

VANCOUVER WATERFRONT PARK

THE GRANT STREET PIER

GRI

PBS

WSP



PRESENTERS

+ Hod Wells, PE, LEED AP, ENV SP
Structural Engineering

+ Matt Shanahan, PE, GE
Geotechnical Engineering

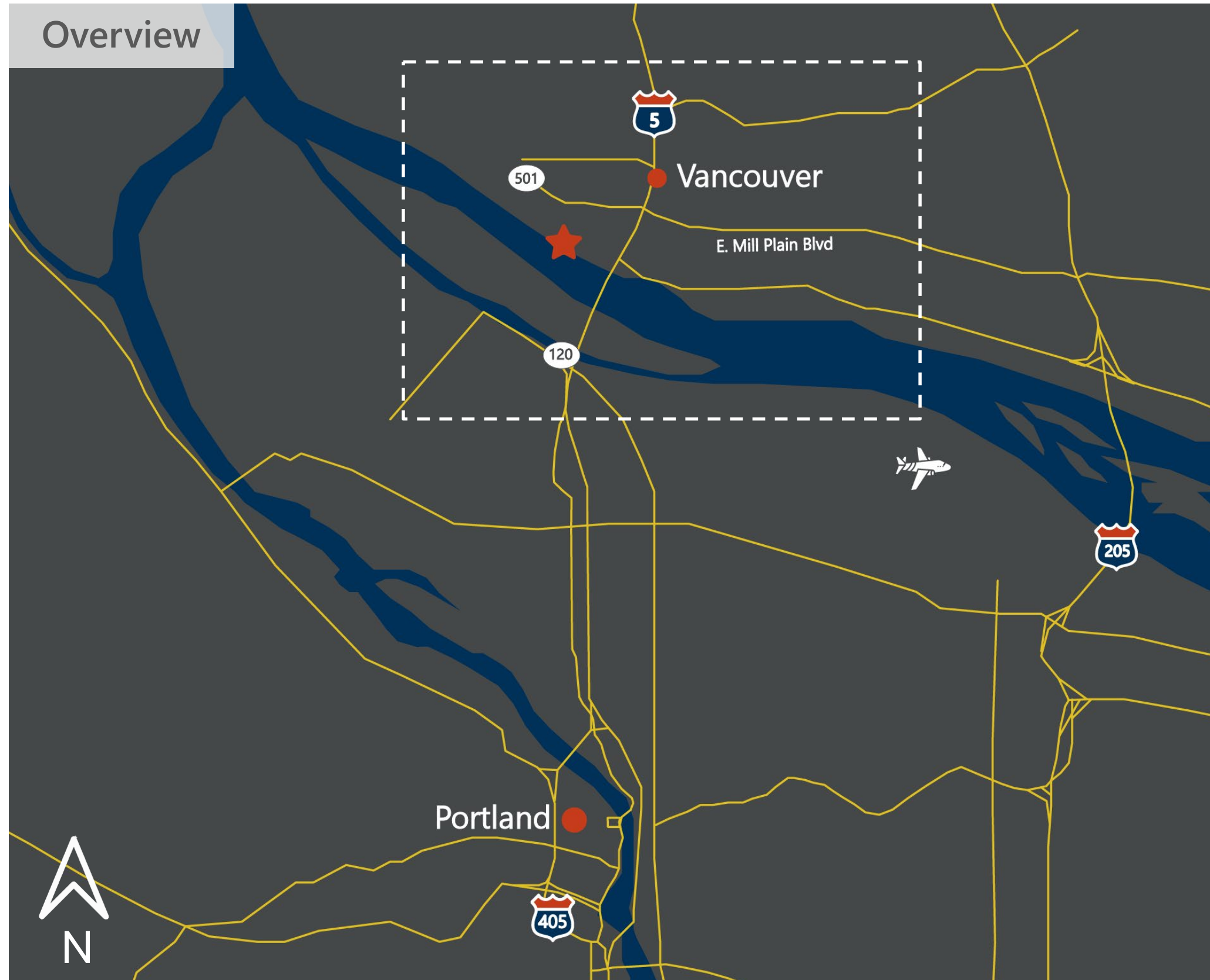
+ Dr. Stephen Schneider, PhD, SE
Structural Engineering





SITE LOCATION

Overview



Inset

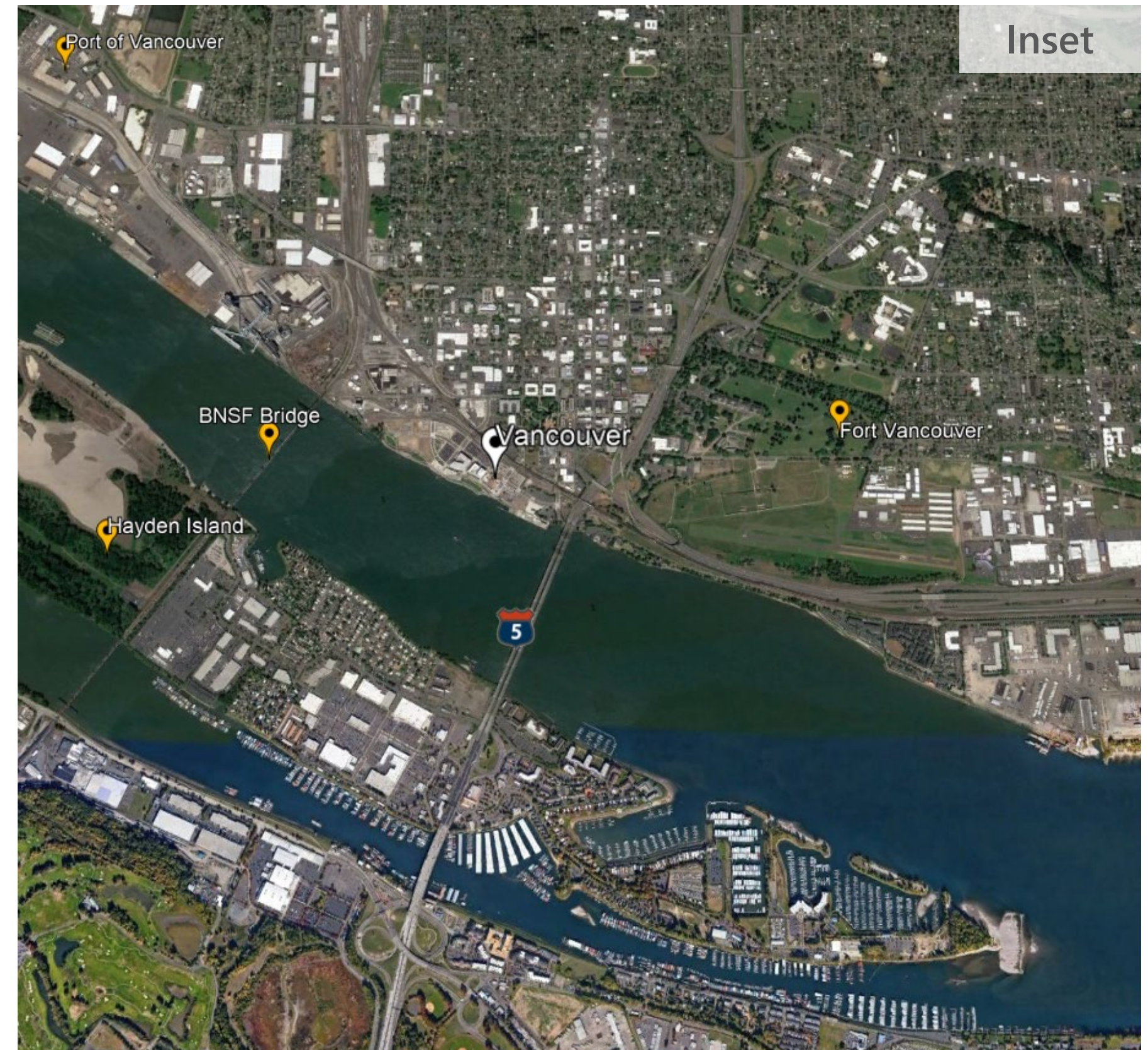
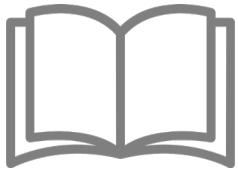




Photo credit: *Vanishing Vancouver*, 2013,
Arcadia Publishing.



