GEI Consultants

INFRASTRUCTURE ALTERNATIVES, INC.
CLEAN WATER SOLUTIONS

US Army Corps of Engineers ®
Chicago District

DIKE EXPANSION PILOT TEST AT INDIANA HARBOR & CANAL CDF

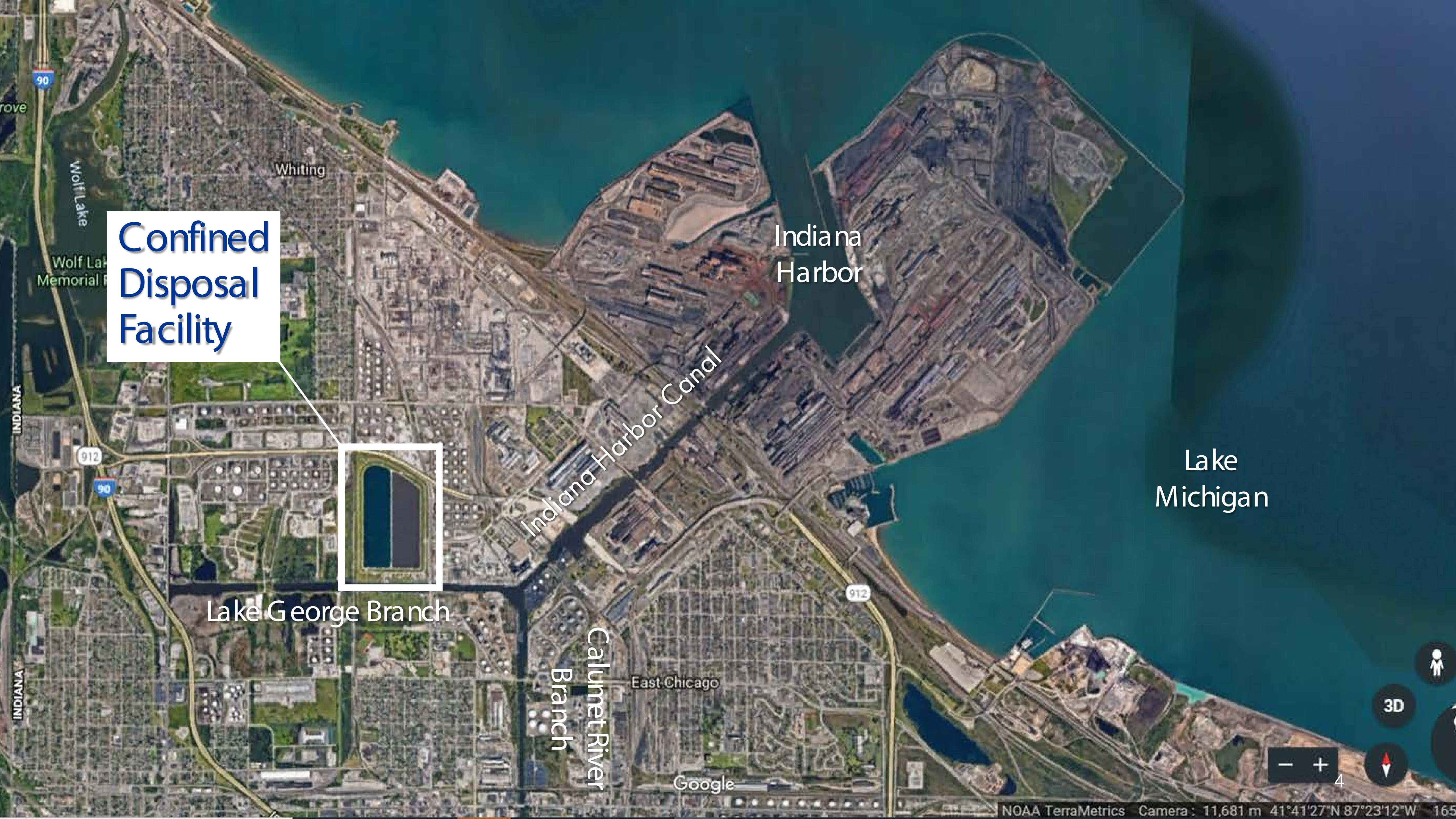
East Chicago, IN, USA

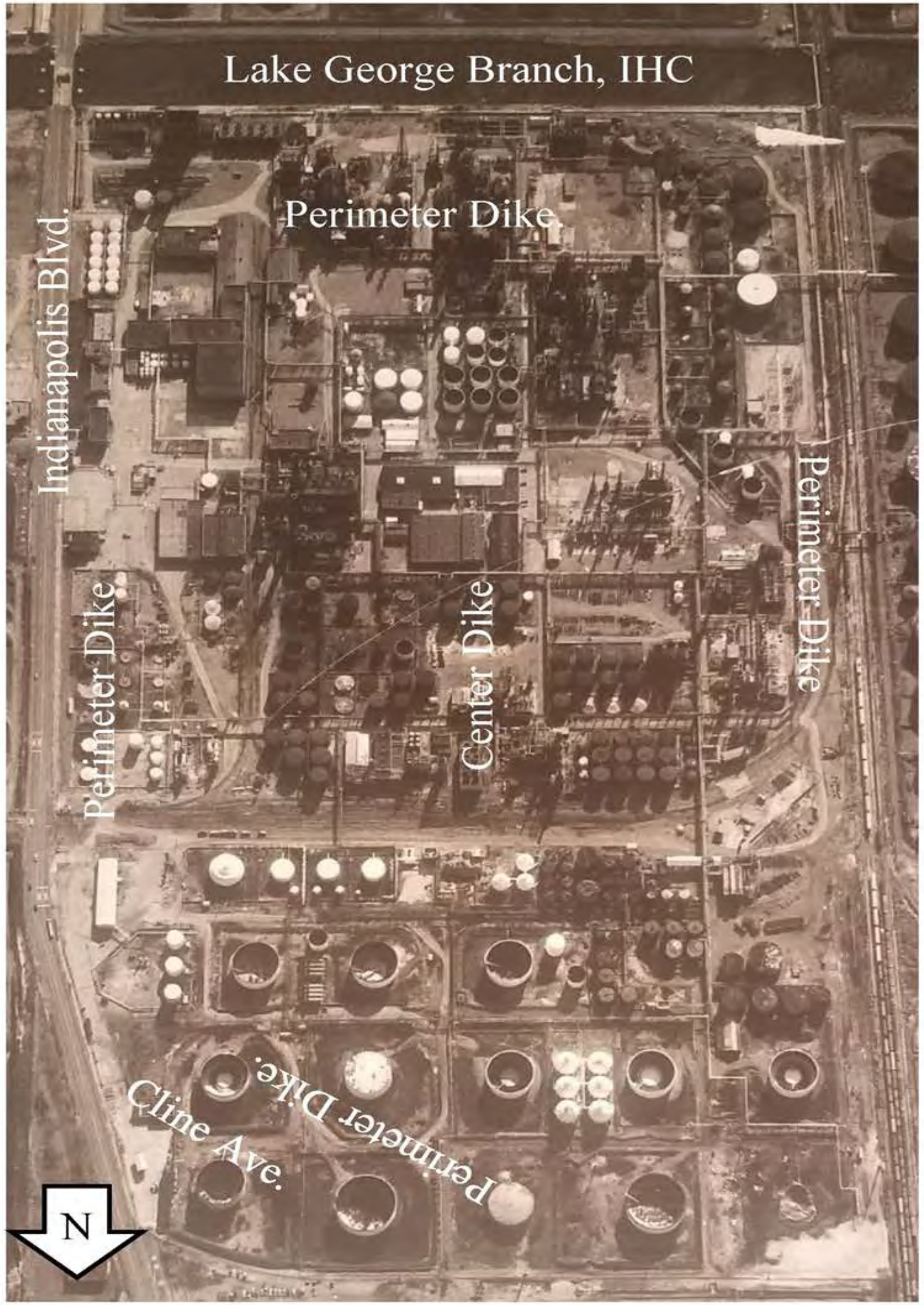
PROJECT SITE

- Indiana Harbor & Canal CDF located in East Chicago, IN, USA
- Operated by USACE – Chicago District
- Disposal and containment of contaminated sediments from the IHC
- Additional storage for a water cover over the impounded sediment for air emissions suppression
- Perimeter containment dike (compacted clay) and smaller center dike divides the CDF into two cells
- CDF constructed over old refinery site

BACKGROUND

- Indiana Harbor & Canal is an authorized federal navigation project
- Heavily industrialized area
- Bottom sediments from the IHC are contaminated and not suitable for open-lake disposal
- Current IHC CDF dike configuration provides 2.7 M CY storage (40 YR sediment backlog + 2 FT water cover)
- USACE has explored options for expansion and added capacity in the CDF


Confined Disposal Facility
Indiana Harbor
Lake Michigan
Indiana Harbor Canal
Lake George Branch
Calumet River Branch
Whiting
Wolf Lake
East Chicago
INDIANA
90
912
3D
Google
NOAA TerraMetrics Camera : 11,681 m 41°41'27"N 87°23'12"W



