hrs	water	freshwater	*Salmo gairdneri* Richardson	rainbow trout	2.5 - 4.0 cm	mortality	4. Faulk, M. et al., 1973
LC50	76000	mg/L	direct contact	96 hrs	water	freshwater	*Oncorhynchus mykiss*	rainbow trout	1 gram weight	mortality	5. Sprague, J. et al., 1979
LC0	100000	mg/L	direct contact	96 hrs	water	freshwater	*Poecilia sp.*	Mollies	not reported	mortality	6. Grantham,C.K., and J.P. Sloan, 1975
Saltwater											
NOAEL	10	mg/L	direct contact	7 days	water	34 ppt salinity	*Cancer anthonyi*	yellow crab	embryo	mortality/reproduct.	7. Macdonald J.M. et al., 1988
NOAEL	200	mg/L	direct contact	24 hours	water	marine	*Mallotus villosus*	capelin	larvae	survival	8. Payne, J.F. et al., 2006
LC50	1000	mg/L	direct contact	7 days	water	34 ppt salinity	*Cancer anthonyi*	yellow crab	embryo	mortality	7. Macdonald J.M. et al., 1988
NOAEL	1000	mg/L	direct contact	24 hours	water	marine	*Chionoecetes opilio*	snow crab	larvae	survival	8. Payne, J.F. et al., 2006
NOAEL	1000	mg/L	direct contact	24 hours	water	marine	jellyfish	jellyfish	planktonic	survival	8. Payne, J.F. et al., 2006
NOAEL	1000	mg	ingestion	4x/one month	water	marine	*Pseudopleuronectes americanus*	winter flounder	300 gram weight	survival	8. Payne, J.F. et al., 2006
EC50	16200	mg/L	direct contact	96 hour	water	28-31 ppt salinity	*Pandalus danae*	dock shrimp	larvae	swimming	9. Carls, M.G. et al., 1984
EC50	71400	mg/L	direct contact	96 hour	water	28-31 ppt salinity	*Metacarcinus magister*	dungeness crab	larvae	swimming	9. Carls, M.G. et al., 1984
NOAEL	200000	mg/L	direct contact	10 month	water	seawater	*Tautogolabrus adspersus*	cunner	70.7 +/-20.8 gms	growth	10. Payne, J. et al., 2011
TERRESTRIAL STUDIES											
Mammals											
NOAEL	8	mg/kg	ingestion	apprx 60 days[a]	diet	NA	CF-1 mice	mice	weanling	growth/repro/mortal	11. Hutcheson, D., 1975
LD50	364000	mg/kg	intragastric	28 -52 hours	dosed	NA	CBL-Wistar Albino Rats	rat	130-160 gm wght	mortality	12. Boyd, M.D. and Abel, M., 1966
LD0	163000	mg/kg	intragastric	14 days	dosed	NA	CBL-Wistar Albino Rats	rat	130-160 gm wght	mortality	12. Boyd, M.D. and Abel, M., 1966
Terrestrial Invertebrates											
NOAEL	10000	mg/kg	direct contact		sandy loam soil	NA	*Folsomia Candida*	soil arthropod	adult	mortality	13. Kuperman, R.G. et al., 2006
NOAEL	10000	mg/kg	direct contact		sandy loam soil	NA	*Eisenia Fetida*	earth worm	adult	mortality	13. Kuperman, R.G. et al., 2006
NOAEL	10000	mg/kg	direct contact		sandy loam soil	NA	*Enchytraeus Crypticus*	white worm	adult	mortality	13. Kuperman, R.G. et al., 2006
NOAEL	1000000	mg/kg	direct contact	14 days	clayey soil	NA	*Onychiurus folsomi*	springtail insect	not reported	mortality	14. Menzie et al., 2008
NOAEL	300000	mg/kg	direct contact	14 days	loamy soil	NA	*Eisenia andrei*	worm	not reported	mortality	14. Menzie et al., 2008

Notes

[a]Three generations of mice

References

1. Khangarot,B.S., and P.K. Ray, 1989, Investigation of Correlation Between Physicochemical Properties of Metals and Their Toxicity to the Water Flea Daphnia magna Straus, Ecotoxicol. Environ. Saf.18(2): 109-121 (from ECOTOX)
2. Khangarot,B.S., 1991, Toxicity of Metals to a Freshwater Tubificid Worm, Tubifex tubifex (Muller), Bull. Environ. Contam. Toxicol.46:906-912 (from ECOTOX)
3. Khangarot, B.S. and Das, S., 2009, Acute toxicity of metals and reference toxicants to a freshwater ostracod, Cypris subglobosa Sowerby, 1840 and correlation to EC50 values of other test models, Journal of Hazardous Materials 172, 641–649
4. Faulk, M. et al., Acute Toxicity of Petrochemical Drilling Fluids Components and Wastes to Fish, 1973, Environment Canada,Technical Report Series
5. Sprague, J. et al., 1979, Separate and Joint Toxicity to Rainbow Trout of Substances Used in Drilling Fluids for Oil Exploration, Environ. Pollut. 0013-9327
6. Grantham,C.K., and J.P. Sloan, 1975, EPA 560/1-75-004, 1975, Toxicity Study Drilling Fluid Chemicals on Aquatic LifeConf.Proc.on Environ.Aspects of Chemical Use in Well-Drilling Operations, Research Triangle Inst., NC (from ECOTOX)
7. Macdonald J.M. et al., 1988, Acute toxicities of eleven metals to early life-history stages of the yellow crab Cancer anthonyi, Marine Biology 98, 201-207
8. Payne, J.F. et al., 2006. Risks assoc. with drill. fluids at petrol. developm. sites in the offsh.: Eval. of the potent. for an aliph. HC- based drill. fluid to produce sedimen. toxicity and for barite to be acut. toxic to plankton. Can. Tech. Rep. Fish. Aquat. Sci. 2679
9. Carls, M.G. et al., 1984, Toxic Contributions of Specific Drilling Mud Components to Larval Shrimp and Crabs, Marine Environmental Research 12, 45-62.
10. Payne, J. et al., 2011, Produced Water: Overview of Composition, Fates, and Effects, Chapter 21 Risks to Fish Associated with Barium in Drilling Fluids and Produced Water: A Chronic Toxicity Study with Cunner (Tautogolabrus adspersus)
11. Hutcheson, D. et al., 1975, Studies of Nutritional Safety of Some Heavy Metals in Mice, The Journal of Nutrition, Vol 105, no.6.
12. Boyd, M.D. and Abel, M., 1966, The Acute Toxicity of Barium Sulfate Administered Intragastrically, Canad. Med. Ass. J.
13. Kuperman, R.G. et al., 2006, Toxicity Benchmarks for Antimony, Barium, and Beryllium Determin. using Reproduc. Endpoints for Folsomia Candida, Eisenia Fetida, and Enchytraeus Crypticus, Environ. Toxicol. and Chem., Vol. 25, No. 3, pp. 754–762
14. Menzie, C. et al., 2008, The Importance of Understanding the Chemical Form of a Metal in the Environment: The Case of Barium Sulfate, Human and Ecological Risk Assessment, 14: 974–991

TABLE 15. Summary: Total Mercury Soil to Plant Bioconcentration Factors

Reference	Geometric Means	
Fernández-Martínez et al., 2015	Geometric Mean Total Mercury Plant BCF	0.02
Rodriguez et al., 2007	Geometric Mean Total Mercury Plant BCF	0.95
Hamilton et al., 2008	Geometric Mean Total Mercury Plant BCF	1.02
	Total Geometric Mean Total Mercury Plant BCF	0.27

Note:
BCF=Bioconcentration Factor

References:

Fernández-Martínez, R. et al. 2015. Mercury accumulation and speciation in plants and soils from abandoned cinnabar mines. Geoderma 253–254, 30–38.

Rodriguez, L. et al. 2007. Capability of Selected Crop Plants for Shoot Mercury Accumulation from Polluted Soils: Phytoremediation Perspectives. Journal of Phytoremediation, 9:1–13, 2007.

Hamilton, M. et al. 2008. Determination and comparison of heavy metals in selected seafood, water,vegetation and sediments by inductively coupled plasma-optical emission spectrometry from an industrialized and pristine waterway in Southwest Louisiana. Microchemical Journal 88 (2008) 52–55.

TABLE 16. Total Mercury in Soils and Plants near Cinnabar Mines and Bioconcentration Factor Calculations (Fernández-Martínez et. al., 2015)

Mining area	Sampling Location	Plant species	Soil to Plant BCF
La Soterraña	P1-E1	*Crupina vulgaris*	0.029
	P3-E4	*Typha latifolia*	0.014
	P3-E5	*Phyllitis scolopendrium*	0.013
	P3-H6	*Dryopteris filix-mas*	0.186
Los Rueldos	P8-E7	*Calluna vulgaris*	0.010
	P8-H7	*Dryopteris affinis*	0.017
		Geometric Mean Total Hg Plant BCF	0.02

Reference:

Fernández-Martínez, R. et al. 2015. Mercury accumulation and speciation in plants and soils from abandoned cinnabar mines. Geoderma 253–254, 30–38.