HISTORY OF THE WATERFRONT



Shipyards



Sawmills



Paper Mills



Wharves



Ferries



WORKING WATERFRONT



ont, ca. 1930

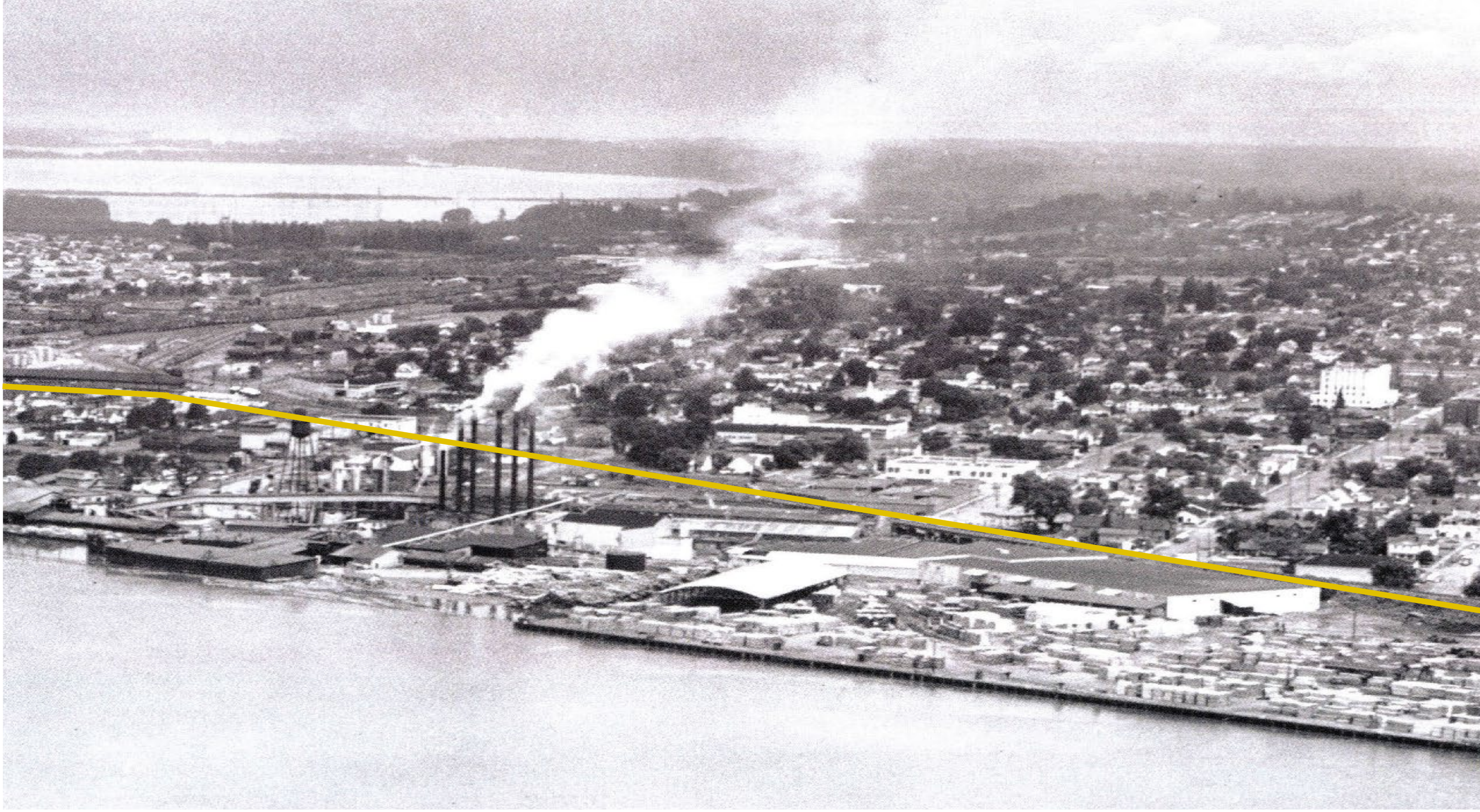


Al Kadow on the docks during Vancouver flood, 1948



Port growth continued throughout the 1950s

WORKING WATERFRONT





HISTORIC CHRONOLOGY

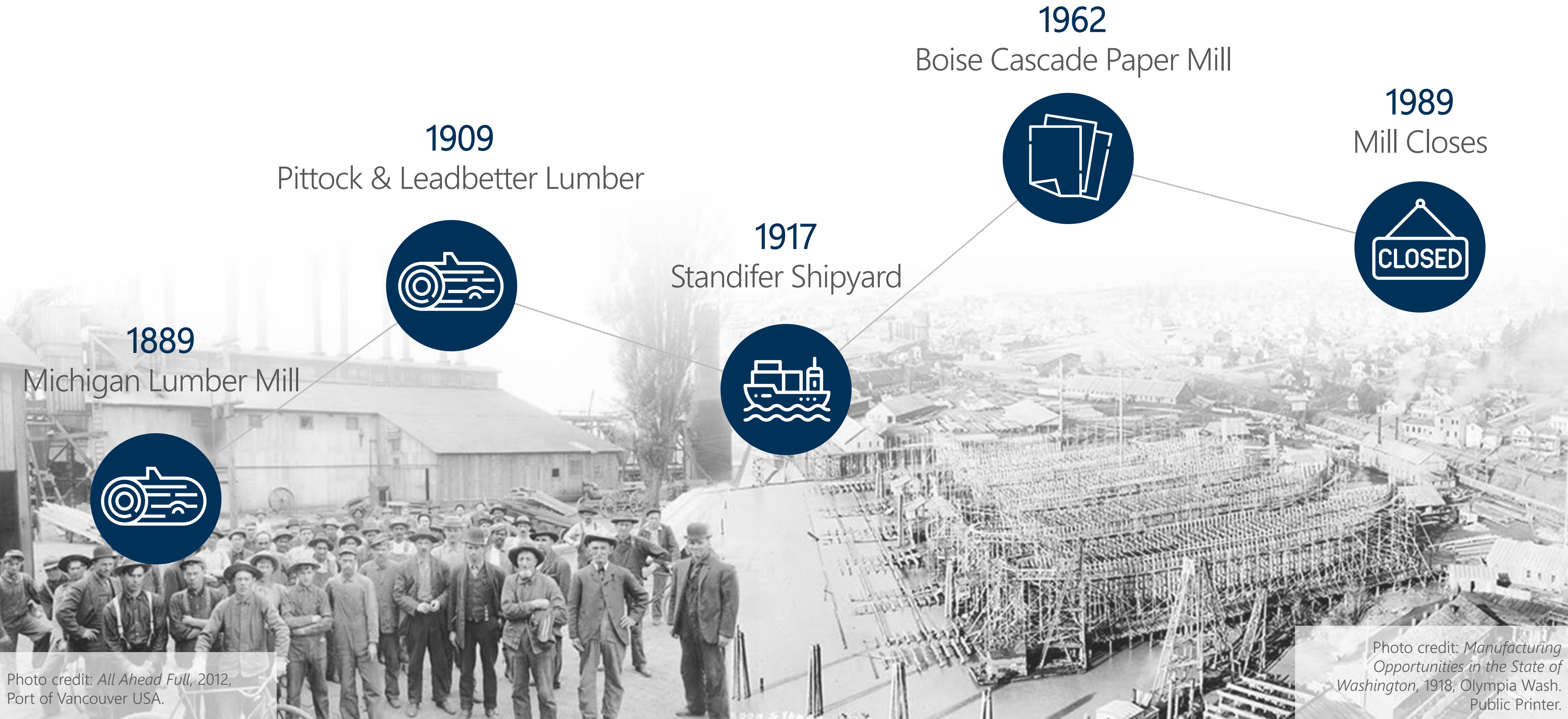


Photo credit: *All Ahead Full*, 2012, Port of Vancouver USA.

Photo credit: *Manufacturing Opportunities in the State of Washington*, 1918, Olympia Wash. Public Printer.



WATERFRONT MASTER PLAN

- + 35 acres of brownfield development
- + 3,000+ new residential units
- + 1 million square feet of mixed-use development
- + 7-acre waterfront park and trail



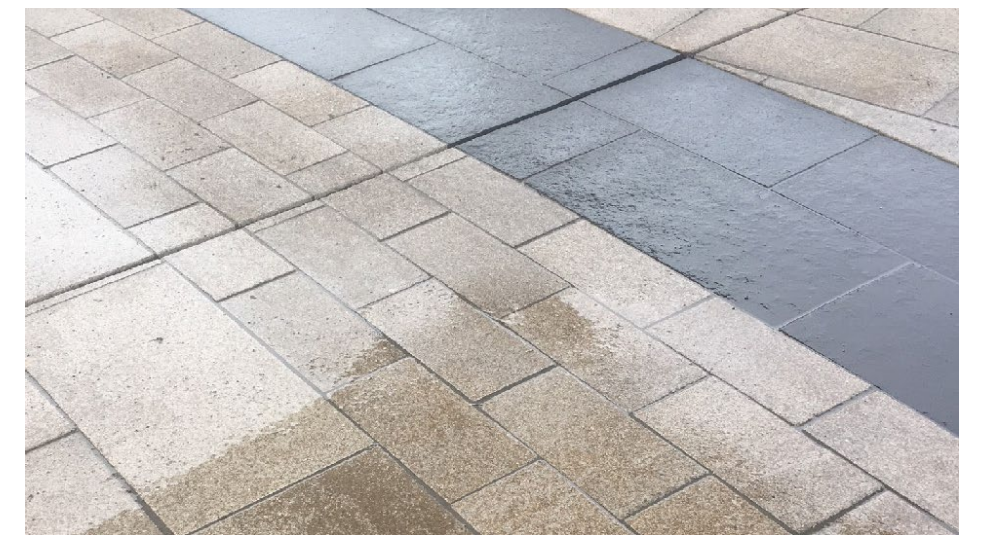
FORMER BOISE CASCADEMILL

GRANT ST

ESTHER ST

COLUMBIA RIVER







RE-ESTABLISH A PUBLIC CONNECTION TO THE RIVER



GRANT STREET PIER

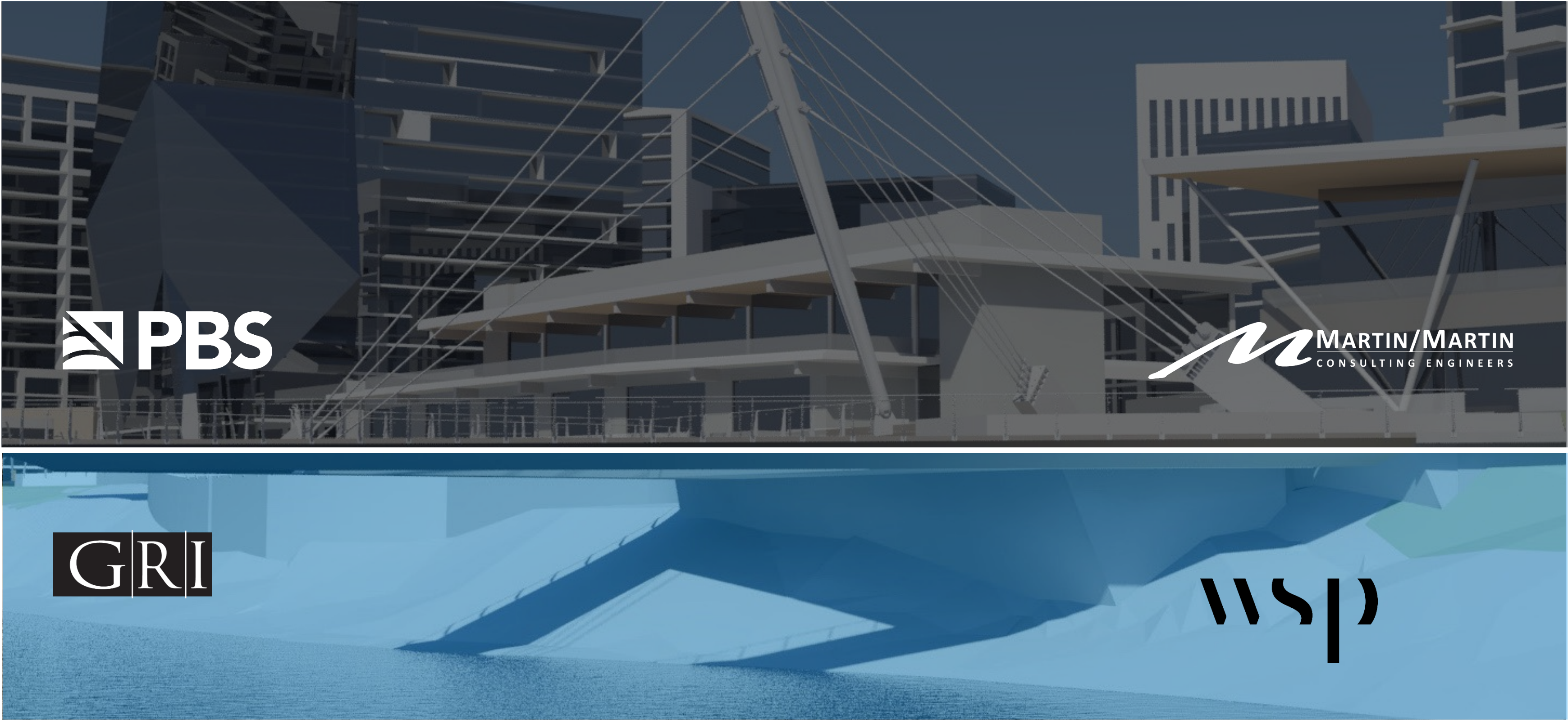


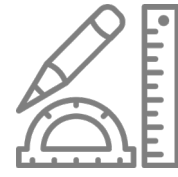
GRANT STREET PIER AND PLAZA



GRANT STREET PIER

CIVIL/STRUCTURAL ENGINEERING TEAM





UNIQUE STRUCTURE GEOMETRY





PUENTE DE LA UNIDAD, MEXICO

Photo credit: José Rodolfo Espinosa
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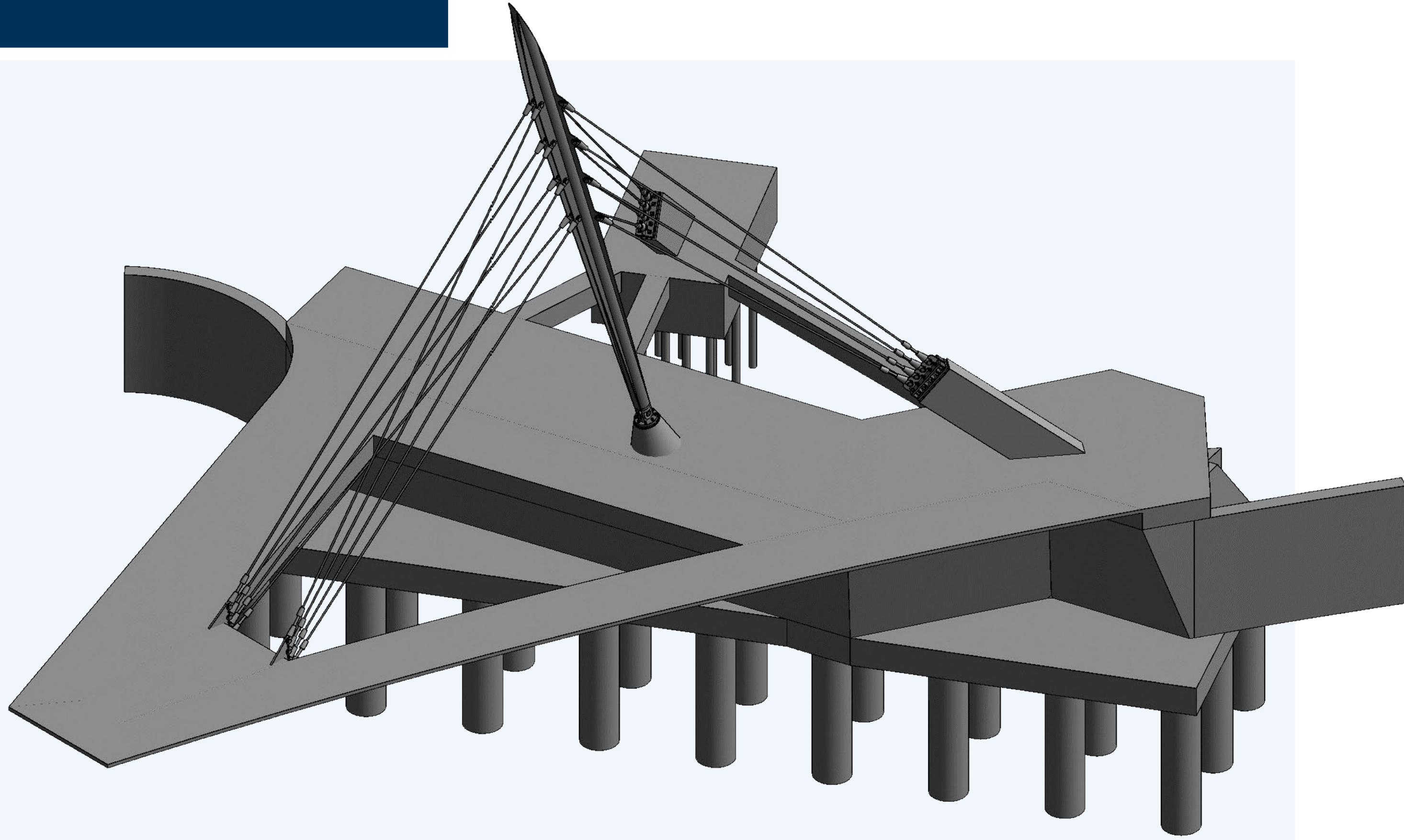


GATESHEAD MILLENNIUM BRIDGE, UNITED KINGDOM

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GRANT STREET PIER CONSTRUCTION