Lake George Branch, IHC
Perimeter Dike
Indianapolis Blvd.
Perimeter Dike
Center Dike
Perimeter Dike
Perimeter Dike
Cline Ave.
N

Lake George Branch, IHC
Indianapolis Blvd.
N


07/13/2011

SITE CHARACTERISTICS & OPERATIONS

- CDF site (location of old refinery) regulated under RCRA
- Soil and contaminated groundwater on site from historical refining operations
- Contaminated groundwater mitigation installed, part of initial CDF construction
- Water cover is maintained over the sediments to suppress VOCs emissions
- Excess water in the CDF is treated & discharged under NPDES permit
- When CDF finally filled, engineered cap system will be constructed over the dewatered sediments in accordance with RCRA requirements

WATER MANAGEMENT ON SITE

- CDF has perimeter contaminated groundwater cutoff wall and extraction system
- Water drainage into the subsurface is captured by the cutoff walls and extraction system
- Contaminated groundwater collected by the extraction system is pumped back to the CDF to maintain water cover
- Excess water is treated in on-site wastewater treatment plant; effluent discharged under facility NPDES permit
- Eventually, with the addition of cleaner sediments from maintenance dredging, the need for ponded operation will be re-evaluated

FUTURE EXPANSION OF THE CDF

- USACE plans to increase CDF capacity, by expanding perimeter dike and increasing crest elevation by up to 11 FT
- Center dike would also require modification
- Sediment filled geotextile tubes one option explored for expansion of the center dike
- Allow beneficial reuse of the dredged sediment
- Conserves CDF capacity
- Readily constructible in a fully- or partially-submerged setting
- Could be configured to maintain access to the dike crest

CHALLENGES TO EXPANSION

- Ponded operation, inability to dewater cells
- Conventional construction in the dry is cost-prohibitive
- Alternative methods of construction are needed
- Critical to maximize existing CDF capacity and limit imported materials for construction (due to cost)
- Beneficial reuse of impounded sediment is ideal
- Construction in partially submerged conditions and sediments are unstable without confinement
- Geotextile tubes filled with IHC sediment for expanding the center dike of primary interest

OVERVIEW OF THE PILOT TEST

- Fall 2018, pilot test was performed
- Studied the potential for enlarging and increasing the height of the center dike with geotextile tubes
- Developed recommendations for full-scale geotextile tube installation in the IHC CDF
- Could geotextile tubes be stacked along the center dike, under partial submersion, and achieve the desired elevation, while remaining stable?

PILOT TEST OBJECTIVES

- USACE contracted Strata Earth Services (Palatine, IL, USA) under several Task Orders, 2015 – 2018
- Subcontractors: GEI Consultants (Lansing, MI, USA) and IAI (Rockford, MI, USA)
- Study the IHC CDF sediment
- Develop a mix design to dewater and stabilize the sediment
- Perform subsurface exploration and analyze stability of the center dike
- Develop a pilot test program to evaluate the use of sediment-filled geotextile tubes to raise the center dike

BENCH SCALE TESTING

- Hanging bag tests, with subsequent strength testing on dewatered material
- Raw samples of dredged material provided from active dredge stream into the CDF
- Sediment samples were dewatered to a minimum of 88% of in-situ solids in the hanging bags (38.5 – 48.0 % solids)
- Strength testing yielded peak internal friction angle as measured by direct shear ranging from 25.5 to 27.9 degrees


Sample 4
1-hr composite

CENTER DIKE BORINGS & TESTING

- (2) center dike borings
- Sediment sampling and testing in the west cell of the CDF at (3) locations
- One center dike boring and all sediment sampling locations were located adjacent to the 100 FT long pilot test section
- Sediment borings offset into the west cell ~ 80 FT from the dike crest, spaced ~ 25 FT apart
- At each location, (3) boreholes: sampling, vane shear testing, instrumentation install
- Inclinometer installed in center dike, designed to monitor potential slope movements during the pilot test
- Inclinometer could also be used as a long-term monitoring device for full-scale implementation


SD-01B
SD-01C
SD-01A
SD-2A
SD-02C
SD-2B
SD-03C
SD-03A
SD-03B
CD-01
0 25 50
Feet
CD-01
CD-02
Legend
Soil Boring
Sediment Boring
Approximate Pilot Test Location
0 250 500
Feet
SOURCE:
Aerial Photography: USDA NAIP 9/19/2016