TABLE 17. Total Mercury in Soils and Plants and Bioconcentration Factor Calculations (Rodriguez et. al., 2007)

Media: Soil and Vegetation	Total Mercury mg/kg	Soil to Plant BCF
Soil	33.56	
Lupine	30.65	0.91
Lentil	33.25	0.99
Chickpea	31	0.92
Barley	32.53	0.97
Geometric Mean Total Hg Plant BCF		0.95

Reference:

Rodriguez, L. et al. 2007. Capability of Selected Crop Plants for Shoot Mercury Accumulation from Polluted Soils: Phytoremediation Perspectives. Journal of Phytoremediation, 9:1–13, 2007.

TABLE 18. Total Mercury in Southwest Louisiana Soils and Plants and Bioconcentration Factor Calculations (Hamilton et. al., 2008)

Sample Location	Total Hg mg/kg	Sample Location	Total Hg mg/kg
Vegetation 63–64, Site 1	6.41	Sediments 75, 78, Site 1	6.2
Vegetation 65–66, Site 2	6.69	Sediments 76, 79, Site 2	6.22
Vegetation 67–68, Site 3	6.36		
Vegetation 69–70, Site 4	6.25		
Vegetation 71–72, Site 5	6.25		
Vegetation 73–74, Site 6	6.14		
Geometric Veg. Mean	6.35	Geometric Sed. Mean	6.21
		Geometric Mean Hg Plant BCF (conc. in veg/conc. in sed.)	1.02

Reference:

Hamilton, M. et al. 2008. Determination and comparison of heavy metals in selected seafood, water,vegetation and sediments by inductively coupled plasma-optical emission spectrometry from an industrialized and pristine waterway in Southwest Louisiana. Microchemical Journal 88 (2008) 52–55.

TABLE 19. Summary: Total Mercury Sediment to Benthic Invertebrate Bioconcentration Factors

Location	Geometric Mean Total Mercury Sed. to Invert. BCF	Reference
St. Lawrence, Canada	0.035	Razavi, 2013
Lavaca, TX	1.1	USFW, 1994
EWL, LA (EWL Site)	0.90	ERM, 2019
EWL, LA (EWL Reference)	2.2	ERM, 2019
St. Lawrence, Cornwall Zooplankton	0.40	Ridal et. al., 2010
St.Lawrence, Cornwall Benthos	0.40	Ridal et al., 2010
Total Mercury Sediment to Invertebrate BCF	0.48	

Note:
BCF=Bioconcentration Factor

References:

Razavi, R. 2013. Ebullition Rates And Mercury Concentrations In St. Lawrence River Sediments And a Benthic Invertebrate. Environmental Toxicology and Chemistry, Vol. 32, No. 4, pp. 857–865.

U.S. Fish And Wildlife Service. 1994. Accumulation Of Mercury In Sediments, Prey, And Shorebirds of Lavaca Bay, Texas, Phase II Report.

ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

Ridal, J. et al. 2010. Potential causes of enhanced transfer of mercuryto St. Lawrence River Biota: implications for sedimentmanagement strategies at Cornwall, Ontario, Canada. Hydrobiologia 647:81–98.

TABLE 20. Total Mercury in St. Lawrence Sediments and Benthic Invertebrates and Bioconcentration Factor Calculations (Razavi, 2013)

Media: Invertebrates and Sediments	Mean Total Mercury (ng/g dw)	Bioconcentration Factor (BCF) Total Mercury Sediment to Invertebrates (amphipod total Hg conc. ÷ sediment total Hg conc.)
Amphipods	173	**0.035**
Sediments	5000	

Reference:

Razavi, R. 2013. Ebullition Rates And Mercury Concentrations In St. Lawrence River Sediments And a Benthic Invertebrate. Environmental Toxicology and Chemistry, Vol. 32, No. 4, pp. 857–865.

TABLE 21. Total Mercury in Lavaca Bay, TX. Sediments and Benthic Invertebrates and Bioconcentration Factor Calculations

Matrix / Biota	Mean Total Mercury mg/kg dw	Bioconcentration Factor (BCF) Total Mercury Sediment to Invertebrates (invertebrate total mercury conc.÷ total mercury sediment conc.)
Sediment	0.26	
Mussel	0.27	1.0
Oyster	0.26	1.0
Polychaete	0.20	0.77
Xanthid crab	0.18	0.69
Fiddler crab	0.83	3.2
Geometric Mean Total Mercury Invertebrate BCF		1.1

Reference:
U.S. Fish And Wildlife Service. 1994. Accumulation Of Mercury In Sediments, Prey, And Shorebirds of Lavaca Bay, Texas, Phase II Report.

TABLE 22. Total Mercury in EWL Sediments and Crabs and Bioconcentration Factor Calculations (ERM, 2019)

Area	Sample ID	Total Mercury Concentration in Crab Tissue	Total Mercury Concentration in Sediment	Total Mercury Sediment to Crab BCF (Conc. in Crab Tissue ÷ Conc. in Sediment)
EWL Site	EWL-T-01A-C	0.055		
EWL Site	EWL-T-01-C	0.055		
EWL Site	EWL-T-02-C	0.047		
EWL Site	EWL-T-03-C	0.063		
EWL Site	EWL-T-04-C	0.043		
EWL Site	EWL-T-05-C	0.050		
EWL Site	EWL-T-06-C	0.055		
EWL Site	EWL-T-07-C	0.046		
EWL Site	EWL-T-08-C	0.049		
EWL Site	EWL-T-09-C	0.046		
EWL Site	EWL-T-10-C	0.058		
EWL Site	EWL-T-11-C	0.047		
EWL Site	EWL-T-12-C	0.042		
EWL Site Geometric Mean		**0.050**	**0.055**	**0.90**
EWL Reference	EWL-TR-01-C	0.045		
EWL Reference	EWL-TR-02-C	0.036		
EWL Reference	EWL-TR-03A-C	0.063		
EWL Reference	EWL-TR-03-C	0.043		
EWL Reference	EWL-TR-04-C	0.057		
EWL Reference	EWL-TR-05-C	0.035		
EWL Reference	EWL-TR-06-C	0.072		
EWL Reference	EWL-TR-07-C	0.038		
EWL Reference	EWL-TR-08-C	0.035		
EWL Reference	EWL-TR-09-C	0.046		
EWL Reference Geometric Mean		**0.046**	**0.020**	**2.2**

Notes:
Concentrations are in mg/kg wet weight.
Concentrations for crab are for tissue.
Crab sampling was performed in December 2010/January 2011.
Sediment data are from 0-2 feet and collected in 2010 at EWL.
BCF=Bioconcentration Factor
EWL=East White Lake

Reference:
ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 23. Total Mercury in St. Lawrence River Sediments and Benthic Invertebrates and Bioconcentration Factor Calculations (Ridal et al., 2010)

Matrix / Biota	Sample Location				Total Mercury Bioconcentration Factors (conc. in invert. ÷ conc. in sed.)
	1	2	3	4	
Zooplankton (ng/g dw)	502	608	245	111	
Sediment (ng/g dw) Top 10 cm	774	2238	1744	104	**Geometric Mean Total Mercury Zooplankton BCF**
Total Hg BCF Zooplankton	0.65	0.27	0.14	1.1	0.40
Benthos (ng/g dw)	338	300	666	118	
Sediment (ng/g dw) Top 10 cm	774	2238	1744	104	**Geometric Mean Total Mercury Benthos BCF**
Total Hg BCF Benthos	0.44	0.13	0.38	1.1	0.40

Note:
BCF=Bioconcentration Factor

Reference:

Ridal, J. et al. 2010. Potential causes of enhanced transfer of mercury to St. Lawrence River Biota: implications for sediment management strategies at Cornwall, Ontario, Canada. Hydrobiologia 647:81–98.