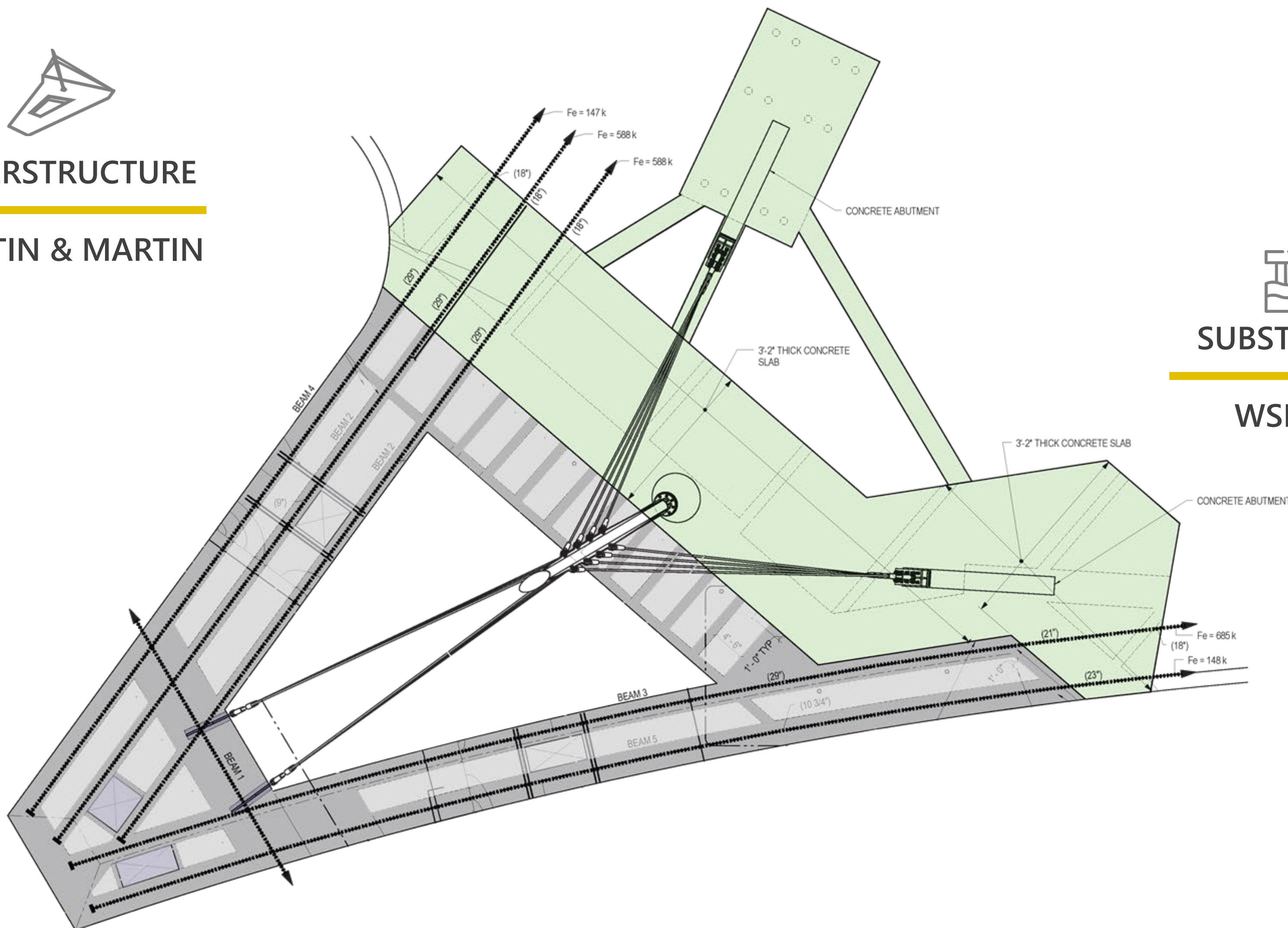
SUPERSTRUCTURE

MARTIN & MARTIN

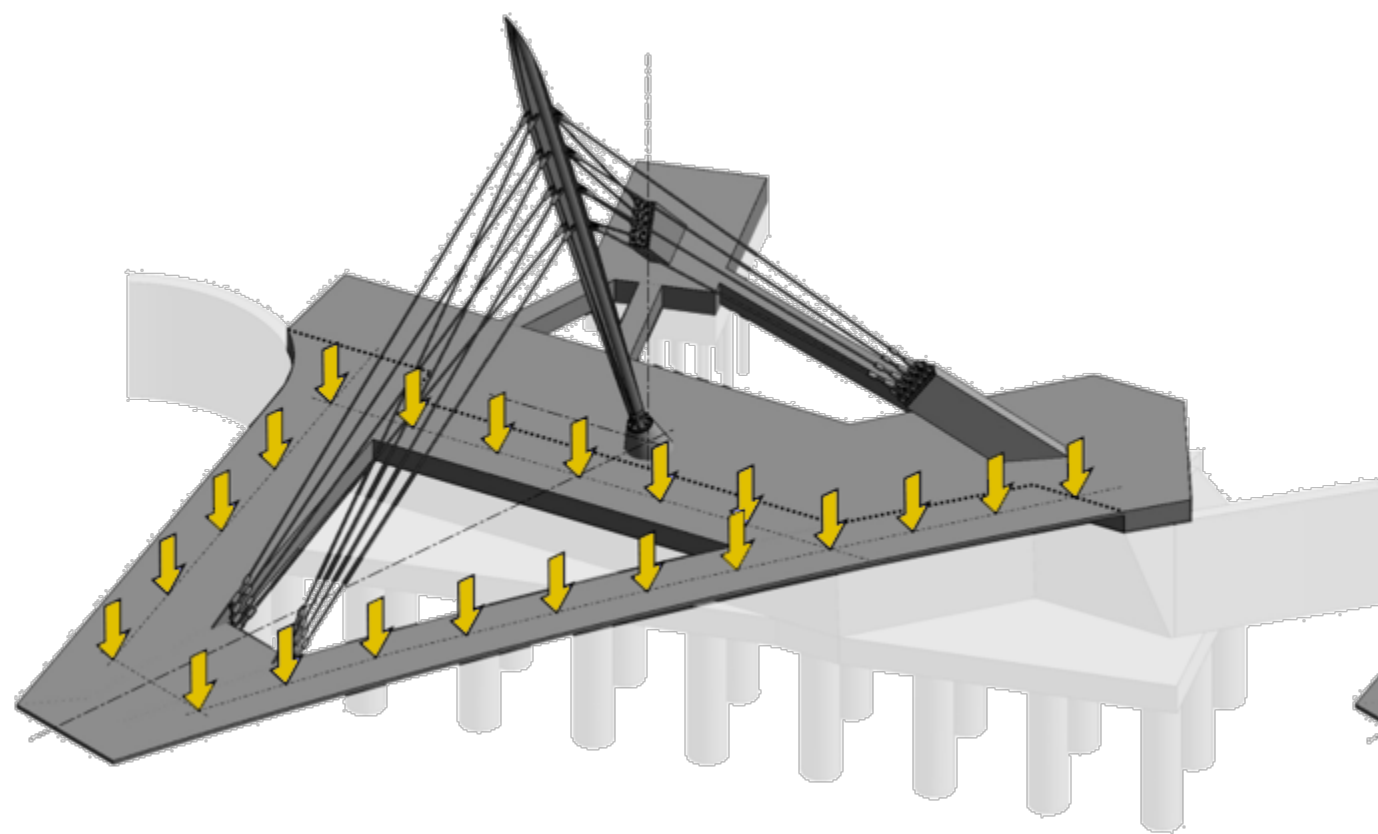


SUBSTRUCTURE

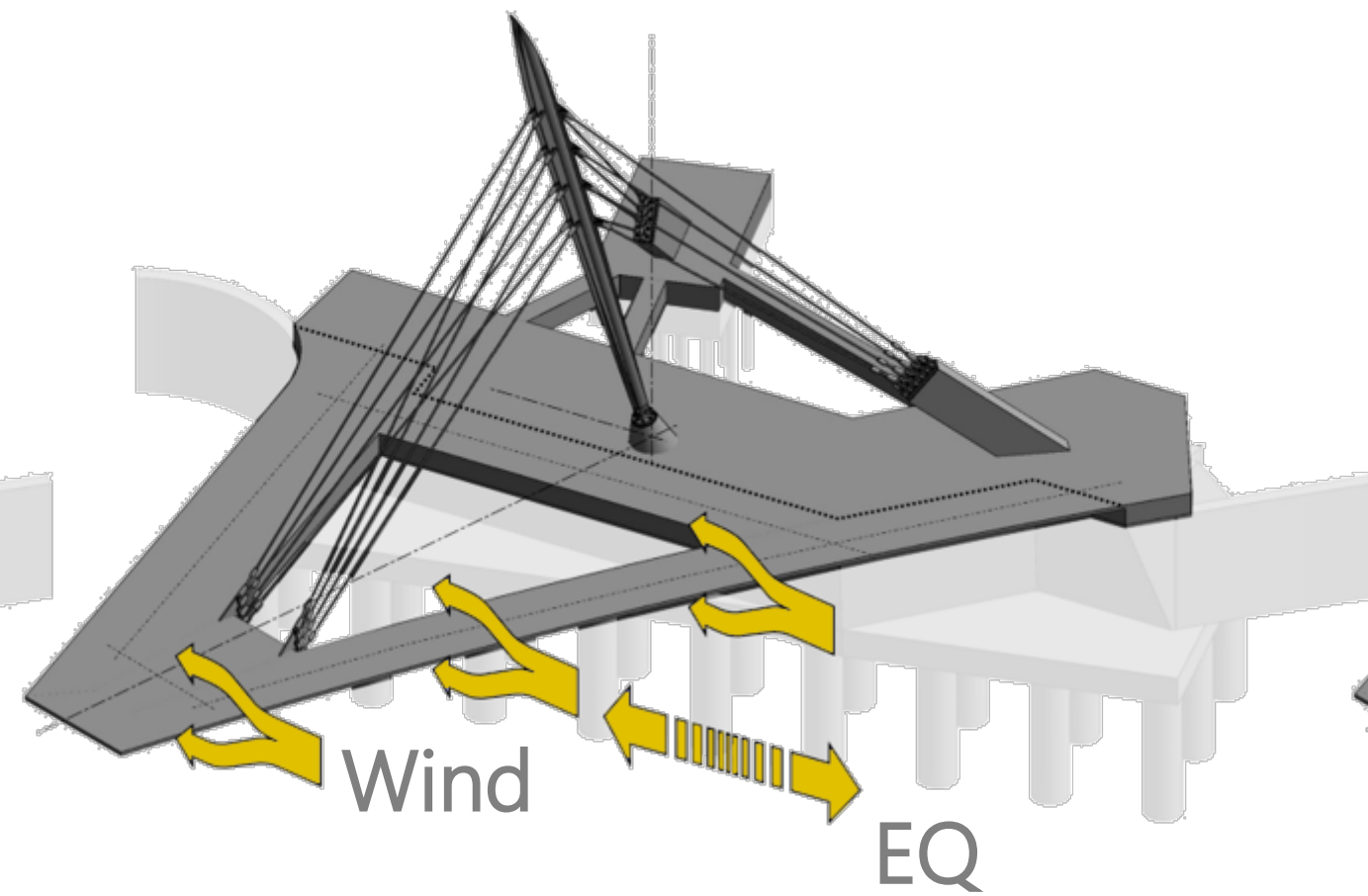
WSP & GRI



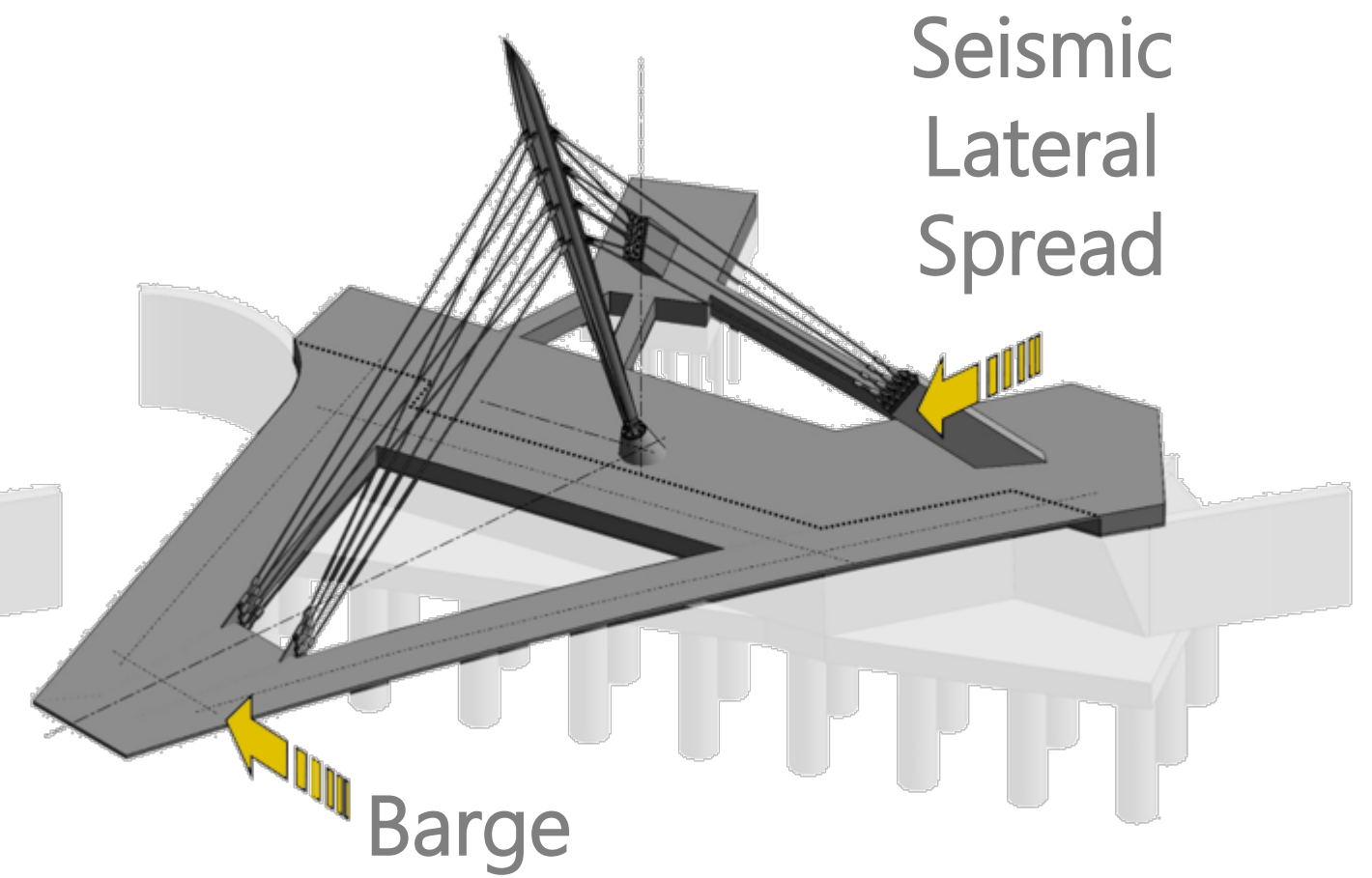
LOADS ON PIER



GRAVITY



LATERAL

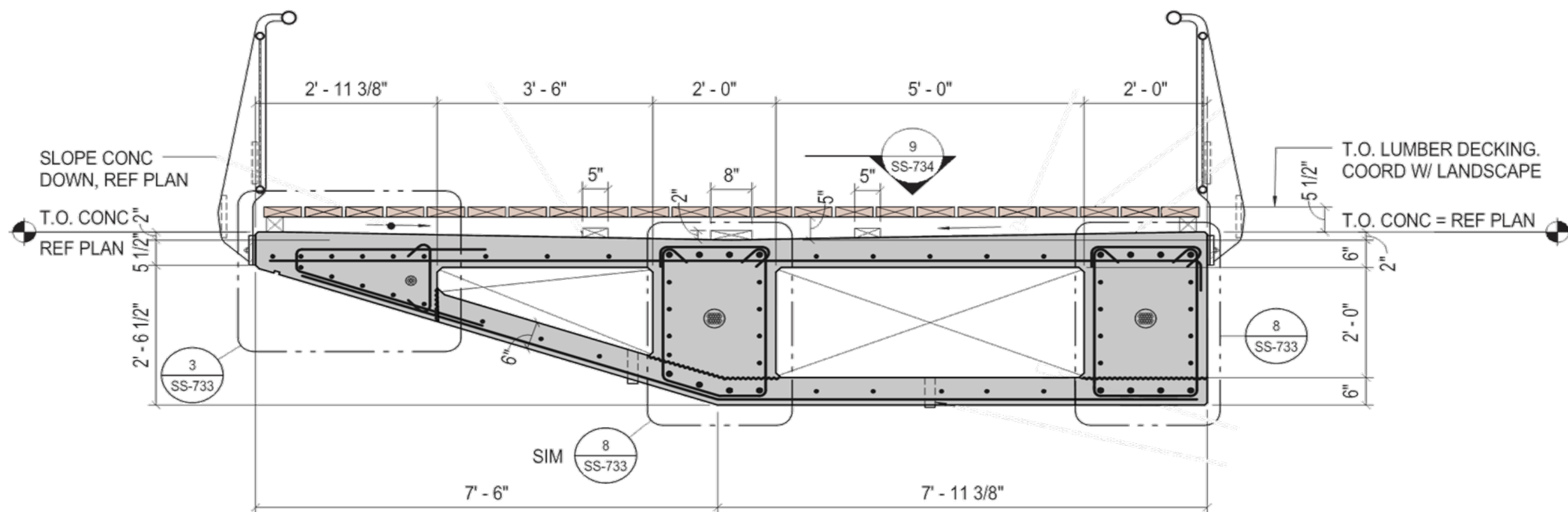