PILOT TEST PERFORMANCE

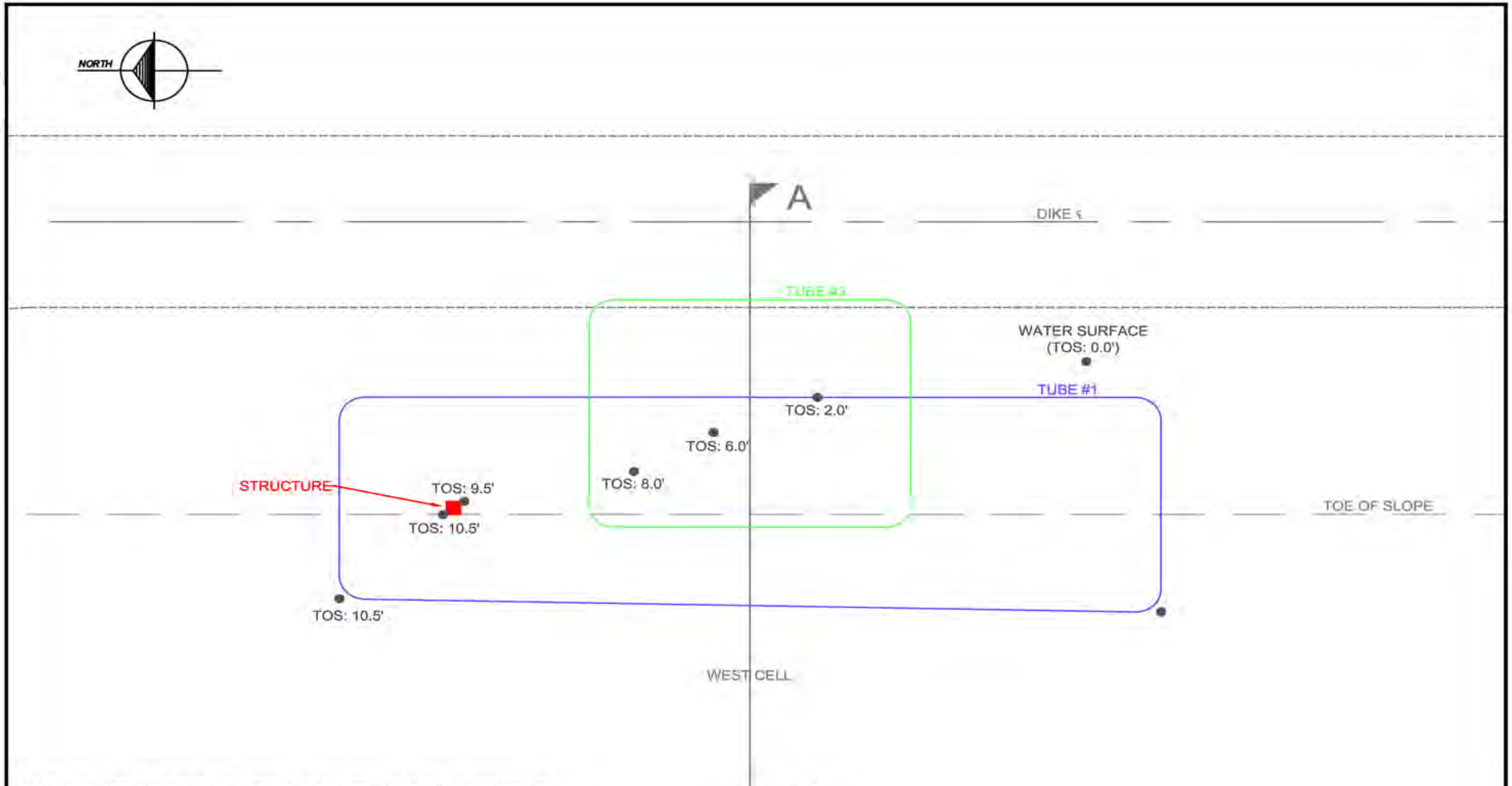
- 6" GeoForm Dino6 hydraulic auger dredge
- 30 GPH Velodyne polymer feed system
- 10 GPH Neptune polymer feed system
- Ten Cate Geotube® containers
- SNF Flopam A-6350 and C-6237 polymer products
- Support equipment, including skid steer, cables, pumps, pipeline, barges and work boats

SEQUENCE OF OPERATIONS

1. Initial center dike inclinometer reading obtained
2. Sediment in the footprint of the test section dredged to the CDF bottom; discharged to other CDF cell
3. Geotextile tube fill and polymer piping installed
4. First geotextile tube deployed and anchored to center dike
5. First geotextile tube filled with dredged material from the CDF cell
6. Second geotextile tube deployed and filled, over top of first (bottom) tube
7. Upon completion of second tube, another inclinometer reading was obtained