TABLE 24. Summary: Total Mercury Sediment to Fish Bioconcentration Factors

Location	Geometric Mean Total Mercury Sediment to Fish BCF	Reference
White Lake at Abbeville, LA	3.9	LDEQ LEAU database, 2019
Upper Prong Schooner Bayou, LA	3.9	LDEQ LEAU database, 2019
EWL, LA. Site	0.20	ERM, 2019
EWL, LA. Reference	0.51	ERM, 2019
Total Mercury Sediment to Fish BCF	1.1	

References:

LDEQ. 2019. Data taken from the LDEQ's Louisiana Environmental Assessment Utility (LEAU) database. https://waterdata.deq.louisiana.gov/

ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 25. Total Mercury in Fish and Sediments in White Lake and Schooner Bayou as Collected by LDEQ

Site	LDEQ Site 310: White Lake at Abbeville, LA				LDEQ Site 756: Upper Prong Schooner Bayou			
Date	4/2/1998	7/23/2003	7/12/2004	7/10/2008	8/31/1998	9/30/2002	8/4/2004	6/22/2009
Fish Tissue Concentration	0.15	0.41	0.06	0.1978	0.08	0.72	0.51	0.0661
	0.05	0.15	0.22	0.6438	0.24	0.21	0.06	0.0577
	0.02	0.4	0.28	0.2286	0.19	0.41	0.2	0.0572
	0.04	0.37	0.3	0.3809	0.35	0.2	0.27	0.0948
	0.03	0.24	0.72	0.2693		0.61	0.08	0.0688
	0.03	0.41	0.04	0.2242		0.5	0.11	0.0543
	0.0001	0.27	0.28	0.2079		0.62	0.24	0.0785
	0.05	0.17	0.47	0.2628		0.27	0.12	0.1467
	0.07	0.58	0.23	0.1911		0.24	0.44	
	0.33	0.29	0.44	0.573		0.21	0.09	
	0.02	0.13	0.21	0.2966			0.4	
	0.05	0.17	0.69	0.2683			0.06	
	0.14	0.3		0.2659				
	0.18	0.17		0.2729				
				0.1996				
				0.1778				
				0.2325				
				0.2288				
Geometric Mean Fish Tissue Concentration	0.038	0.264	0.251	0.266	0.189	0.355	0.165	0.074
Sediment Concentration	0.01	0.05895	0.0849	0.0575	0.13	0.05466	0.02558	NA
Geometric Mean Sediment to Fish BCF[a]	3.85	4.47	2.95	4.62	1.45	6.50	6.44	NA
Geometric Mean Sediment to Fish BCF for LDEQ Site	3.9				3.9			

Notes:
[a]Fish Tissue Concentration ÷ Sediment Concentration
Concentrations are in mg/kg.
Data from LDEQ's Louisiana Environmental Assessment Utility (LEAU) database. https://waterdata.deq.louisiana.gov/

TABLE 26. Total Mercury in Fish and Sediments and Bioconcentration Factor Calculations (ERM, 2019)

Area	Sample ID	Total Mercury Concentration in Fish Tissue	Total Mercury Concentration in Sediment	Total Mercury Sediment to Fish BCF Conc. in Fish Tissue ÷ Conc. in Sediment
EWL Site	EWL-T-01A-F	NA		
EWL Site	EWL-T-01-F	0.0119		
EWL Site	EWL-T-02-F	0.0105		
EWL Site	EWL-T-03-F	0.0098		
EWL Site	EWL-T-04-F	0.0131		
EWL Site	EWL-T-05-F	0.0117		
EWL Site	EWL-T-06-F	0.0109		
EWL Site	EWL-T-07-F	0.0102		
EWL Site	EWL-T-08-F	0.0097		
EWL Site	EWL-T-09-F	0.0104		
EWL Site	EWL-T-10-F	0.0125		
EWL Site	EWL-T-11-F	0.0114		
EWL Site	EWL-T-12-F	0.0106		
EWL Site Geometric Mean		**0.0110**	**0.0555**	**0.20**
EWL Reference	EWL-TR-01-F	NA		
EWL Reference	EWL-TR-02-F	0.0120		
EWL Reference	EWL-TR-03A-F	NA		
EWL Reference	EWL-TR-03-F	0.0098		
EWL Reference	EWL-TR-04-F	0.0116		
EWL Reference	EWL-TR-05-F	0.0104		
EWL Reference	EWL-TR-06-F	0.0101		
EWL Reference	EWL-TR-07-F	0.0098		
EWL Reference	EWL-TR-08-F	0.0101		
EWL Reference	EWL-TR-09-F	0.0101		
EWL Reference Geometric Mean		**0.0105**	**0.0205**	**0.51**

Notes:
Concentrations are in mg/kg wet weight.
Concentrations for shad fish are for tissue.
Fish sampling was performed in December 2010/January 2011.
Sediment data are from 0-2 feet and collected in 2010 at EWL.
BCF=Bioconcentration Factor
EWL=East White Lake

Reference:
ERM. 2019. East White Lake Ecological Risk Assessment, Section 16 Property, East White Lake Oil and Gas Field, Vermilion Parish, Louisiana. September 16, 2019.

TABLE 27. Summary: Total Mercury Soil/Sediment Bioavailability Factors

Location	Geometric Mean Total Mercury Soil/Sed. Bioavailability Factors (conc. in porewater ÷ conc. in sed.)	Reference
Savannah River	0.00009	Xu et al., 2019
Spiked Sediment	0.018	Chibunda et al., 2009
Chloralkalai Plant	0.00002	Chalmers et al., 2013
Geometric Mean	**0.00031**	

References:

Xu, X. et al. 2019. Mercury speciation, bioavailability, and biomagnification in contaminated streams on the Savannah River Site (SC, USA), Science of The Total Environment. 668, 261-270.

Chibunda, R. T. et al. 2009. Chronic Toxicity of Mercury (HgCl2) to the Benthic Midge *Chironomus riparius.* Int. J. Environ. Res., 3(3):455-462

Chalmers, A. et al. 2013. Characterization of Mercury Contamination in the Androscoggin River, Coos County, New Hampshire, USGS, USEPA, USDOI

TABLE 28. Total Mercury In Savannah River Soil/Sediment/Porewaters and Bioavailabilty Calculations (Xu et al., 2019)

Area units	Soil Total Mercury ng/kg dw	Soil Methylmercury ng/g dw	MeHg %	Total Mercury in Porewater ng/L	Total Mercury Soil/Sed. Bioavailability (Total Hg porewater conc.÷Total Hg sediment conc.)
MB-a	50000	0.9	1.8	6.9	0.00014
MB-b	51000	0.6	1.1	4	0.00008
MB-c	52000	0.6	1.1	4	0.00008
FMC-a	77000	1.2	1.5	7.2	0.00009
FMC-b	76000	1	1.3	4.5	0.00006
FMC-c	58000	1.4	2.5	8.4	0.00014
Geometric Mean Total Mercury Soil/Sediment Bioavailability Factor					0.00009

Reference:

Xu, X. et al. 2019. Mercury speciation, bioavailability, and biomagnification in contaminated streams on the Savannah River Site (SC, USA), Science of The Total Environment. 668, 261-270.

TABLE 29. Total Mercury in Spiked Soil/Sediment/Porewater and Bioavailability Calculations (Chibunda et al., 2009)

Conc. in Sediment mg /Kg dry weight	Conc. in Porewater mg/L	Total Mercury Soil/Sed. Bioavailability Factor (conc. in porewater ÷ conc. in sediment)
0.59	0.00001	0.00002
0.93	0.09	0.09
2.42	0.14	0.06
3.84	0.32	0.08
7.20	0.51	0.07
12.68	0.80	0.06
Geometric Mean Total Mercury Soil/Sed. Bioavailability Factor		0.018

Reference:

Chibunda, R. T. et al. 2009. Chronic Toxicity of Mercury (HgCl2) to the Benthic Midge *Chironomus riparius.* Int. J. Environ. Res., 3(3):455-462.

TABLE 30. Total Mercury In Soil/Sediment/Porewater near a Chloralkali Plant and Bioavailabilty Calculations (Chalmers et al., 2013)

Location	Total Mercury Soil/Sediment Concentration mg/kg	Total Mercury Porewater Concentration mg/L	Soil/Sediment Bioavailability Factor
Sed. Reference 1 Location	0.03	0.0000007	0.000023
Sed. Downstream	0.114	0.00000172	0.000015
Sed. Reference 2 Location	0.026	0.0000007	0.000027
Sed. Nearstream Reach	0.117	0.00000132	0.000011
Sed. Farstream	0.111	0.00000172	0.000015

Total Geometric Mean Total Mercury Soil/Sed. Bioavailability Factor	0.00002

Note:
Sediment and porewater are median concentrations.

Reference:
Chalmers, A. et al. 2013. Characterization of Mercury Contamination in the Androscoggin River, Coos County, New Hampshire, USGS, USEPA, USDOI.

TABLE 31. Calculation of Lead Soil-to-Bird Bioconcentration Factor

Matrix[a]	Lead (mg/kg dry)	
Location:	Bake Oven Knob	Palmerton
Soil horizon		
01	99	1200
02	490	2700
A1	150	41
A2	17	17
Average Soil Concentration	105	218
Songbird Carcass (average)	15	56
Soil-to-bird BCF	0.1422	0.2569
Soil-to-bird BCF (Geometric Mean)	**0.191**	

Notes:
a) Each soil sample is a pool of 10 samples.
Bake Oven Knob birds: catbird, wood thrush, black-and-white warbler, warbler,

Palmerton birds: Carolina chickadee, catbird, brown thrasher, robin, wood thrush, black-and-white warbler, yellow-throated warbler, common grackle, rufous-sided towhee, and field sparrow.