EXTREME

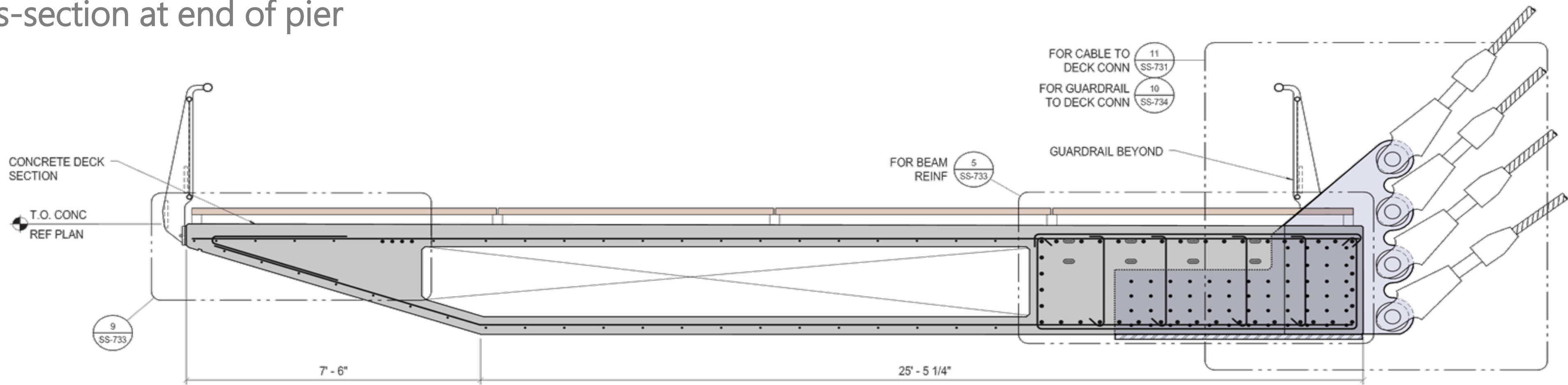


SUPERSTRUCTURE DESIGN

Typical cross-section deck along pier

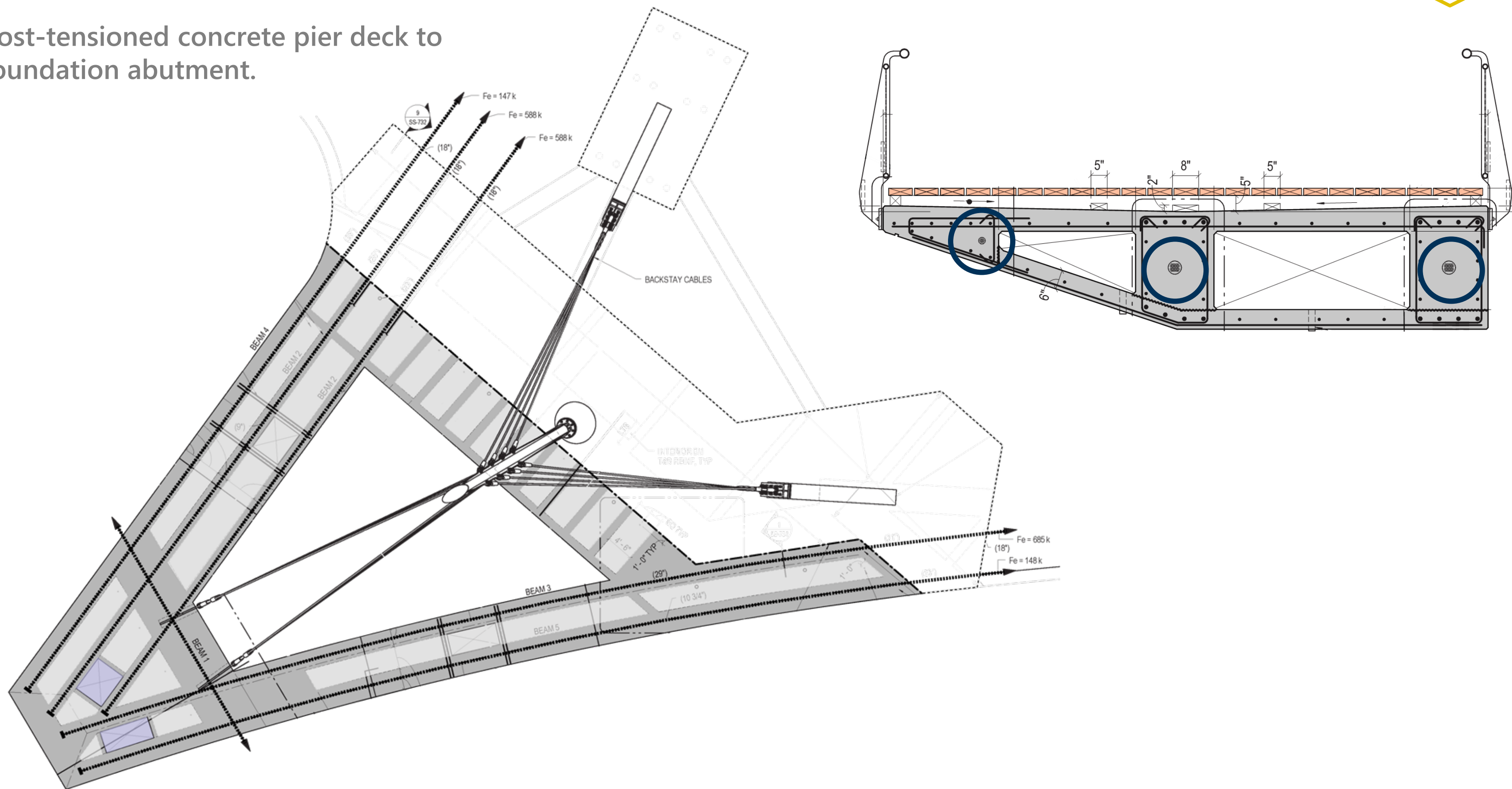


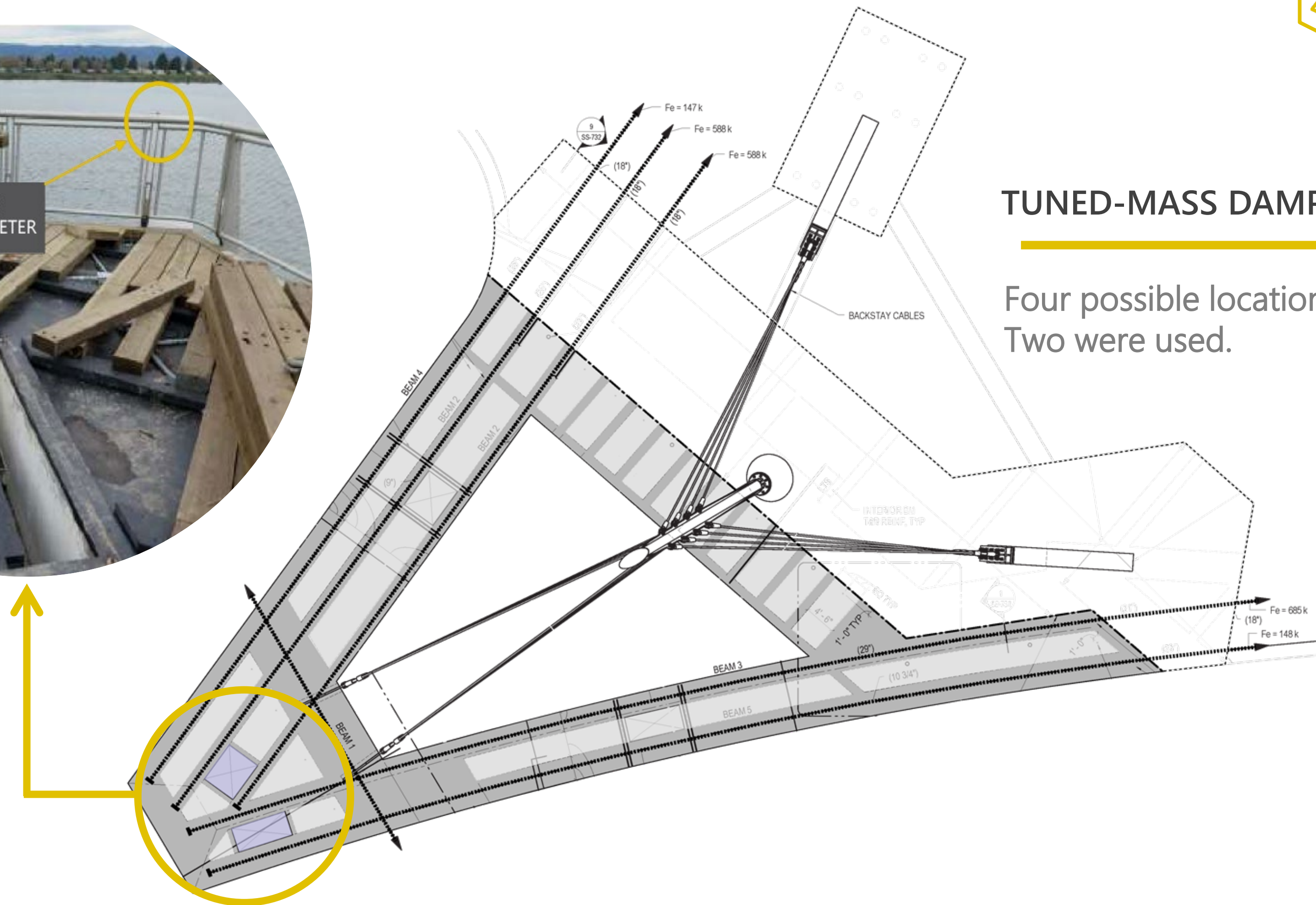
Cross-section at end of pier





Post-tensioned concrete pier deck to foundation abutment.



