FORMER ZEPHYR OIL REFINERY

GREAT LAKES LEGACY ACT

WETLAND SEDIMENT CLEANUP AND HABITAT RESTORATION

MUSKEGON, MICHIGAN

Funded by the U.S. Environmental Protection Agency Great Lakes National Program Office and the Michigan Department of Environmental Quality

www.epa.gov/muskegon-lake-aoc

www.greatlakesmud.org

Contractor:

Sevenson Environmental Services, Inc.

Engineer:

EA Engineering, Science, and Technology, (MI) PLC and Its Affiliate
EA Science and Technology

Subcontractors:

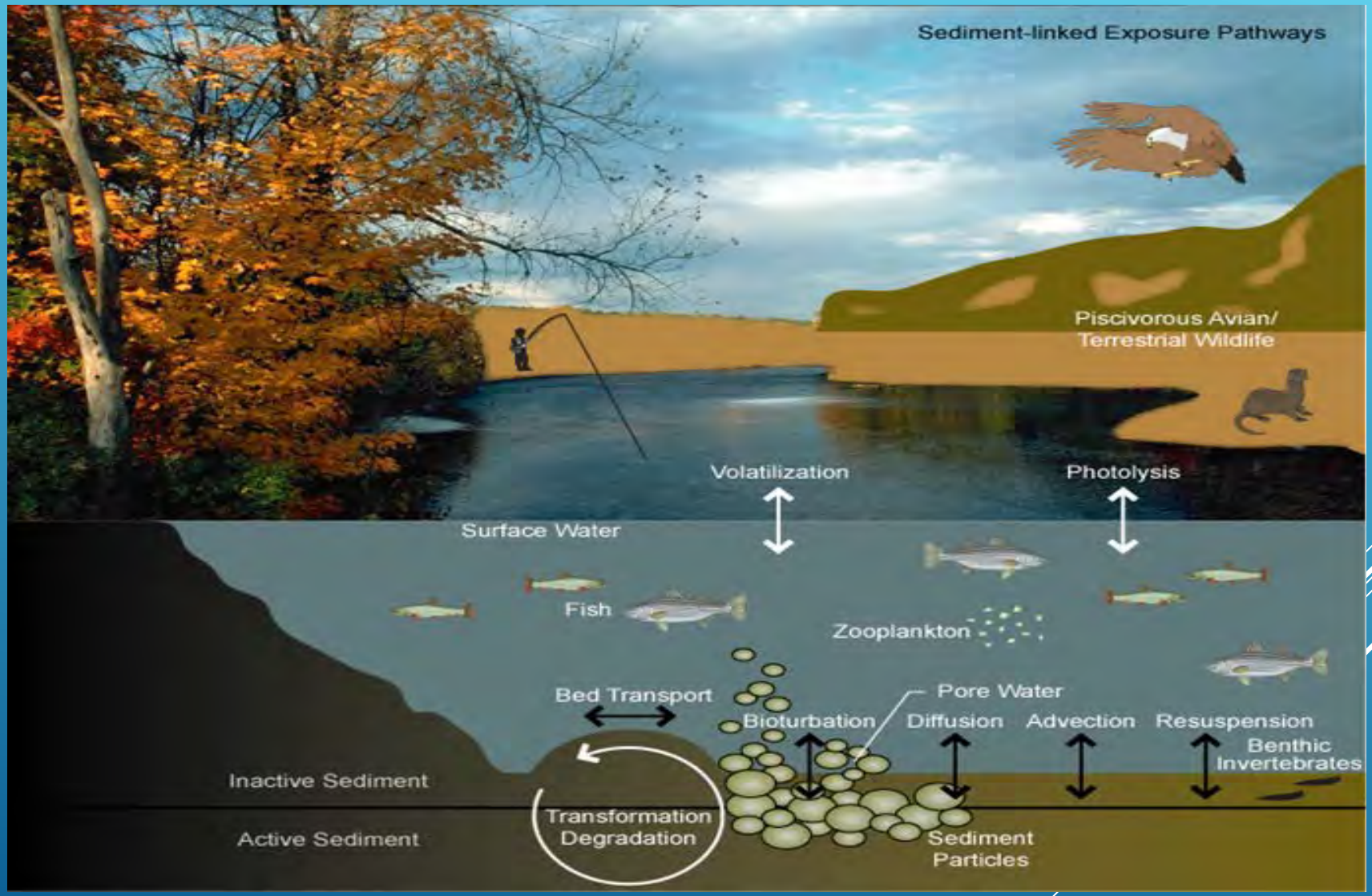
Foth ECT

MAP OF MUSKEGON AOC

AOC Beneficial Use Impairments (BUI)