Reference:

Beyer, W.N., Pattee, O.H., Sileo, L., Hoffman, D.J., and B.M. Mulhern. 1985. Metal Contamination in Wildlife Living Near Two Zinc Smelters. Environmental Pollution (Series A) 38: 63-86.

TABLE 32. Calculation of Mercury Soil-to-Bird Bioconcentration Factor

Matrix[a]	Mercury (mg/kg wet weight)	Soil-to-Bird BCF	Reference
Sediment	0.5		White and Cromartie, 1985
Liver	0.1	0.200	

Matrix[b]	Mercury (mg/kg)	Soil-to-Bird BCF	Reference
Soil	2		Adair et al., 2003.
Kidney	0.22	0.110	

Soil-to-Bird BCF (Geometric Mean)	**0.148**	

Notes:

a) Livers: 10 samples American advocet and 10 samples Black-necked stilt. Sediment: 3 samples, range (0.4 - 0.7 mg/kg), geomean = 0.5 mg/kg

b) Soil concentration is the minimum site geometric mean of four samples at a location. Kidney concentration is the maximum site geometric mean of kidneys at a nesting location. Minimum soil and maximum kidney are used as a conservative approach.

References:

White, D.H. and E. Cromartie. 1985. Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas. Bulletin of Environmental Contamination and Toxicology 34: 295-300.

Adair, B.M., Reynolds, K.D., McMurray, S.T., and G.P. Cobb. 2003. Mercury Occurrence in Prothonotary Warblers (Protonotaria citrea) Inhabiting a National Priorities List Site and Reference Areas in Southern Alabama. Archives of Environmental Contamination and Toxicology 44: 265–271.

APPENDIX J HQ CALCULATIONS

15 March 2022

APPENDIX J-1. Table 1
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**	**Calculations based on 95% UCL values**				
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.000044	SF					
Temporal factor	0.3	TF					
Area use factor	0.000013	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3437	600	0.0002	0.0046	0.00895	2.21	0.0000000488

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-1. Table 2
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird			Calculations based on 95% UCL values
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.05	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.19	FIR	
Proportion of diet, plants	0.64	Pp	
Proportion of diet, soil inverts	0.36	Pi	
Spatial factor	1	SF	
Temporal factor	0.3	TF	
Area use factor	0.3	AUF	

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	3437	600	0.0002	0.0046	0.091	0.0121	1.92	21.4	0.0117

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-1. Table 3
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat							
Parameter	Value	Symbol					
Body weight (kg)	0.01	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	**Calculations based on 95% UCL values**				
Proportion of diet, soil inverts	1	Pi					
Spatial factor	0.52	SF					
Temporal factor	0.3	TF					
Area use factor	0.16	AUF					
			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	95% UCL Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	3437	600	0.0002	0.091	0.00959	46.9	0.0122

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-1. Table 4
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	3437	600	0.0566	0.0566	11.8	1.77	0.00000394

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-1. Table 5
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**	**Calculations based on 95% UCL values**				
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.15	SF					
Temporal factor	0.3	TF					
Area use factor	0.045	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3437	5433	0.0002	0.0046	0.00563	2.06	0.0000171

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-1. Table 6
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on 95%UCL values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**95%UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	3437	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00226	0.411	1.35	0.606	0.136	NA	NA	0.000000457

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-1. Table 7
Soil HQ Calculations (95% UCL Conc.): Area 4 Prelim AOI 1 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	3437	5433	0.0002	0.0046	0.0566	0.000539	0.0443	4.90	0.00000000464

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 1
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**	**Calculations based on 95% UCL values**				
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.000044	SF					
Temporal factor	0.3	TF					
Area use factor	0.000013	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	4425	600	0.0002	0.0046	0.0115	2.85	0.0000000630

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 2
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	95% UCL Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	Soil/ Sediment	Plants	Soil Inverts	HQ
Barium	4425	600	0.0002	0.0046	0.091	0.0156	2.48	27.5	0.0150

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 3
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.01	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.15	FIR
Proportion of diet, soil inverts	1	Pi
Spatial factor	0.52	SF
Temporal factor	0.3	TF
Area use factor	0.16	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	4425	600	0.0002	0.091	0.0123	60.4	0.0157

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 4
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	4425	600	0.0566	0.0566	15.3	2.28	0.00000510

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 5
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**	**Calculations based on 95% UCL values**				
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.15	SF					
Temporal factor	0.3	TF					
Area use factor	0.045	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	4425	5433	0.0002	0.0046	0.00725	2.65	0.0000220

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 6
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on 95%UCL values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**95%UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	4425	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00291	0.529	1.73	0.78	0.175	NA	NA	0.000000586

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-2. Table 7
Soil HQ Calculations (95% UCL Conc.): Area 5 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	95% UCL Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF mammals	Soil/ Sediment	Plants	Mammals	HQ
Barium	4425	5433	0.0002	0.0046	0.0566	0.000694	0.057	6.31	0.00000000598

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai} \;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 1
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**	**Calculations based on 95% UCL values**				
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.000044	SF					
Temporal factor	0.3	TF					
Area use factor	0.000013	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	4597	600	0.0002	0.0046	0.012	2.96	0.0000000654

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 2
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.05	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.19	FIR	**Calculations based on 95% UCL values**
Proportion of diet, plants	0.64	Pp	
Proportion of diet, soil inverts	0.36	Pi	
Spatial factor	1	SF	
Temporal factor	0.3	TF	
Area use factor	0.3	AUF	

			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	4597	600	0.0002	0.0046	0.091	0.0162	2.57	28.6	0.0156

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 3
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			**Calculations based on 95% UCL values**
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.52	SF	
Temporal factor	0.3	TF	
Area use factor	0.16	AUF	

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	4597	600	0.0002	0.091	0.0128	62.7	0.0163

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 4
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	4597	600	0.0566	0.0566	15.8	2.37	0.00000527

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 5
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit		
Parameter	**Value**	**Symbol**
Body weight (kg)	2.118	BW
Soil ingestion proportion	0.063	Ps
Food ingestion Rate (kg/kgBW/d)	0.13	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.15	SF
Temporal factor	0.3	TF
Area use factor	0.045	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	4597	5433	0.0002	0.0046	0.00753	2.75	0.0000228

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 6
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	4597	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00302	0.55	1.8	0.81	0.182	NA	NA	0.000000610

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-3. Table 7
Soil HQ Calculations (95% UCL Conc.): Area 6 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	95% UCL Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF mammals	Soil/ Sediment	Plants	Mammals	HQ
Barium	4597	5433	0.0002	0.0046	0.0566	0.000721	0.0592	6.56	0.00000000621

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 1
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.14	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.00015	SF
Temporal factor	0.3	TF
Area use factor	0.000045	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	4699	600	0.0002	0.0046	0.0122	3.03	0.000000228

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]) \; x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 2
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on 95% UCL values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	95% UCL Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	Soil/ Sediment	Plants	Soil Inverts	HQ
Barium	4699	600	0.0002	0.0046	0.091	0.0166	2.63	29.2	0.0159

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 3
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat							
Parameter	Value	Symbol	Calculations based on 95% UCL values				
Body weight (kg)	0.01	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.15	FIR					
Proportion of diet, soil inverts	1	Pi					
Spatial factor	1	SF					
Temporal factor	0.3	TF					
Area use factor	0.3	AUF					
			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	95% UCL Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	4699	600	0.0002	0.091	0.0131	64.1	0.0321

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 4
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.002	SF
Temporal factor	0.3	TF
Area use factor	0.0006	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	4699	600	0.0566	0.0566	16.2	2.42	0.0000186

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 5
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit			
Parameter	**Value**	**Symbol**	
Body weight (kg)	2.118	BW	
Soil ingestion proportion	0.063	Ps	
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on 95% UCL values**
Proportion of diet, plants	1	Pp	
Spatial factor	0.52	SF	
Temporal factor	0.3	TF	
Area use factor	0.16	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	4699	5433	0.0002	0.0046	0.0077	2.81	0.0000809

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 6
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.011	SF
Temporal factor	0.3	TF
Area use factor	0.0033	AUF

Calculations based on 95%UCL values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**95%UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	4699	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00309	0.562	1.84	0.828	0.186	NA	NA	0.00000208

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-4. Table 7
Soil HQ Calculations (95% UCL Conc.): Area 8 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote			
Parameter	**Value**	**Symbol**	
Body weight (kg)	14	BW	
Soil ingestion proportion	0.028	Ps	
Food ingestion Rate (kg/kgBW/d)	0.028	FIR	**Calculations based on 95% UCL values**
Proportion of diet, plants	0.1	Pp	
Proportion of diet, mammals	0.9	Pm	
Spatial factor	0.000059	SF	
Temporal factor	0.3	TF	
Area use factor	0.000018	AUF	