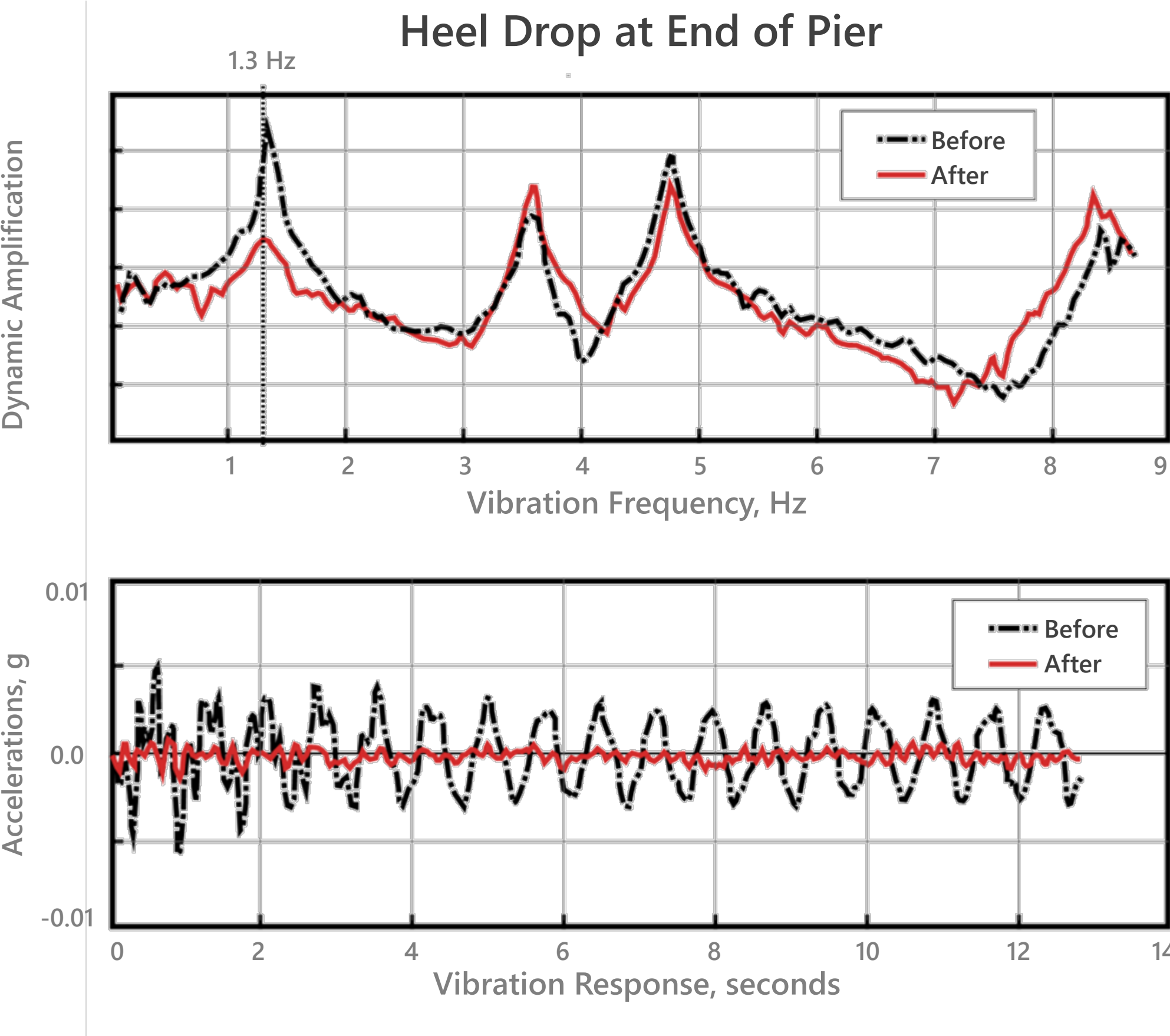
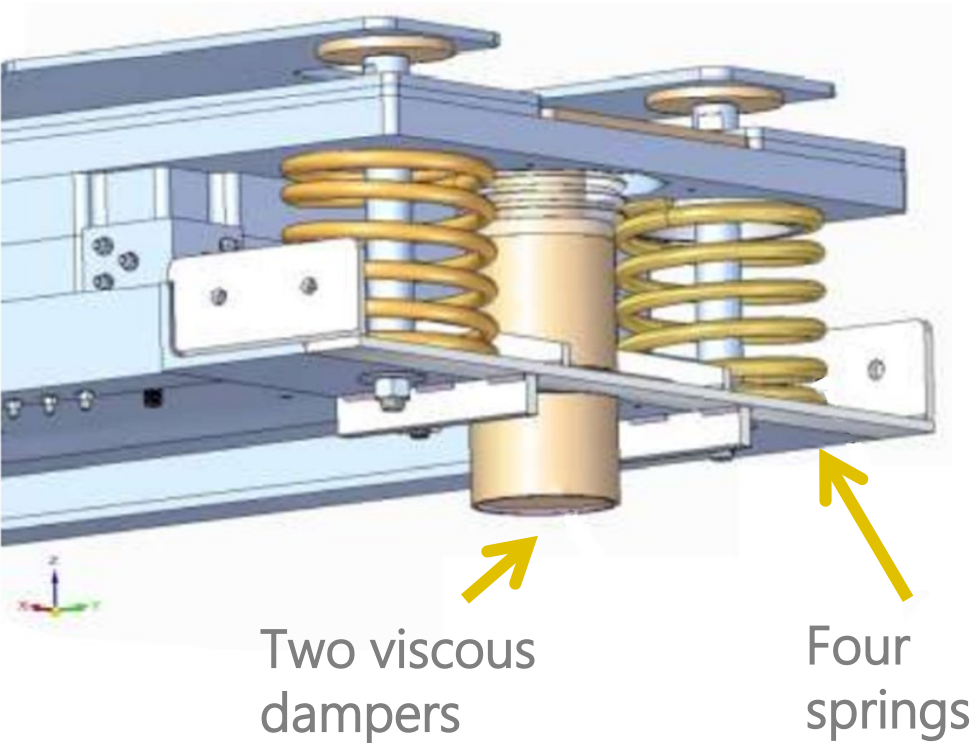


TUNED-MASS DAMPERS

Four possible locations.
Two were used.