IAI
iaiwater.com


3617
3616



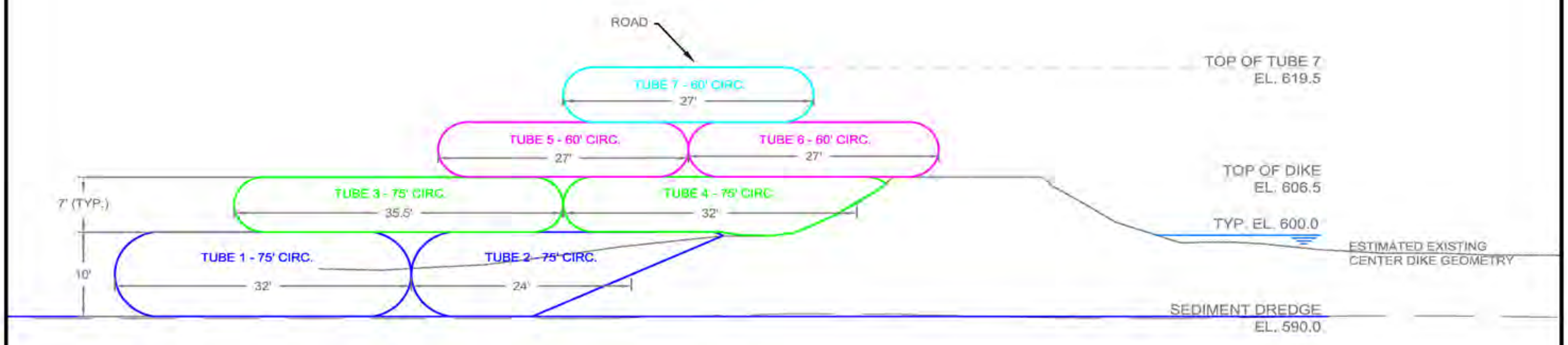
NOTE: TOS, TOP OF SEDIMENT MEASUREMENT
IS DEPTH BELOW WATER SURFACE.
MEASUREMENTS ARE APPROXIMATE.

DESIGNED BY PST	DATE 11.2018	
DRAWN BY JRT	DATE 11.2018	
CHECKED BY PST	DATE 11.2018	
FILE IHC	EDIT	
SCALE	1:1	
DRAWING	1" = 20'	
PLOT		
PROJECT		
FIGURE NO.	1	

PROPOSED CENTER DIKE RAISE

PILOT TEST PLAN VIEW – AS BUILT

INFRASTRUCTURE ALTERNATIVES, INC.
CLEAN WATER SOLUTIONS
7888 Childsdale Ave. NE | Rockford, MI 49341 | Phone 616.866.1600 | iaiwater.com



DESIGNED BY IAI	DATE 11/2018	
DRAWN BY JRT	DATE 11/2018	
CHECKED BY PS	DATE 11/2018	
FILE	EDIT	
SCALE 1:1		
DRAWING NTS	PLOT	
PROJECT INDIANAHARB		
FIGURE NO. 1		

PROPOSED CENTER DIKE RAISE

INDIANA HARBOR AND CANAL CDF
EAST CHICAGO, INDIANA

PROPOSED TUBE CONFIGURATION – OPTION 1

INFRASTRUCTURE ALTERNATIVES, INC.
CLEAN WATER SOLUTIONS
7888 Childsdale Ave. NE | Rockford, MI 49341 | Phone 616.866.1600 | iaiwater.com

CONCLUSIONS & RECOMMENDATIONS FOR FULL-SCALE IMPLEMENTATION

- Develop geotextile tube layout and stacking plans (geometry) that will best fit the profile of the center dike and the desired final height
- Allow incorporation of conventional fill above the water line, if needed to achieve height
- Remove impounded sediment from the footprint of the installation, to the bottom, for stability
- Remove sediment from footprint in an on-going operation as tubes are filled

CONCLUSIONS & RECOMMENDATIONS FOR FULL-SCALE IMPLEMENTATION

- Fill material unit weight is key factor for tube stability
- Utilize QA testing for grain size & unit weight during filling
- Dredge at a high flow rate to spread coarse materials evenly through tube length
- Remove debris from the geotextile tube footprint to protect fabric
- Establish limits on differential head pressure (water level) in the two ponds, for max. slope stability of center dike

ACKNOWLEDGEMENTS

Paper co-authors:

- Aaron Wright, IAI
- Carlin Grundemann, P.E., GEI Consultants
- Jan Merl, P.E., USACE Chicago District
- Justin Griffeth, E.I.T., USACE Chicago District

Special thanks to:

- Jamie Matus, GEI Consultants
- Paul Stage, IAI
- Sara Knight, Strata Earth Services
- USACE for use of historical and pilot test photos