			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**95% UCL Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	4699	5433	0.0002	0.0046	0.0566	0.000737	0.0605	6.70	0.0000000220

Notes:
Soil concentrations are in mg/kg dry weight.
95% UCL soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 1
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**					
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on average values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.000044	SF					
Temporal factor	0.3	TF					
Area use factor	0.000013	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2537	600	0.0002	0.0046	0.00661	1.63	0.0000000360
Lead	27.2	1.63	0.01	0.0389	0.00354	0.148	0.00000123
Mercury	0.12	3.25	0.00031	0.27	0.000000484	0.00454	0.0000000184

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 2
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	2537	600	0.0002	0.0046	0.091	0.00897	1.42	15.8	0.00861
Lead	27.2	1.63	0.01	0.0389	0.266	0.00481	0.129	0.495	0.116
Mercury	0.12	3.25	0.00031	0.27	1.693	0.000000657	0.00394	0.0139	0.00165

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 3
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.01	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.15	FIR
Proportion of diet, soil inverts	1	Pi
Spatial factor	0.52	SF
Temporal factor	0.3	TF
Area use factor	0.16	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	2537	600	0.0002	0.091	0.00708	34.6	0.00900
Lead	27.2	1.63	0.01	0.266	0.00379	1.09	0.105
Mercury	0.12	3.25	0.00031	1.693	0.000000519	0.0305	0.00146

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 4
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	2537	600	0.0566	0.0566	8.74	1.31	0.00000291
Lead	27.2	1.63	0.1054	0.191	0.175	0.0473	0.0000237
Mercury	0.12	3.25	0.0534	0.148	0.00039	0.000162	0.0000000296

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai} \;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 5
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit		
Parameter	**Value**	**Symbol**
Body weight (kg)	2.118	BW
Soil ingestion proportion	0.063	Ps
Food ingestion Rate (kg/kgBW/d)	0.13	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.15	SF
Temporal factor	0.3	TF
Area use factor	0.045	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2537	5433	0.0002	0.0046	0.00416	1.52	0.0000126
Lead	27.2	4.7	0.01	0.0389	0.00223	0.138	0.00134
Mercury	0.12	1.01	0.00031	0.27	0.000000305	0.00421	0.000188

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 6
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on average values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	2537	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00167	0.303	0.994	0.447	0.101	NA	NA	0.000000336
Lead	27.2	4.7	0.01	0.0389	0.266	0.1054	0.191	NA	NA	0.000895	0.0275	0.0311	0.00893	0.00364	NA	NA	0.0000152
Mercury	0.12	1.01	0.00031	0.27	1.693	0.0534	0.148	NA	NA	0.000000122	0.000843	0.000875	0.00002	0.0000124	NA	NA	0.00000172

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-5. Table 7
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 1 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF mammals	Soil/ Sediment	Plants	Mammals	HQ
Barium	2537	5433	0.0002	0.0046	0.0566	0.000398	0.0327	3.62	0.00000000343
Lead	27.2	4.7	0.01	0.0389	0.1054	0.000213	0.00296	0.0722	0.0000000818
Mercury	0.12	1.01	0.00031	0.27	0.0534	0.0000000292	0.0000907	0.000161	0.00000000127

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 1
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**					
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on average values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.0000037	SF					
Temporal factor	0.3	TF					
Area use factor	0.0000011	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2176	600	0.0002	0.0046	0.00567	1.4	0.00000000260

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 2
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	0.2	SF
Temporal factor	0.3	TF
Area use factor	0.06	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	2176	600	0.0002	0.0046	0.091	0.00769	1.22	13.5	0.00147

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 3
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat		
Parameter	Value	Symbol
Body weight (kg)	0.01	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.15	FIR
Proportion of diet, soil inverts	1	Pi
Spatial factor	0.043	SF
Temporal factor	0.3	TF
Area use factor	0.013	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	2176	600	0.0002	0.091	0.00607	29.7	0.000639

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 4
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.000048	SF
Temporal factor	0.3	TF
Area use factor	0.000014	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	2176	600	0.0566	0.0566	7.5	1.12	0.000000207

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 5
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit			
Parameter	Value	Symbol	
Body weight (kg)	2.118	BW	
Soil ingestion proportion	0.063	Ps	
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on average values**
Proportion of diet, plants	1	Pp	
Spatial factor	0.013	SF	
Temporal factor	0.3	TF	
Area use factor	0.0039	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	Soil/ Sediment	Plants	HQ
Barium	2176	5433	0.0002	0.0046	0.00356	1.3	0.000000936

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 6
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Calculations based on average values

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.00027	SF
Temporal factor	0.3	TF
Area use factor	0.000081	AUF

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	2176	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00143	0.26	0.852	0.384	0.0862	NA	NA	0.0000000236

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-6. Table 7
Soil HQ Calculations (Average Conc.): Area 4 Prelim AOI 2 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.0000014	SF
Temporal factor	0.3	TF
Area use factor	0.0000004	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	2176	5433	0.0002	0.0046	0.0566	0.000341	0.028	3.10	0.000000000242

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 1
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**					
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on average values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.000044	SF					
Temporal factor	0.3	TF					
Area use factor	0.000013	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3084	600	0.0002	0.0046	0.00803	1.99	0.0000000440

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ])\ x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 2
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.05	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.19	FIR	**Calculations based on average values**
Proportion of diet, plants	0.64	Pp	
Proportion of diet, soil inverts	0.36	Pi	
Spatial factor	1	SF	
Temporal factor	0.3	TF	
Area use factor	0.3	AUF	

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	3084	600	0.0002	0.0046	0.091	0.0109	1.73	19.2	0.0105

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

<u>Where:</u>

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 3
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	**Calculations based on average values**
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.52	SF	
Temporal factor	0.3	TF	
Area use factor	0.16	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	3084	600	0.0002	0.091	0.0086	42.1	0.0109

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 4
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	3084	600	0.0566	0.0566	10.6	1.59	0.00000354

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 5
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit			
Parameter	**Value**	**Symbol**	
Body weight (kg)	2.118	BW	
Soil ingestion proportion	0.063	Ps	
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on average values**
Proportion of diet, plants	1	Pp	
Spatial factor	0.15	SF	
Temporal factor	0.3	TF	
Area use factor	0.045	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3084	5433	0.0002	0.0046	0.00505	1.84	0.0000153

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]) \; x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 6
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on average values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	3084	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00203	0.369	1.21	0.544	0.122	NA	NA	0.000000409

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-7. Table 7
Soil HQ Calculations (Average Conc.): Area 5 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote			
Parameter	**Value**	**Symbol**	
Body weight (kg)	14	BW	
Soil ingestion proportion	0.028	Ps	
Food ingestion Rate (kg/kgBW/d)	0.028	FIR	**Calculations based on average values**
Proportion of diet, plants	0.1	Pp	
Proportion of diet, mammals	0.9	Pm	
Spatial factor	0.000017	SF	
Temporal factor	0.3	TF	
Area use factor	0.0000051	AUF	

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	3084	5433	0.0002	0.0046	0.0566	0.000484	0.0397	4.40	0.00000000417

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 1
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove		
Parameter	Value	Symbol
Body weight (kg)	0.12	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.14	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.000044	SF
Temporal factor	0.3	TF
Area use factor	0.000013	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	Soil/ Sediment	Plants	HQ
Barium	3785	600	0.0002	0.0046	0.00986	2.44	0.0000000539
Lead	29.4	1.63	0.01	0.0389	0.00383	0.16	0.00000133
Mercury	0.123	3.25	0.00031	0.27	0.000000496	0.00465	0.0000000189

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 2
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	3785	600	0.0002	0.0046	0.091	0.0134	2.12	23.6	0.0129
Lead	29.4	1.63	0.01	0.0389	0.266	0.00519	0.139	0.535	0.125
Mercury	0.123	3.25	0.00031	0.27	1.693	0.000000674	0.00404	0.0142	0.00168

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 3
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	**Value**	**Symbol**	**Calculations based on average values**
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.52	SF	
Temporal factor	0.3	TF	
Area use factor	0.16	AUF	

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	3785	600	0.0002	0.091	0.0106	51.7	0.0134
Lead	29.4	1.63	0.01	0.266	0.0041	1.17	0.112
Mercury	0.123	3.25	0.00031	1.693	0.000000532	0.0312	0.00150

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 4
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	3785	600	0.0566	0.0566	13	1.95	0.00000434
Lead	29.4	1.63	0.1054	0.191	0.189	0.0511	0.0000256
Mercury	0.123	3.25	0.0534	0.148	0.0004	0.000166	0.0000000303