DAMPING APPROX.
25% OF CRITICAL





FOUNDATION SOLUTIONS

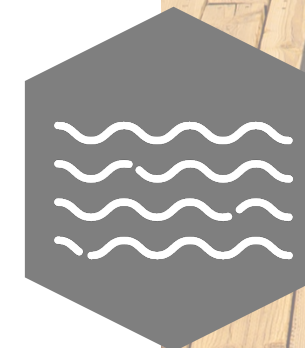
CONSTRAINTS OF FOOTPRINT



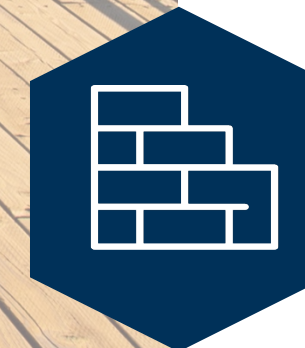
CREATIVE LAYOUT



RIVER WATER LEVEL



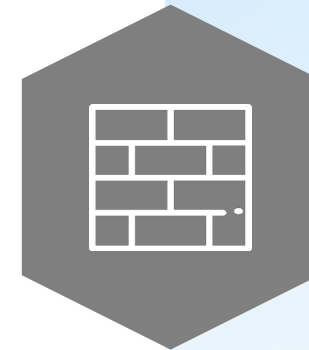
FOUNDATION CONSTRUCTED
INSIDE COFFERDAM





FOUNDATION SOLUTIONS

HIGH FOUNDATION LOADS



SUPPORT STRUCTURE



LATERAL SPREADING



USE THE COFFERDAM AS A
PERMANENT STRUCTURE



UNKNOWN SUBSURFACE DEBRIS

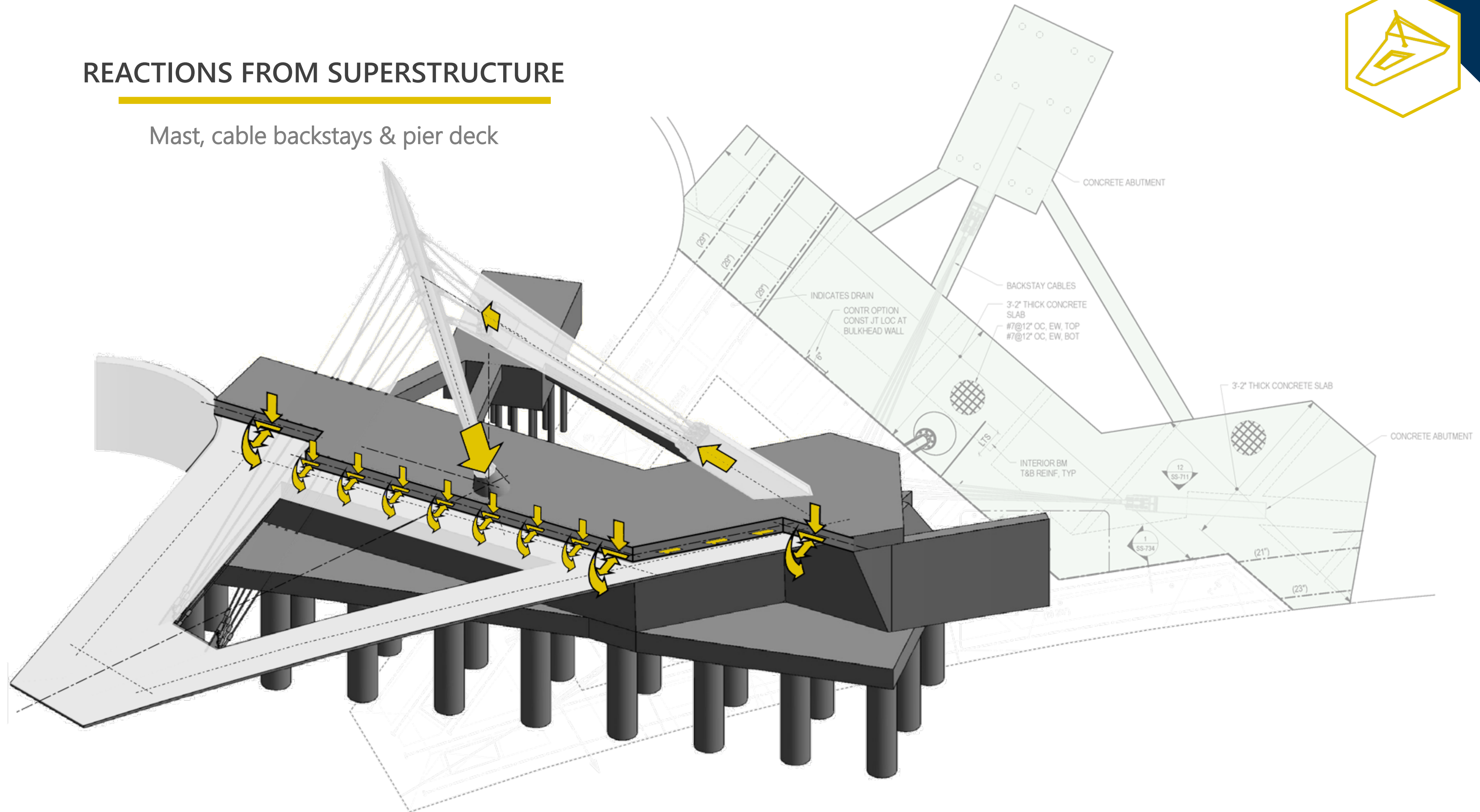


DRILLED SHAFT REPAIR



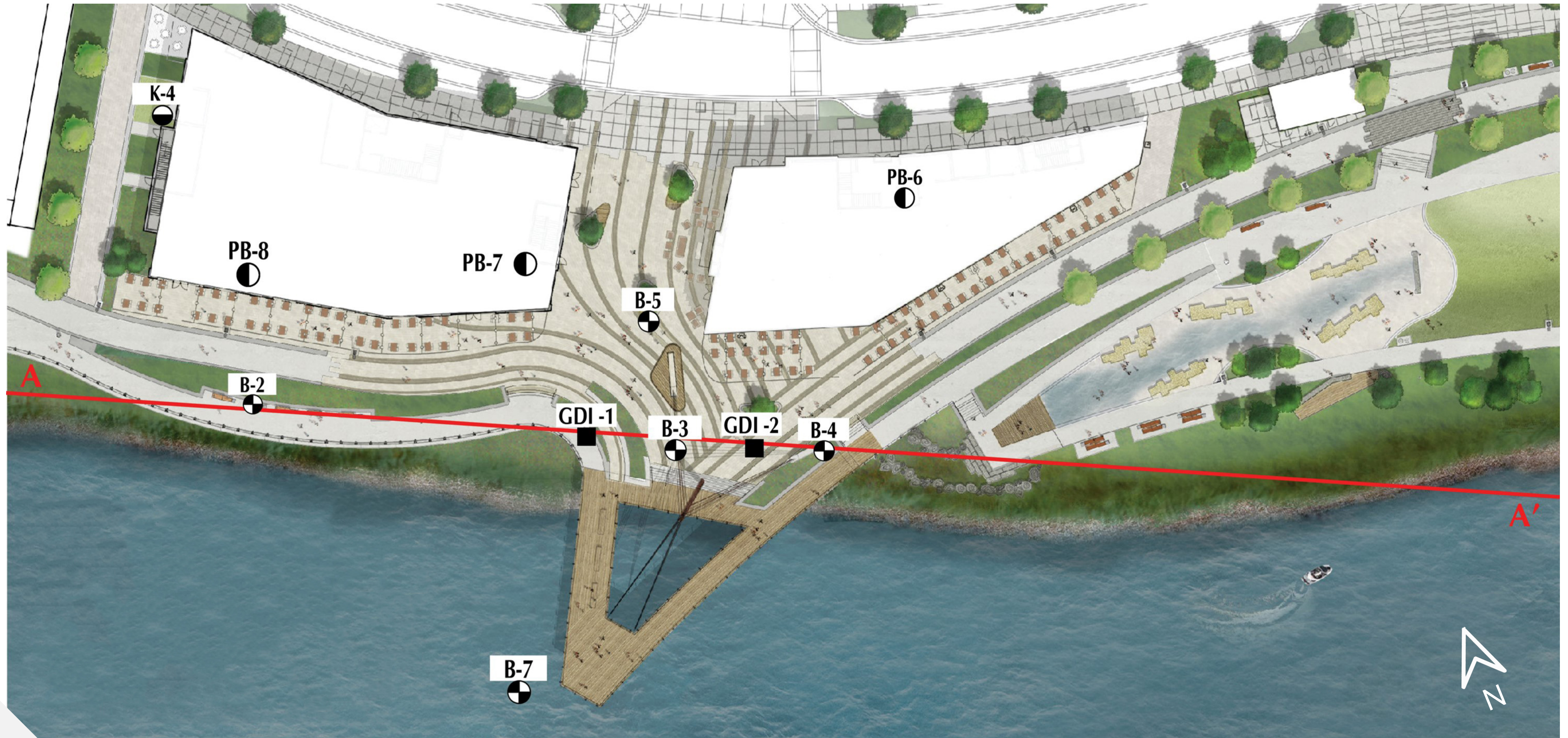
REACTIONS FROM SUPERSTRUCTURE

Mast, cable backstays & pier deck



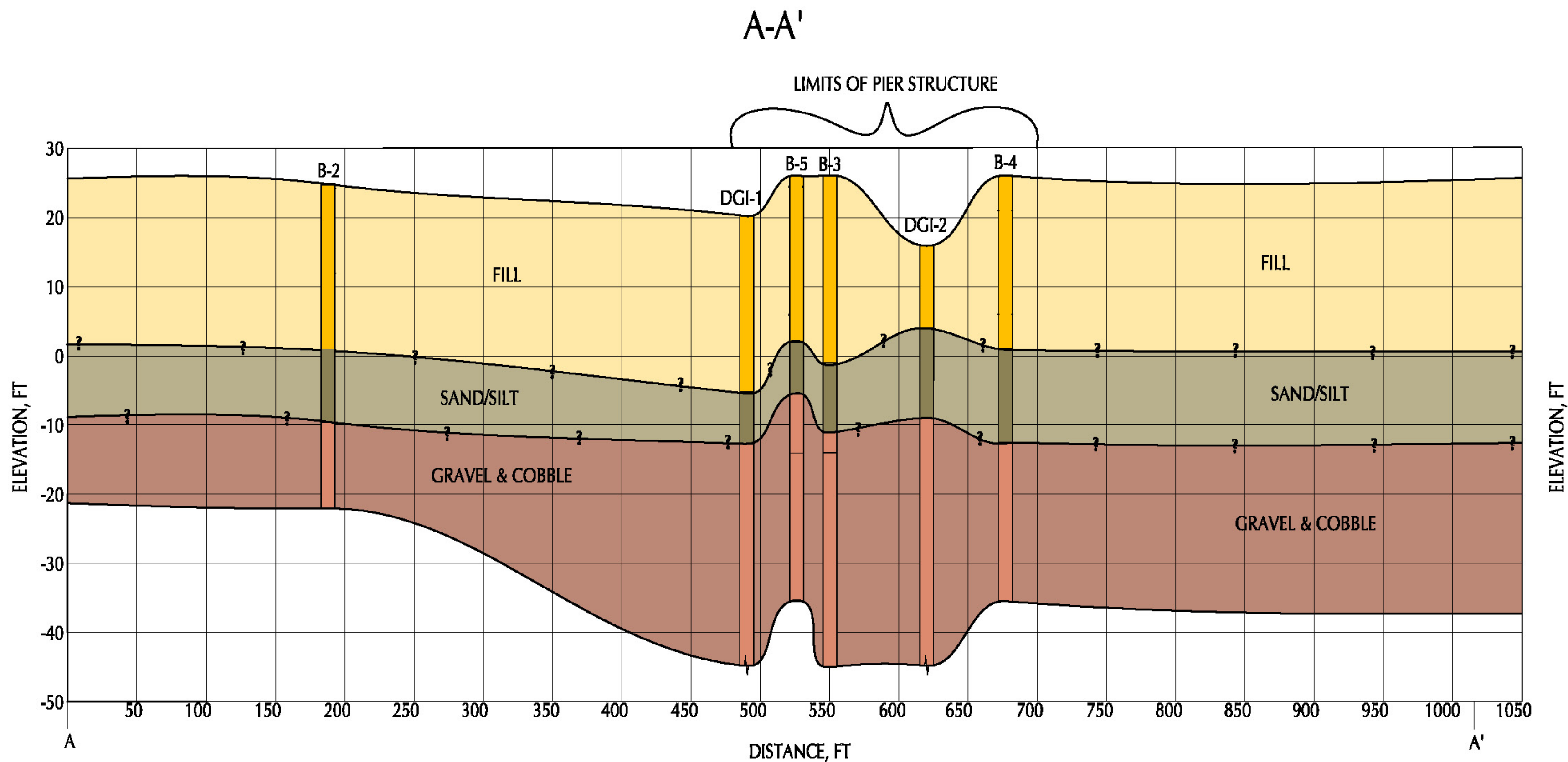


SUBSURFACE





SUBSURFACE PROFILE



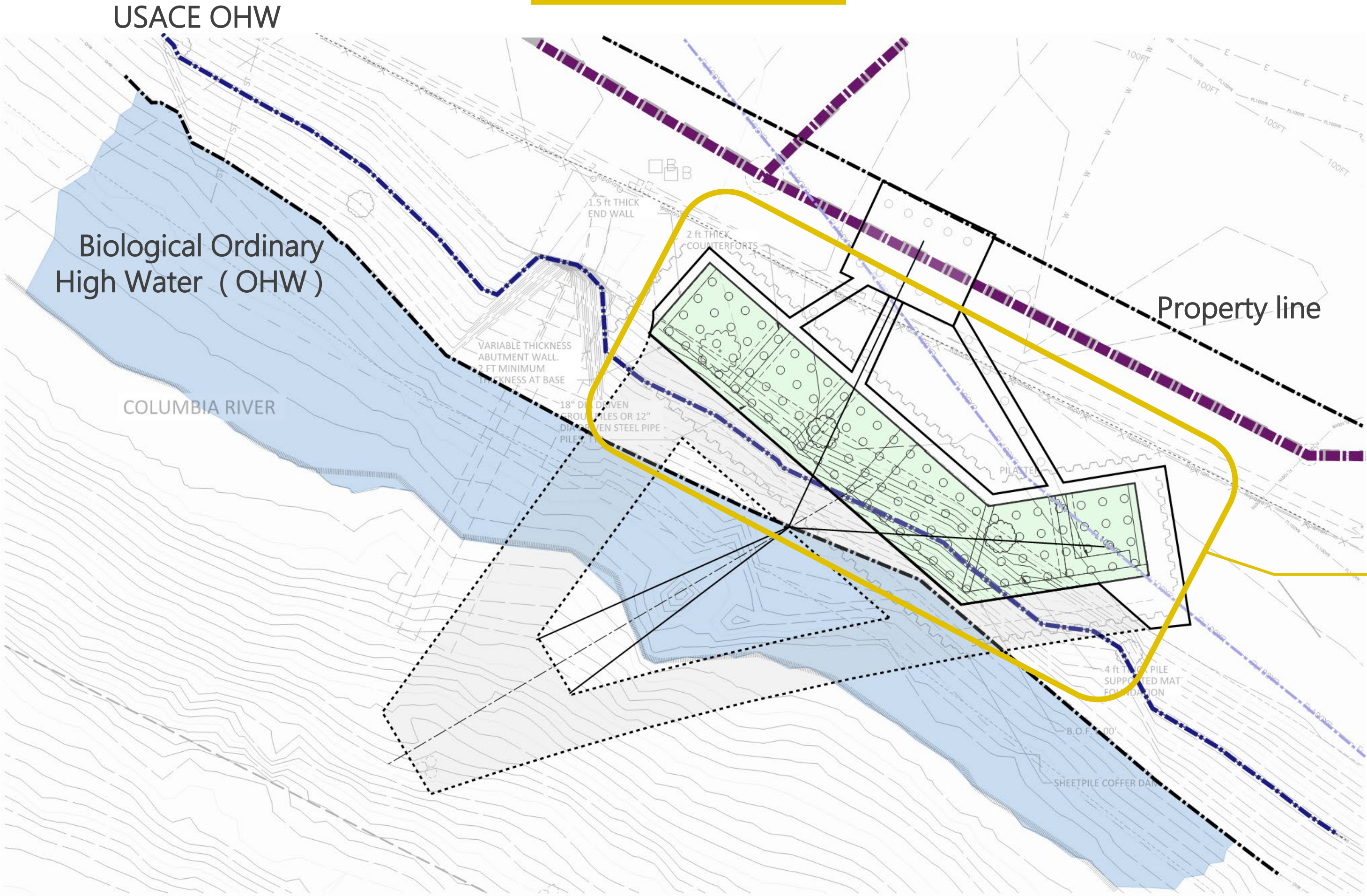
VERTICAL SCALE: 1' = 20 FT
HORIZONTAL SCALE: 1' = 100 FT