- Remove the contaminated sediments contributing to the Beneficial Use Impairments (BUI) within the Muskegon Lake AOC
  - Degradation of fish and wildlife populations
  - Degradation of benthos
  - Loss of fish and wildlife habitat
- Minimize the risk to human health and the environment during remediation
- Upon completion, restore habitat to the remediated areas

SITE CONCEPTUAL EXPOSURE MODEL EXAMPLE



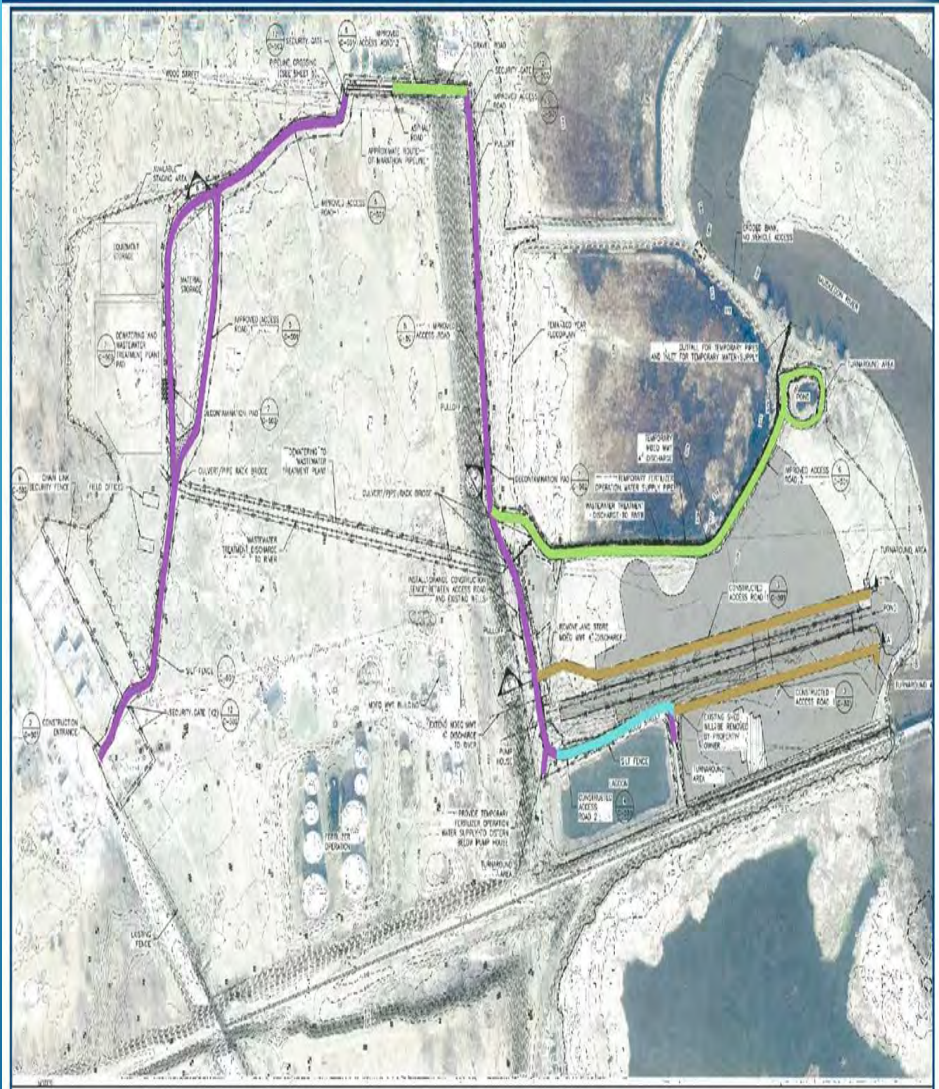

Bear Creek Self-Storage
Upland Former Refinery Area
Bear Creek
120
Former Waste Lagoon
Wetlands in Fire Suppression Ditch Area
Celery Lane Pond
Fire Suppression Ditch
North Branch of the Muskegon River