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 5
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit		
Parameter	Value	Symbol
Body weight (kg)	2.118	BW
Soil ingestion proportion	0.063	Ps
Food ingestion Rate (kg/kgBW/d)	0.13	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.15	SF
Temporal factor	0.3	TF
Area use factor	0.045	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	Soil/ Sediment	Plants	HQ
Barium	3785	5433	0.0002	0.0046	0.0062	2.26	0.0000188
Lead	29.4	4.7	0.01	0.0389	0.00241	0.149	0.00145
Mercury	0.123	1.01	0.00031	0.27	3.12E-07	0.00432	0.000192

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 6
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on average values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	3785	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00249	0.453	1.48	0.667	0.15	NA	NA	0.000000502
Lead	29.4	4.7	0.01	0.0389	0.266	0.1054	0.191	NA	NA	0.000967	0.0297	0.0337	0.00965	0.00393	NA	NA	0.0000164
Mercury	0.123	1.01	0.00031	0.27	1.693	0.0534	0.148	NA	NA	0.000000125	0.000864	0.000896	0.0000205	0.0000127	NA	NA	0.00000176

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-8. Table 7
Soil HQ Calculations (Average Conc.): Area 6 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF mammals	Soil/ Sediment	Plants	Mammals	HQ
Barium	3785	5433	0.0002	0.0046	0.0566	0.000593	0.0488	5.40	0.00000000512
Lead	29.4	4.7	0.01	0.0389	0.1054	0.00023	0.0032	0.0781	0.0000000885
Mercury	0.123	1.01	0.00031	0.27	0.0534	0.0000000299	0.000093	0.000166	0.00000000131

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 1
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**	**Calculations based on average values**				
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.00015	SF					
Temporal factor	0.3	TF					
Area use factor	0.000045	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3767	600	0.0002	0.0046	0.00981	2.43	0.000000183

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 2
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	3767	600	0.0002	0.0046	0.091	0.0133	2.11	23.4	0.0128

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 3
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.01	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.15	FIR
Proportion of diet, soil inverts	1	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	3767	600	0.0002	0.091	0.0105	51.4	0.0257

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 4
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.002	SF
Temporal factor	0.3	TF
Area use factor	0.0006	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	3767	600	0.0566	0.0566	13	1.94	0.0000149

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 5
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**	**Calculations based on average values**				
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.52	SF					
Temporal factor	0.3	TF					
Area use factor	0.16	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3767	5433	0.0002	0.0046	0.00617	2.25	0.0000648

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ])\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 6
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.011	SF
Temporal factor	0.3	TF
Area use factor	0.0033	AUF

Calculations based on average values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	3767	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00248	0.451	1.48	0.664	0.149	NA	NA	0.00000167

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-9. Table 7
Soil HQ Calculations (Average Conc.): Area 8 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote									
Parameter	**Value**	**Symbol**							
Body weight (kg)	14	BW							
Soil ingestion proportion	0.028	Ps							
Food ingestion Rate (kg/kgBW/d)	0.028	FIR	**Calculations based on average values**						
Proportion of diet, plants	0.1	Pp							
Proportion of diet, mammals	0.9	Pm							
Spatial factor	0.000059	SF							
Temporal factor	0.3	TF							
Area use factor	0.000018	AUF							
			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	3767	5433	0.0002	0.0046	0.0566	0.000591	0.0485	5.37	0.0000000177

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 1
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.14	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.000044	SF
Temporal factor	0.3	TF
Area use factor	0.000013	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	Soil/ Sediment	Plants	HQ
Barium	7000	600	0.0002	0.0046	0.0182	4.51	0.0000000996
Lead	54.5	1.63	0.01	0.0389	0.0071	0.297	0.00000246
Mercury	0.157	3.25	0.00031	0.27	0.000000634	0.00593	0.0000000241

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]) \ x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 2
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	7000	600	0.0002	0.0046	0.091	0.0247	3.92	43.6	0.0238
Lead	54.5	1.63	0.01	0.0389	0.266	0.00963	0.258	0.992	0.232
Mercury	0.157	3.25	0.00031	0.27	1.693	0.000000860	0.00515	0.0182	0.00216

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 3
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.01	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.15	FIR
Proportion of diet, soil inverts	1	Pi
Spatial factor	0.52	SF
Temporal factor	0.3	TF
Area use factor	0.16	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	7000	600	0.0002	0.091	0.0195	95.6	0.0249
Lead	54.5	1.63	0.01	0.266	0.0076	2.17	0.208
Mercury	0.157	3.25	0.00031	1.693	0.000000679	0.0399	0.00192

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 4
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	7000	600	0.0566	0.0566	24.1	3.61	0.00000804
Lead	54.5	1.63	0.1054	0.191	0.35	0.0947	0.0000475
Mercury	0.157	3.25	0.0534	0.148	0.000511	0.000211	0.0000000387

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 5
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**					
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on maximum values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.15	SF					
Temporal factor	0.3	TF					
Area use factor	0.045	AUF					

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	7000	5433	0.0002	0.0046	0.0115	4.19	0.0000348
Lead	54.5	4.7	0.01	0.0389	0.00446	0.276	0.00269
Mercury	0.157	1.01	0.00031	0.27	0.000000399	0.00551	0.000246

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}])\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 6
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	7000	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00461	0.837	2.74	1.23	0.277	NA	NA	0.000000927
Lead	54.5	4.7	0.01	0.0389	0.266	0.1054	0.191	NA	NA	0.00179	0.0551	0.0624	0.0179	0.00729	NA	NA	0.0000304
Mercury	0.157	1.01	0.00031	0.27	1.693	0.0534	0.148	NA	NA	0.000000160	0.0011	0.00114	0.0000261	0.0000163	NA	NA	0.00000224

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-10. Table 7
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 1 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	7000	5433	0.0002	0.0046	0.0566	0.0011	0.0902	9.98	0.00000000945
Lead	54.5	4.7	0.01	0.0389	0.1054	0.000427	0.00594	0.145	0.000000164
Mercury	0.157	1.01	0.00031	0.27	0.0534	0.0000000382	0.000119	0.000211	0.00000000167

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 1
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**					
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on maximum values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.0000037	SF					
Temporal factor	0.3	TF					
Area use factor	0.0000011	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3130	600	0.0002	0.0046	0.00815	2.02	0.00000000375

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 2
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird									
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**						
Body weight (kg)	0.05	BW							
Soil ingestion proportion	0.093	Ps							
Food ingestion Rate (kg/kgBW/d)	0.19	FIR							
Proportion of diet, plants	0.64	Pp							
Proportion of diet, soil inverts	0.36	Pi							
Spatial factor	0.2	SF							
Temporal factor	0.3	TF							
Area use factor	0.06	AUF							
			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	3130	600	0.0002	0.0046	0.091	0.0111	1.75	19.5	0.00213

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]) \ x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 3
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat							
Parameter	Value	Symbol					
Body weight (kg)	0.01	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	Calculations based on maximum values				
Proportion of diet, soil inverts	1	Pi					
Spatial factor	0.043	SF					
Temporal factor	0.3	TF					
Area use factor	0.013	AUF					
			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	3130	600	0.0002	0.091	0.00873	42.7	0.000918

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 4
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.000048	SF
Temporal factor	0.3	TF
Area use factor	0.000014	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	3130	600	0.0566	0.0566	10.8	1.61	0.000000298

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 5
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**				
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.013	SF					
Temporal factor	0.3	TF					
Area use factor	0.0039	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	3130	5433	0.0002	0.0046	0.00513	1.87	0.00000135

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 6
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.00027	SF
Temporal factor	0.3	TF
Area use factor	0.000081	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	3130	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00206	0.374	1.23	0.552	0.124	NA	NA	0.0000000340

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-11. Table 7
Soil HQ Calculations (Maximum Conc.): Area 4 Prelim AOI 2 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.0000014	SF
Temporal factor	0.3	TF
Area use factor	0.0000004	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	3130	5433	0.0002	0.0046	0.0566	0.000491	0.0403	4.46	0.000000000348

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 4 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 1
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**					
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on maximum values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.000044	SF					
Temporal factor	0.3	TF					
Area use factor	0.000013	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	6390	600	0.0002	0.0046	0.0166	4.12	0.0000000910

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 2
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird			
Parameter	Value	Symbol	
Body weight (kg)	0.05	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.19	FIR	**Calculations based on maximum values**
Proportion of diet, plants	0.64	Pp	
Proportion of diet, soil inverts	0.36	Pi	
Spatial factor	1	SF	
Temporal factor	0.3	TF	
Area use factor	0.3	AUF	

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	Soil/ Sediment	Plants	Soil Inverts	HQ
Barium	6390	600	0.0002	0.0046	0.091	0.0226	3.57	39.8	0.0217