FILL

SAND/SILT

GRAVEL & COBBLE

FOUNDATION DESIGN CONSIDERATIONS



100-yr flood

Stormwater pipe

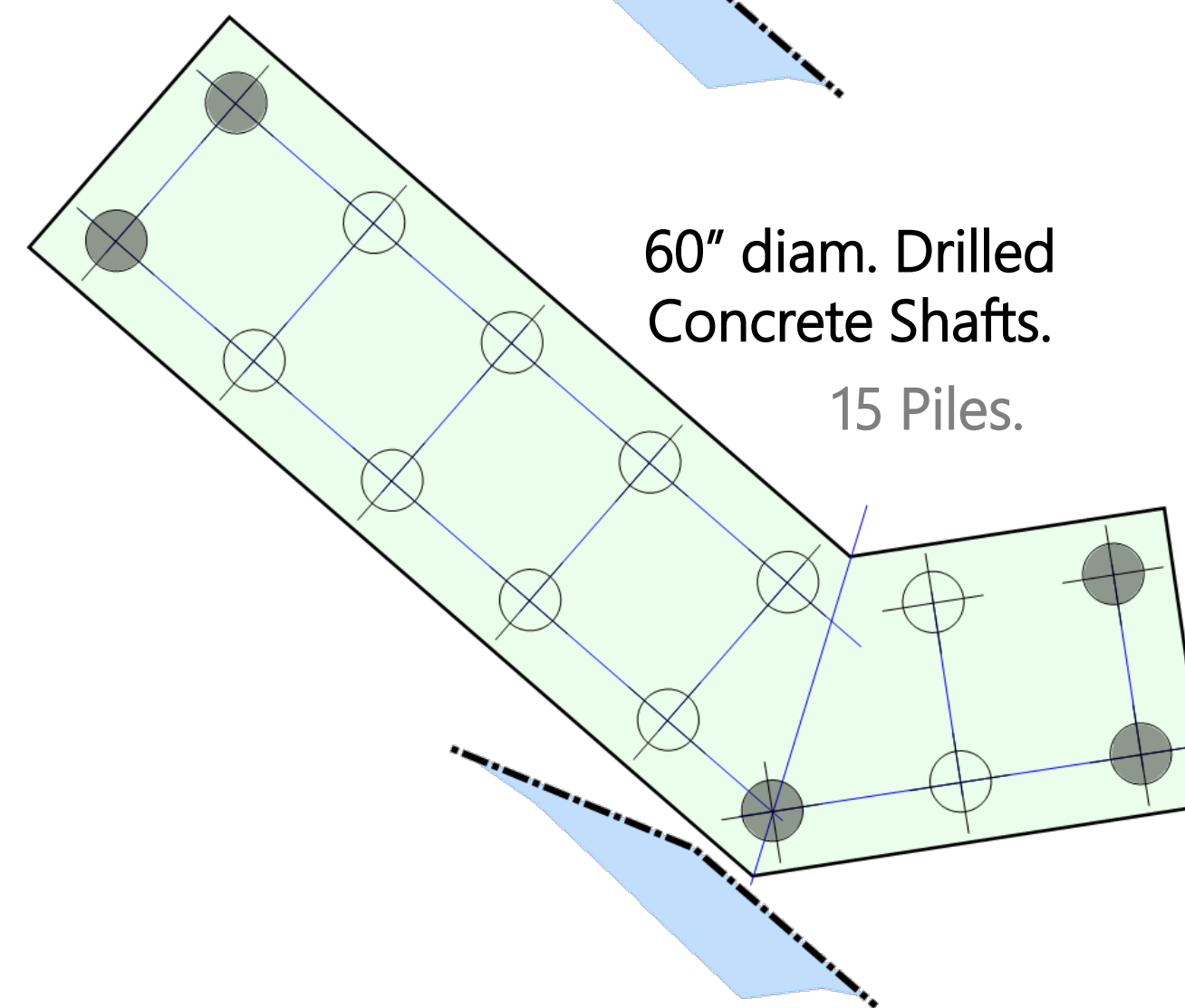
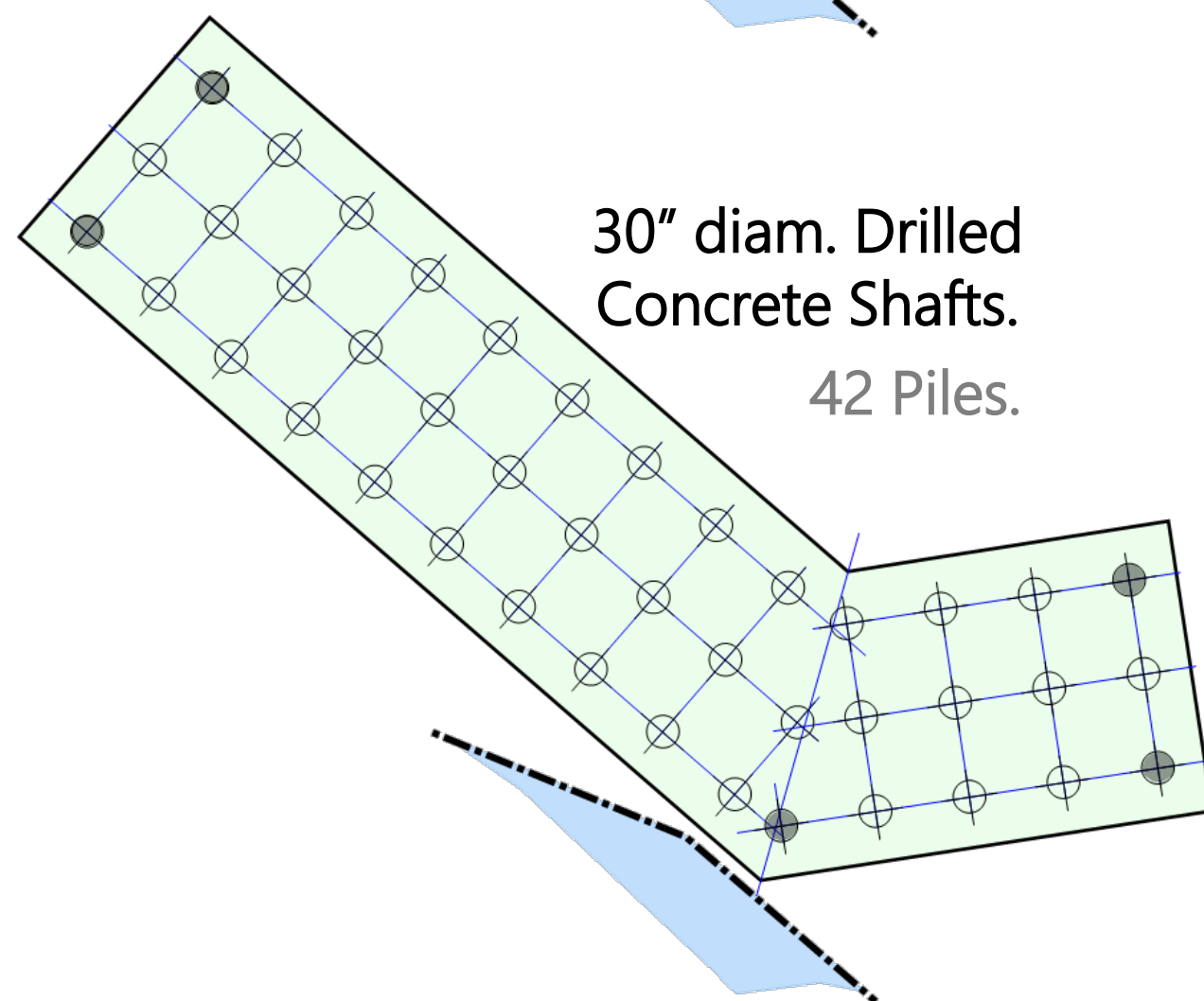
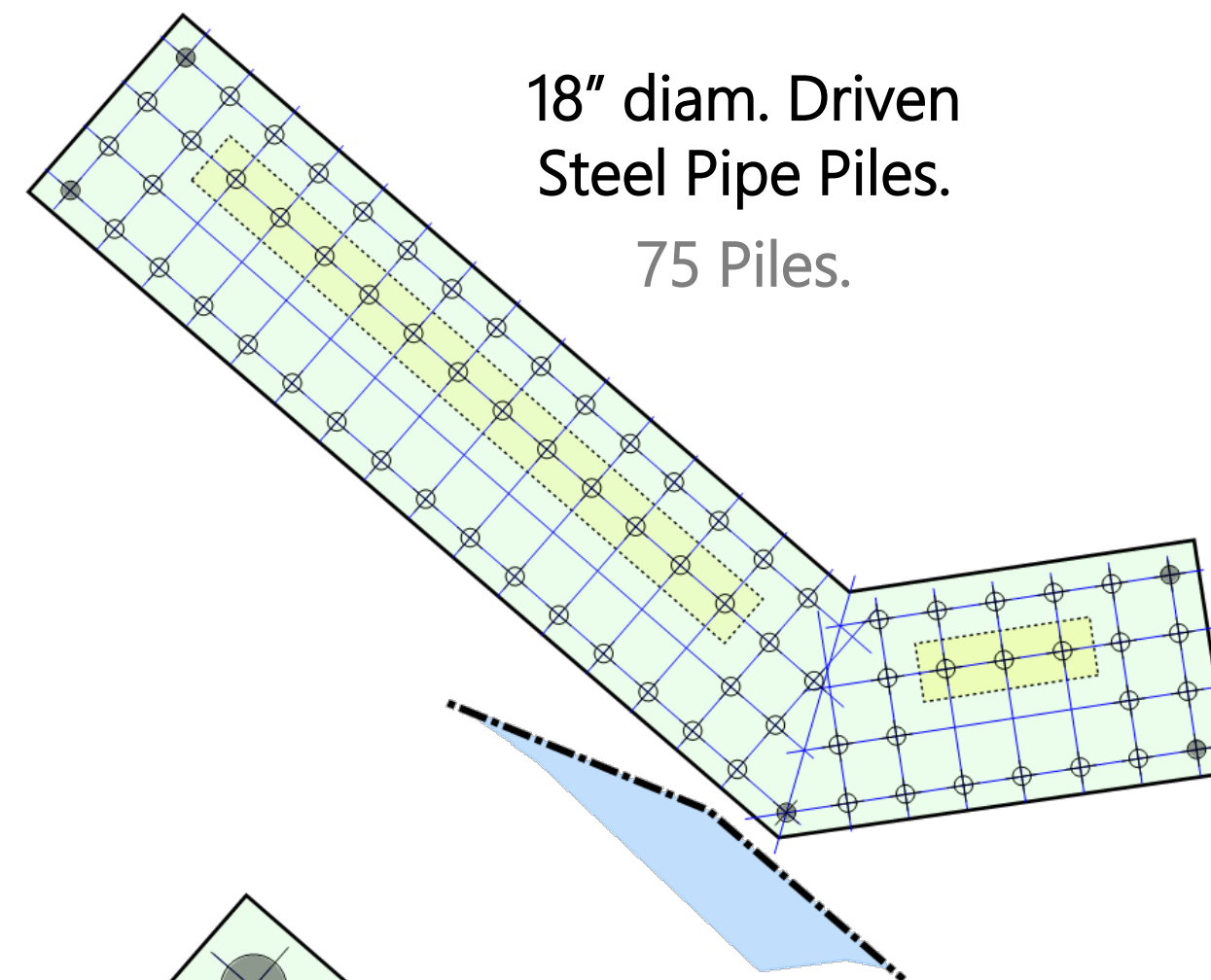
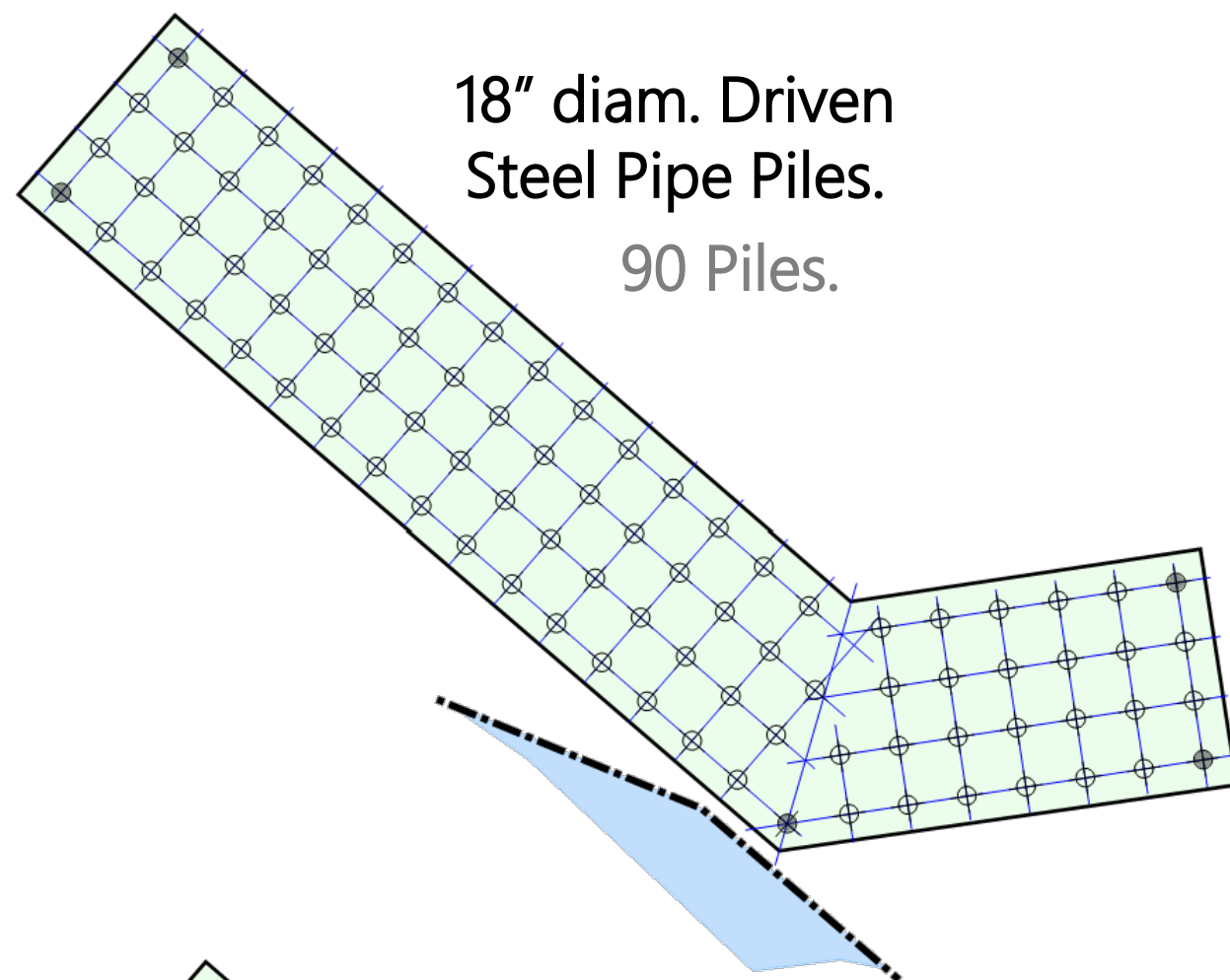
Property line

Biological Ordinary
High Water (OHW)