ZEPHYR OIL REFINERY


852,000 N
851,000 N
850,000 N
APPROXIMATE ROUTE OF MARATHON PIPELINE
FEMA 100 YEAR FLOODPLAIN
COMPOSITE SAMPLES AT AT ENTRANCES AND ACCESS ROADS @ 500' MAX INTERVAL
12,628,000 E
EQUIPMENT STORAGE
MATERIAL STORAGE
DEWATERING AND WASTEWATER TREATMENT PLANT PAD WITH (6) COMPOSITE SAMPLES (75,900 SF)
MUSKEGON RIVER
IMPROVED ACCESS ROAD 1
DECONTAMINATION PAD WITH COMPOSITE SAMPLE
POND
DECONTAMINATION PAD WITH COMPOSITE SAMPLE
IMPROVED ACCESS ROAD 2
FIELD OFFICES
DEWATERING TO WASTEWATER TREATMENT PLANT
CONSTRUCTED ROAD ACCESS 1
FIRE SUPPRESSION DITCH
WETLAND AREA
WASTEWATER TREATMENT DISCHARGE TO RIVER
IMPROVED ACCESS ROAD 1
POND
MDEQ WWT BUILDING
WETLAND AREA
12,396,000 E
CONSTRUCTION ENTRANCE
LAGOON
FERTILIZER OPERATION
CONSTRUCTED ROAD ACCESS 1
CONSTRUCTED ROAD ACCESS 2


660,200 N
660,000 N
648,800 N
IMPROVED ACCESS ROAD 1
DECONTAMINATION PAD WITH COMPOSITE SAMPLE
POND
IMPROVED ACCESS ROAD 2
MUSKEGON RIVER
12,280,000 E
FIRE SUPPRESSION DITCH
WOOD STREET
CONSTRUCTED ROAD ACCESS 1
POND
CONSTRUCTED ROAD ACCESS 1
12,285,000 E
LAGOON
CONSTRUCTED ROAD ACCESS 2
ESTIMATED LIMITS OF LEAD SEDIMENT AREA