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 3
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat							
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**				
Body weight (kg)	0.01	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.15	FIR					
Proportion of diet, soil inverts	1	Pi					
Spatial factor	0.52	SF					
Temporal factor	0.3	TF					
Area use factor	0.16	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	6390	600	0.0002	0.091	0.0178	87.2	0.0227

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 4
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	Maximum Soil Concentration (0-4')	TRV	BCF mammals	BCF birds	Mammals	Birds	HQ
Barium	6390	600	0.0566	0.0566	22	3.29	0.00000733

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 5
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**				
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.15	SF					
Temporal factor	0.3	TF					
Area use factor	0.045	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	6390	5433	0.0002	0.0046	0.0105	3.82	0.0000317

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 6
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**BCF mammals**	**BCF birds**	**BCF benthic inverts**	**BCF fish**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**Fish**	**HQ**
Barium	6390	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.0042	0.764	2.5	1.13	0.253	NA	NA	0.000000848

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]) \ x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-12. Table 7
Soil HQ Calculations (Maximum Conc.): Area 5 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF mammals	Soil/ Sediment	Plants	Mammals	HQ
Barium	6390	5433	0.0002	0.0046	0.0566	0.001	0.0823	9.11	0.00000000863

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 5 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 1
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.14	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.000044	SF
Temporal factor	0.3	TF
Area use factor	0.000013	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	7410	600	0.0002	0.0046	0.0193	4.77	0.000000105
Lead	54.2	1.63	0.01	0.0389	0.00706	0.295	0.00000245
Mercury	0.32	3.25	0.00031	0.27	0.000001290	0.0121	0.0000000491

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 2
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	7410	600	0.0002	0.0046	0.091	0.0262	4.14	46.1	0.0251
Lead	54.2	1.63	0.01	0.0389	0.266	0.00958	0.256	0.986	0.230
Mercury	0.32	3.25	0.00031	0.27	1.693	0.000001750	0.0105	0.0371	0.00439

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 3
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.52	SF	
Temporal factor	0.3	TF	
Area use factor	0.16	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	7410	600	0.0002	0.091	0.0207	101	0.0263
Lead	54.2	1.63	0.01	0.266	0.00756	2.16	0.207
Mercury	0.32	3.25	0.00031	1.693	0.000001380	0.0813	0.00390

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 4
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.00058	SF
Temporal factor	0.3	TF
Area use factor	0.00017	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	Maximum Soil Concentration (0-4')	TRV	BCF mammals	BCF birds	Mammals	Birds	HQ
Barium	7410	600	0.0566	0.0566	25.5	3.82	0.00000850
Lead	54.2	1.63	0.1054	0.191	0.348	0.0942	0.0000472
Mercury	0.32	3.25	0.0534	0.148	0.00104	0.000431	0.0000000788

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 5
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**					
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on maximum values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.15	SF					
Temporal factor	0.3	TF					
Area use factor	0.045	AUF					

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	7410	5433	0.0002	0.0046	0.0121	4.43	0.0000368
Lead	54.2	4.7	0.01	0.0389	0.00444	0.274	0.00267
Mercury	0.32	1.01	0.00031	0.27	0.000000812	0.0112	0.000499

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 6
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.0033	SF
Temporal factor	0.3	TF
Area use factor	0.00099	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	7410	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00488	0.886	2.9	1.31	0.294	NA	NA	0.000000983
Lead	54.2	4.7	0.01	0.0389	0.266	0.1054	0.191	NA	NA	0.00178	0.0548	0.0621	0.0178	0.00725	NA	NA	0.0000303
Mercury	0.32	1.01	0.00031	0.27	1.693	0.0534	0.148	NA	NA	0.000000326	0.00225	0.00233	0.0000532	0.0000332	NA	NA	0.00000457

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-13. Table 7
Soil HQ Calculations (Maximum Conc.): Area 6 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000017	SF
Temporal factor	0.3	TF
Area use factor	0.0000051	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	7410	5433	0.0002	0.0046	0.0566	0.00116	0.0954	10.60	0.0000000100
Lead	54.2	4.7	0.01	0.0389	0.1054	0.000425	0.0059	0.144	0.000000163
Mercury	0.32	1.01	0.00031	0.27	0.0534	0.0000000778	0.000242	0.000431	0.00000000340

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 6 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 1
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	Value	Symbol					
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on maximum values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.00015	SF					
Temporal factor	0.3	TF					
Area use factor	0.000045	AUF					
			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	Soil/ Sediment	Plants	HQ
Barium	7290	600	0.0002	0.0046	0.019	4.69	0.000000353

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 2
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	1	SF
Temporal factor	0.3	TF
Area use factor	0.3	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	7290	600	0.0002	0.0046	0.091	0.0258	4.08	45.4	0.0248

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 3
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	Value	Symbol	
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	**Calculations based on maximum values**
Proportion of diet, soil inverts	1	Pi	
Spatial factor	1	SF	
Temporal factor	0.3	TF	
Area use factor	0.3	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	7290	600	0.0002	0.091	0.0203	99.5	0.0498

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 4
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.002	SF
Temporal factor	0.3	TF
Area use factor	0.0006	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	Maximum Soil Concentration (0-4')	TRV	BCF mammals	BCF birds	Mammals	Birds	HQ
Barium	7290	600	0.0566	0.0566	25.1	3.75	0.0000289

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 5
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit			
Parameter	**Value**	**Symbol**	
Body weight (kg)	2.118	BW	
Soil ingestion proportion	0.063	Ps	
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on maximum values**
Proportion of diet, plants	1	Pp	
Spatial factor	0.52	SF	
Temporal factor	0.3	TF	
Area use factor	0.16	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	7290	5433	0.0002	0.0046	0.0119	4.36	0.000126

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 6
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.011	SF
Temporal factor	0.3	TF
Area use factor	0.0033	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	7290	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.0048	0.872	2.86	1.29	0.289	NA	NA	0.00000323

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-14. Table 7
Soil HQ Calculations (Max Conc.): Area 8 Prelim AOI (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.000059	SF
Temporal factor	0.3	TF
Area use factor	0.000018	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	7290	5433	0.0002	0.0046	0.0566	0.00114	0.0939	10.40	0.0000000342

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 8 Prelim AOI.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 1
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.12	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.14	FIR	**Calculations based on average values**
Proportion of diet, plants	1	Pp	
Spatial factor	0.0000037	SF	
Temporal factor	0.3	TF	
Area use factor	0.0000011	AUF	

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	1493	600	0.0002	0.0046	0.00389	0.961	0.00000000179

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 2
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	0.2	SF
Temporal factor	0.3	TF
Area use factor	0.06	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	1493	600	0.0002	0.0046	0.091	0.00528	0.835	9.29	0.00101

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 3
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	**Calculations based on average values**
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.043	SF	
Temporal factor	0.3	TF	
Area use factor	0.013	AUF	

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF soil inverts	Soil/ Sediment	Soil Inverts	HQ
Barium	1493	600	0.0002	0.091	0.00417	20.4	0.000439

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 4
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.000048	SF
Temporal factor	0.3	TF
Area use factor	0.000014	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	1493	600	0.0566	0.0566	5.15	0.769	0.000000142

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 5
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit		
Parameter	Value	Symbol
Body weight (kg)	2.118	BW
Soil ingestion proportion	0.063	Ps
Food ingestion Rate (kg/kgBW/d)	0.13	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.013	SF
Temporal factor	0.3	TF
Area use factor	0.0039	AUF

Calculations based on average values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	Soil/ Sediment	Plants	HQ
Barium	1493	5433	0.0002	0.0046	0.00245	0.893	0.000000643

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 6
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon

Parameter	Value	Symbol
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.00027	SF
Temporal factor	0.3	TF
Area use factor	0.000081	AUF

Calculations based on average values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Average Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	1493	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.000982	0.179	0.585	0.263	0.0592	NA	NA	0.0000000162

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-15. Table 7
Soil HQ Calculations (Average Conc.): Area 2 Prelim AOI 2 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote		
Parameter	**Value**	**Symbol**
Body weight (kg)	14	BW
Soil ingestion proportion	0.028	Ps
Food ingestion Rate (kg/kgBW/d)	0.028	FIR
Proportion of diet, plants	0.1	Pp
Proportion of diet, mammals	0.9	Pm
Spatial factor	0.0000014	SF
Temporal factor	0.3	TF
Area use factor	0.0000004	AUF

Calculations based on average values

			Absorbed Fraction (AF)			Absorbed Concentration from Medium and Biota			
COPEC	**Average Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	1493	5433	0.0002	0.0046	0.0566	0.000234	0.0192	2.13	0.000000000166