Site Layout – Access Roads



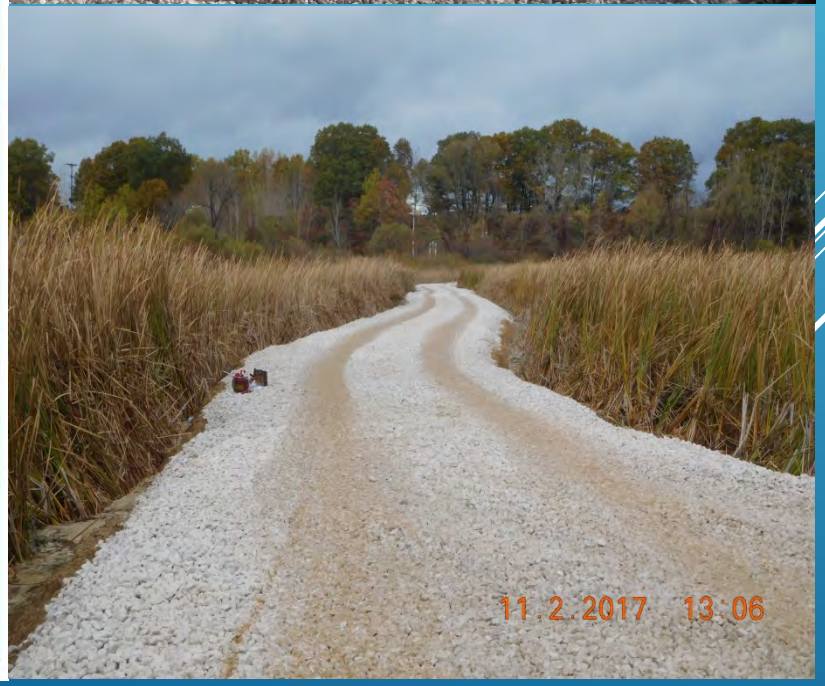
Improved Access Road 1

Improved Access Road 2

Constructed Access Road 1

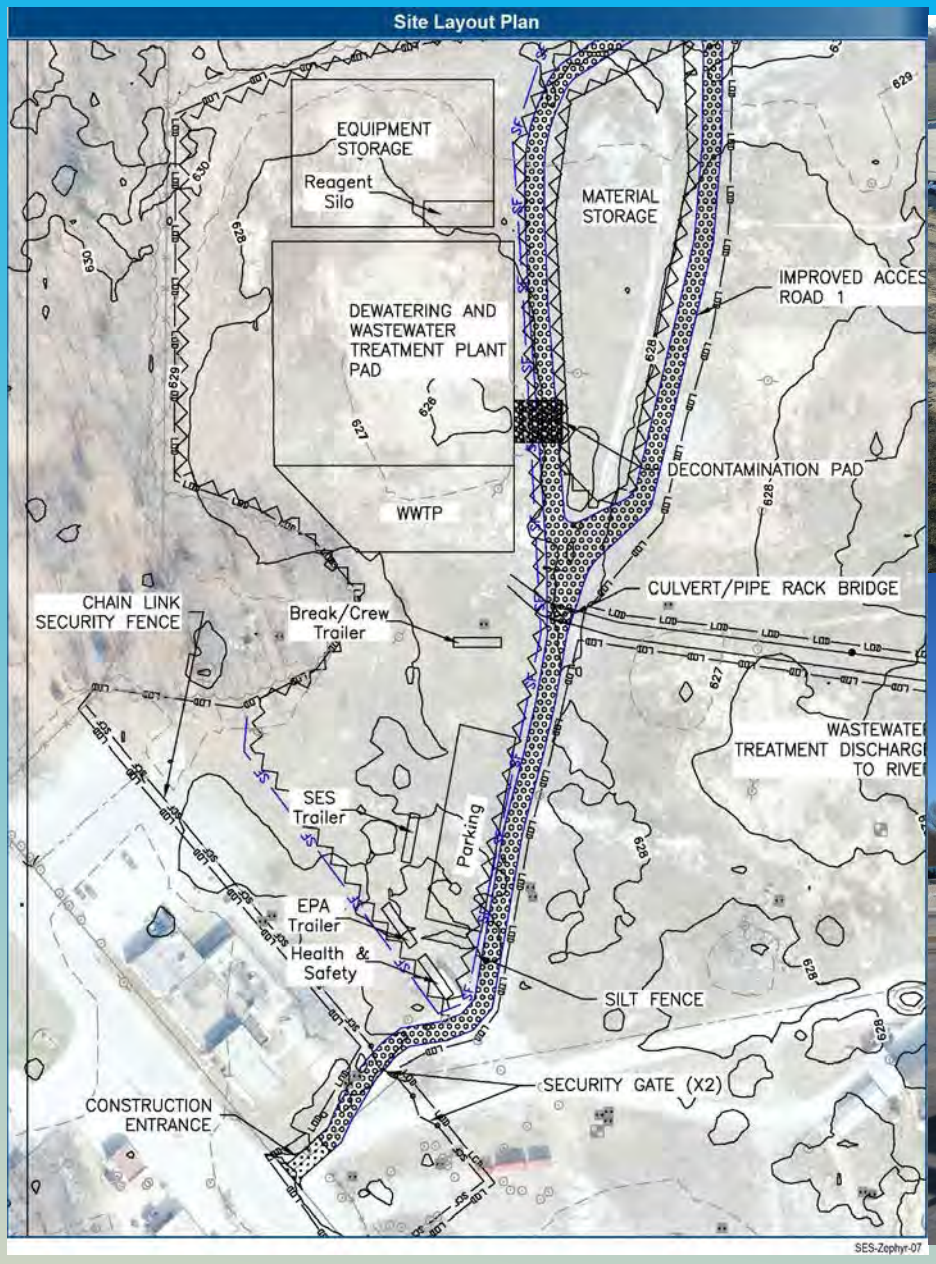
Constructed Access Road 2

SES-Zephyr-05



Soil Erosion/Sediment Control

DEDICATED HAUL TRUCKS

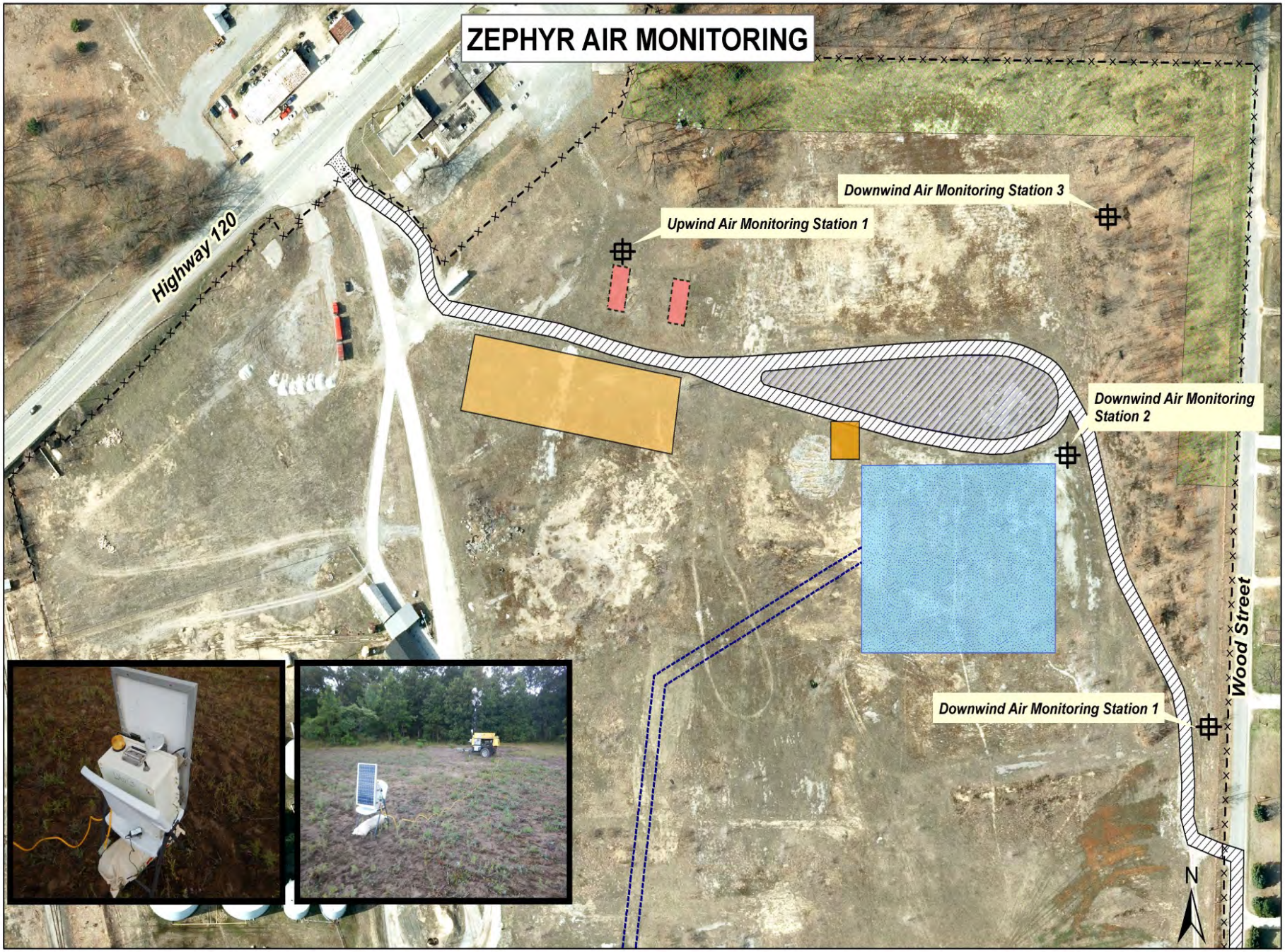

Site Layout Plan
EQUIPMENT STORAGE
Reagent Silo
MATERIAL STORAGE
IMPROVED ACCES
ROAD 1
DEWATERING AND WASTEWATER TREATMENT PLANT PAD
DECONTAMINATION PAD
WWTP
CULVERT/PIPE RACK BRIDGE
CHAIN LINK SECURITY FENCE
Break/Crew Trailer
WASTEWATE
TREATMENT DISCHARG
TO RIVE
SES Trailer
Parking
EPA Trailer
Health & Safety
SILT FENCE
SECURITY GATE (X2)
CONSTRUCTION ENTRANCE
SES-Zephyr-07


03/03/2018

Cofferdam Install

- Steel Sheet Pile
- Earthen Berm Segment

ZEPHYR AIR MONITORING



STEEL SHEETING SYSTEM

Dewatering the Excavation Area

WATER TREATMENT PLANT

Ambient Air Monitoring

Sediment Remediation Grid

Solidification/Stabilization

SEDIMENT SAMPLING

SEDIMENT EXCAVATION

Fire Suppression Ditch

DEWATERING PAD

SEDIMENT TRANSPORT TO LANDFILLS

Animals Using The Site

Animals Using The Site

Restoration Backfill

Wetland Construction

Wetland Construction

Wetland Restoration

Project Achievements

- **48,870** cubic yards of sediments were excavated.
- **91.9** million gallons of water treated.
- **1,370** cubic yards rendered non-haz
- **60,975** hours safe work hours
- Project benefits
  - Removal of sediments contributing to beneficial use impairments (BUIs) including Degradation of fish and wildlife populations, Degradation of benthos, Loss of fish and wildlife habitat.
  - Restore habitat in remediated areas.

Leaking 1932 Oil Well

Before Remediation

Project Complete!