Notes:
Soil concentrations are in mg/kg dry weight.
Average soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 1
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.14	FIR
Proportion of diet, plants	1	Pp
Spatial factor	0.0000037	SF
Temporal factor	0.3	TF
Area use factor	0.0000011	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)		Absorbed Concentration from Medium and Biota		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2740	600	0.0002	0.0046	0.00713	1.76	0.00000000327

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 2
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	0.2	SF
Temporal factor	0.3	TF
Area use factor	0.06	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	2740	600	0.0002	0.0046	0.091	0.00968	1.53	17.1	0.00186

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 3
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	**Calculations based on maximum values**
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.043	SF	
Temporal factor	0.3	TF	
Area use factor	0.013	AUF	

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	2740	600	0.0002	0.091	0.00764	37.4	0.000804

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai} \ ]\right) x \ AUF}{TRV} = HQ$$

Where:

- HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
- $Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
- N = Number of different biota types in diet (food types)
- B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
- P_i = Proportion of biota type (i) in diet
- FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
- AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
- AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
- TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
- P_s = Soil ingestion as a proportion of diet
- AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 4
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.000048	SF
Temporal factor	0.3	TF
Area use factor	0.000014	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	Maximum Soil Concentration (0-4')	TRV	BCF mammals	BCF birds	Mammals	Birds	HQ
Barium	2740	600	0.0566	0.0566	9.44	1.41	0.000000260

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 5
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**				
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.013	SF					
Temporal factor	0.3	TF					
Area use factor	0.0039	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2740	5433	0.0002	0.0046	0.00449	1.64	0.00000118

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 6
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.00027	SF
Temporal factor	0.3	TF
Area use factor	0.000081	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	2740	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.0018	0.328	1.07	0.483	0.109	NA	NA	0.0000000297

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-16. Table 7
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 1 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote			
Parameter	**Value**	**Symbol**	
Body weight (kg)	14	BW	
Soil ingestion proportion	0.028	Ps	
Food ingestion Rate (kg/kgBW/d)	0.028	FIR	**Calculations based on maximum values**
Proportion of diet, plants	0.1	Pp	
Proportion of diet, mammals	0.9	Pm	
Spatial factor	0.0000014	SF	
Temporal factor	0.3	TF	
Area use factor	0.0000004	AUF	

			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	2740	5433	0.0002	0.0046	0.0566	0.00043	0.0353	3.91	0.000000000305

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 1.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 1
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Mourning Dove
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Mourning Dove							
Parameter	**Value**	**Symbol**	**Calculations based on maximum values**				
Body weight (kg)	0.12	BW					
Soil ingestion proportion	0.093	Ps					
Food ingestion Rate (kg/kgBW/d)	0.14	FIR					
Proportion of diet, plants	1	Pp					
Spatial factor	0.0000037	SF					
Temporal factor	0.3	TF					
Area use factor	0.0000011	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2670	600	0.0002	0.0046	0.00695	1.72	0.00000000319

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}\ ]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 2
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Red-winged Blackbird
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.05	BW
Soil ingestion proportion	0.093	Ps
Food ingestion Rate (kg/kgBW/d)	0.19	FIR
Proportion of diet, plants	0.64	Pp
Proportion of diet, soil inverts	0.36	Pi
Spatial factor	0.2	SF
Temporal factor	0.3	TF
Area use factor	0.06	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF soil inverts**	**Soil/ Sediment**	**Plants**	**Soil Inverts**	**HQ**
Barium	2670	600	0.0002	0.0046	0.091	0.00944	1.49	16.6	0.00181

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 3
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Common Yellowthroat
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Common Yellowthroat			
Parameter	**Value**	**Symbol**	
Body weight (kg)	0.01	BW	
Soil ingestion proportion	0.093	Ps	
Food ingestion Rate (kg/kgBW/d)	0.15	FIR	**Calculations based on maximum values**
Proportion of diet, soil inverts	1	Pi	
Spatial factor	0.043	SF	
Temporal factor	0.3	TF	
Area use factor	0.013	AUF	

			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF soil inverts**	**Soil/ Sediment**	**Soil Inverts**	**HQ**
Barium	2670	600	0.0002	0.091	0.00745	36.4	0.000783

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 4
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Red-tailed Hawk
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Red-tailed Hawk		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.1	BW
Soil ingestion proportion	0	Ps
Food ingestion Rate (kg/kgBW/d)	0.07	FIR
Proportion of diet, mammals	0.87	Pm
Proportion of diet, birds	0.13	Pb
Spatial factor	0.000048	SF
Temporal factor	0.3	TF
Area use factor	0.000014	AUF

			Absorbed Fraction (AF)		Absorbed Concentration from		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**BCF mammals**	**BCF birds**	**Mammals**	**Birds**	**HQ**
Barium	2670	600	0.0566	0.0566	9.2	1.38	0.000000254

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 5
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Swamp Rabbit
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Swamp Rabbit							
Parameter	**Value**	**Symbol**					
Body weight (kg)	2.118	BW					
Soil ingestion proportion	0.063	Ps					
Food ingestion Rate (kg/kgBW/d)	0.13	FIR	**Calculations based on maximum values**				
Proportion of diet, plants	1	Pp					
Spatial factor	0.013	SF					
Temporal factor	0.3	TF					
Area use factor	0.0039	AUF					
			Absorbed Fraction (AF)		**Absorbed Concentration from Medium and Biota**		
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**Soil/ Sediment**	**Plants**	**HQ**
Barium	2670	5433	0.0002	0.0046	0.00437	1.6	0.00000115

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \; x \; P_s \; x \; FIR \; x \; AF_{as}] + [\sum_i^N B_i \; x \; P_i \; x \; FIR \; x \; AF_{ai}\;]\right) x \; AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 6
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Raccoon
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Raccoon		
Parameter	**Value**	**Symbol**
Body weight (kg)	5.78	BW
Soil ingestion proportion	0.094	Ps
Food ingestion Rate (kg/kgBW/d)	0.035	FIR
Proportion of diet, plants	0.743	Pp
Proportion of diet, soil inverts	0.123	Pi
Proportion of diet, mammals	0.089	Pm
Proportion of diet, birds	0.02	Pb
Proportion of diet, benthic inverts	0.021	Pbi
Proportion of diet, fish	0.004	Pf
Spatial factor	0.00027	SF
Temporal factor	0.3	TF
Area use factor	0.000081	AUF

Calculations based on maximum values

			Absorbed Fraction (AF)							Absorbed Concentration from Medium and Biota							
COPEC	Maximum Soil Concentration (0-4')	TRV	Soil bio-factor	BCF plants	BCF soil inverts	BCF mammals	BCF birds	BCF benthic inverts	BCF fish	Soil/ Sediment	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	Fish	HQ
Barium	2670	5433	0.0002	0.0046	0.091	0.0566	0.0566	NA	NA	0.00176	0.319	1.05	0.471	0.106	NA	NA	0.0000000290

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a \ x \ P_s \ x \ FIR \ x \ AF_{as}] + [\sum_i^N B_i \ x \ P_i \ x \ FIR \ x \ AF_{ai}]\right) x \ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

APPENDIX J-17. Table 7
Soil HQ Calculations (Maximum Conc.): Area 2 Prelim AOI 2 (0-4'): Coyote
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Fields, Calcasieu and Jefferson Davis Parishes, Louisiana

Coyote			
Parameter	**Value**	**Symbol**	
Body weight (kg)	14	BW	
Soil ingestion proportion	0.028	Ps	
Food ingestion Rate (kg/kgBW/d)	0.028	FIR	**Calculations based on maximum values**
Proportion of diet, plants	0.1	Pp	
Proportion of diet, mammals	0.9	Pm	
Spatial factor	0.0000014	SF	
Temporal factor	0.3	TF	
Area use factor	0.0000004	AUF	

			Absorbed Fraction (AF)			**Absorbed Concentration from Medium and Biota**			
COPEC	**Maximum Soil Concentration (0-4')**	**TRV**	**Soil bio-factor**	**BCF plants**	**BCF mammals**	**Soil/ Sediment**	**Plants**	**Mammals**	**HQ**
Barium	2670	5433	0.0002	0.0046	0.0566	0.000419	0.0344	3.81	0.000000000297

Notes:
Soil concentrations are in mg/kg dry weight.
Maximum soil concentrations in Area 2 Prelim AOI 2.

$$\frac{\left([Soil_a\ x\ P_s\ x\ FIR\ x\ AF_{as}] + [\sum_i^N B_i\ x\ P_i\ x\ FIR\ x\ AF_{ai}\ ]\right)\ x\ AUF}{TRV} = HQ$$

Where:

HQ_a = Hazard Quotient for analyte a (COPEC a) (unitless)
$Soil_a$ = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
N = Number of different biota types in diet (food types)
B_i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P_i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
AF_{ai} = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF_{as} = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV_a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
P_s = Soil ingestion as a proportion of diet
AUF = Area use factor ([spatial factor, SF] x [temporal factor, TF])

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