COLUMBIA RIVER

USACE OHW

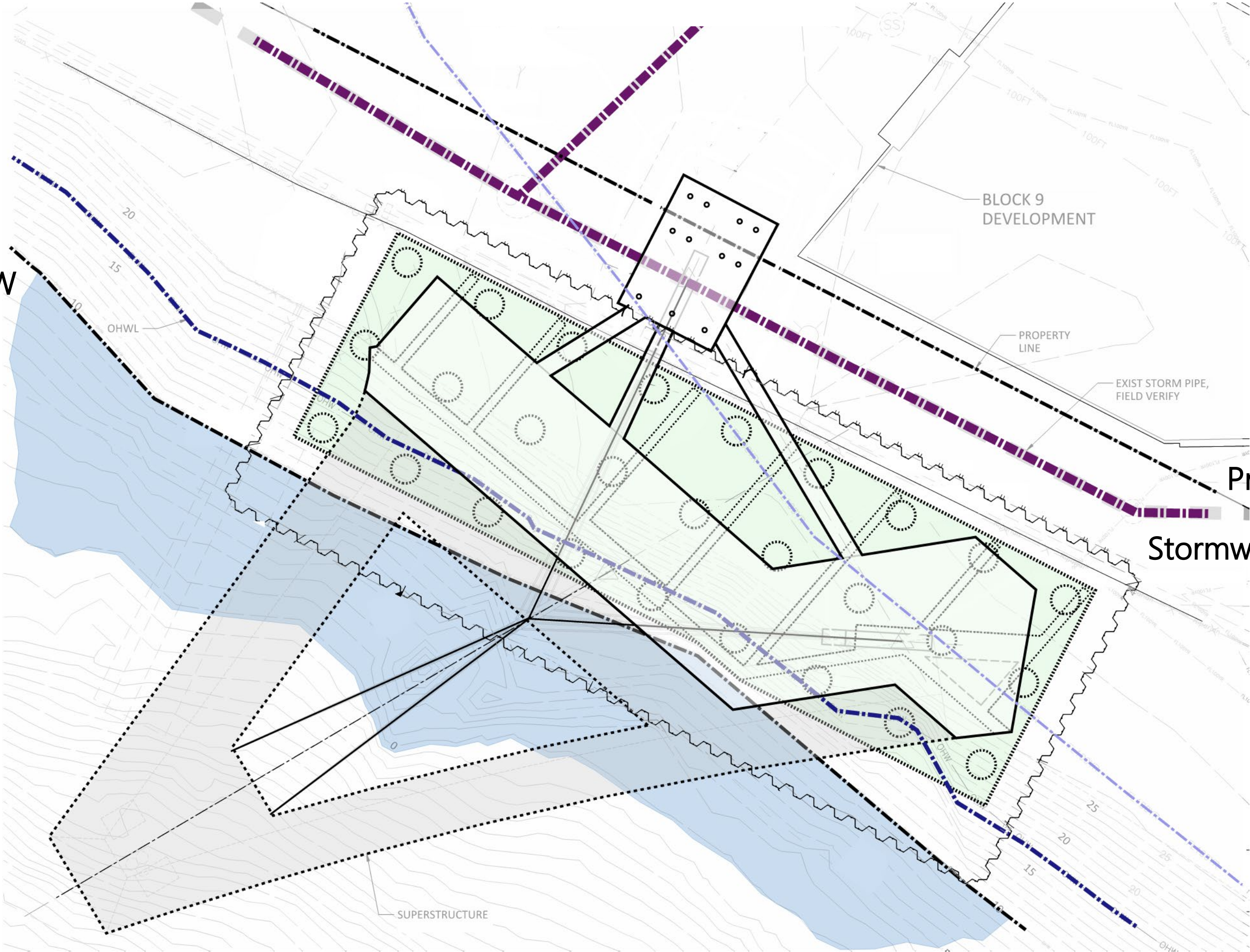
DESIGN VARIATIONS – PILE SIZE



SUBSTRUCTURE FINAL DESIGN

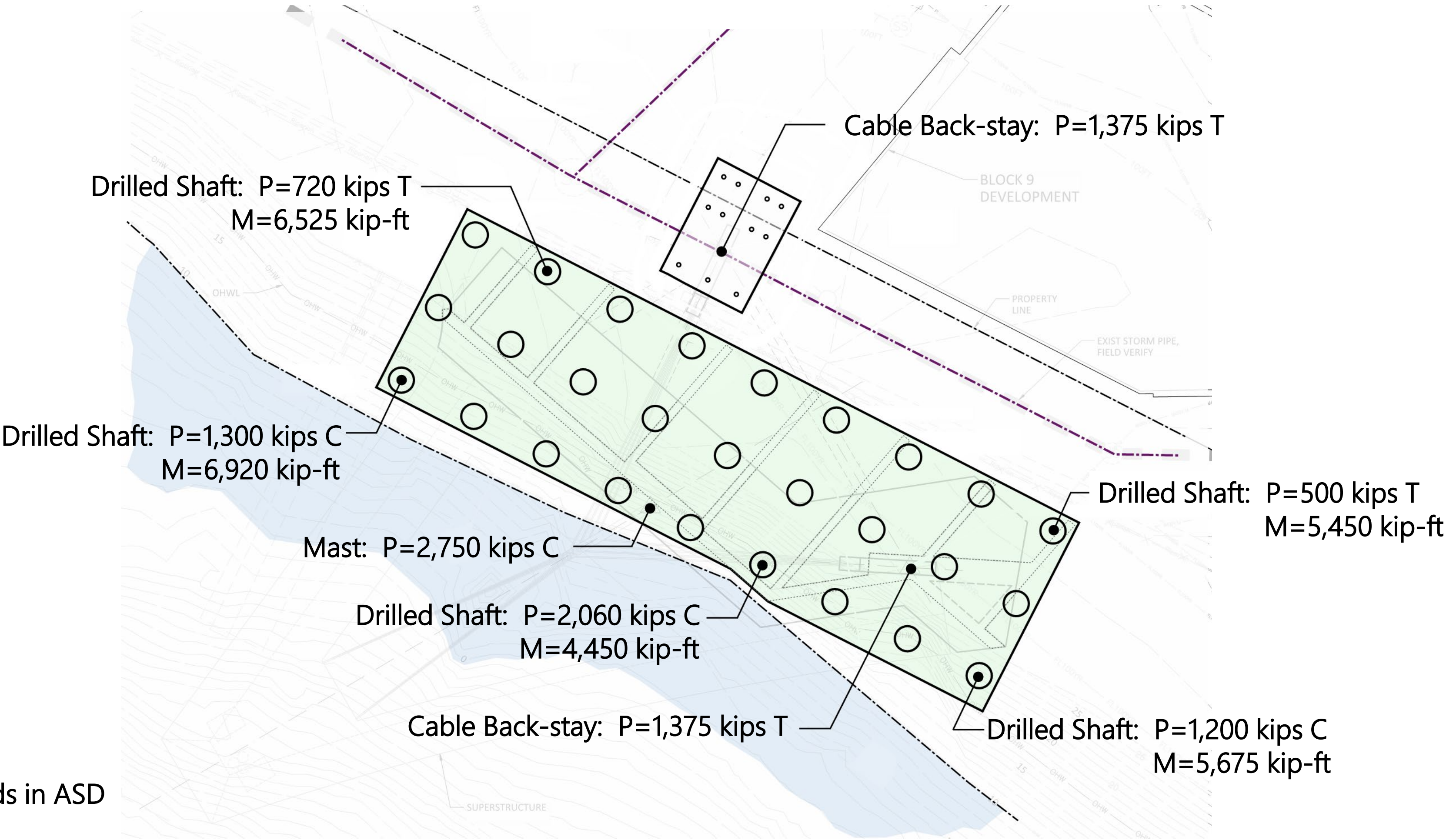


Biological OHW

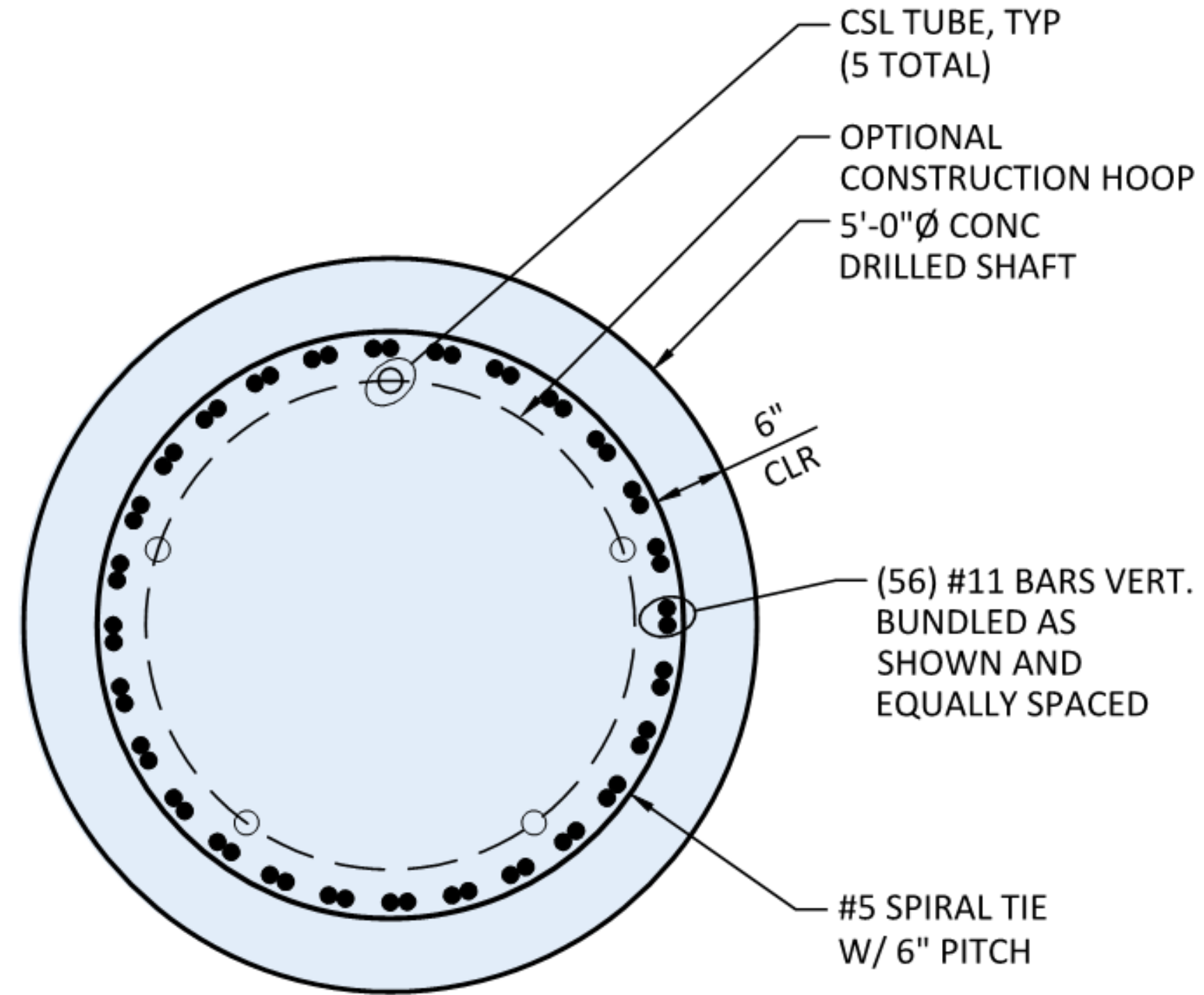


Property line
Stormwater pipe

SUBSTRUCTURE
FINAL DESIGN



All loads in ASD

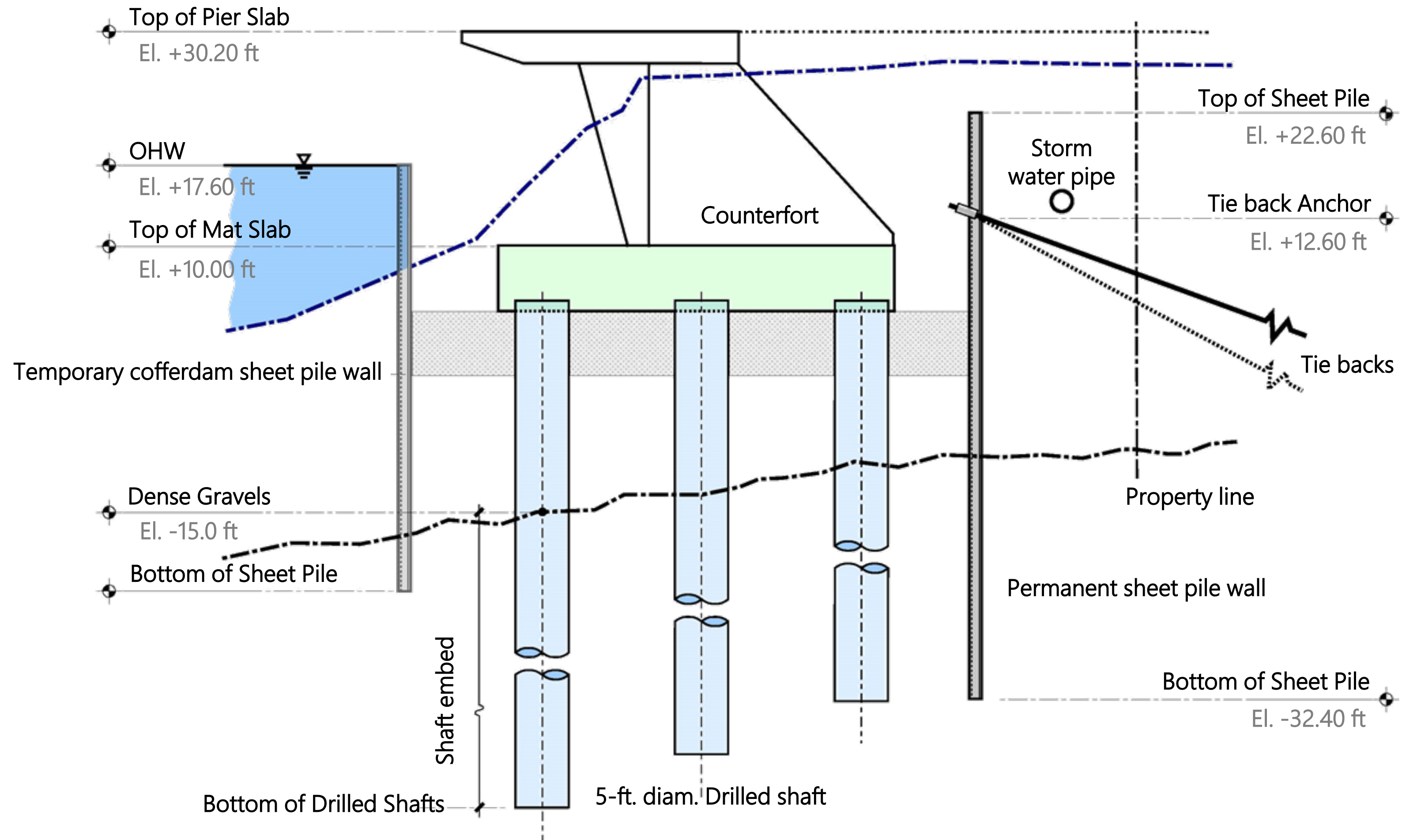


2
GS-502

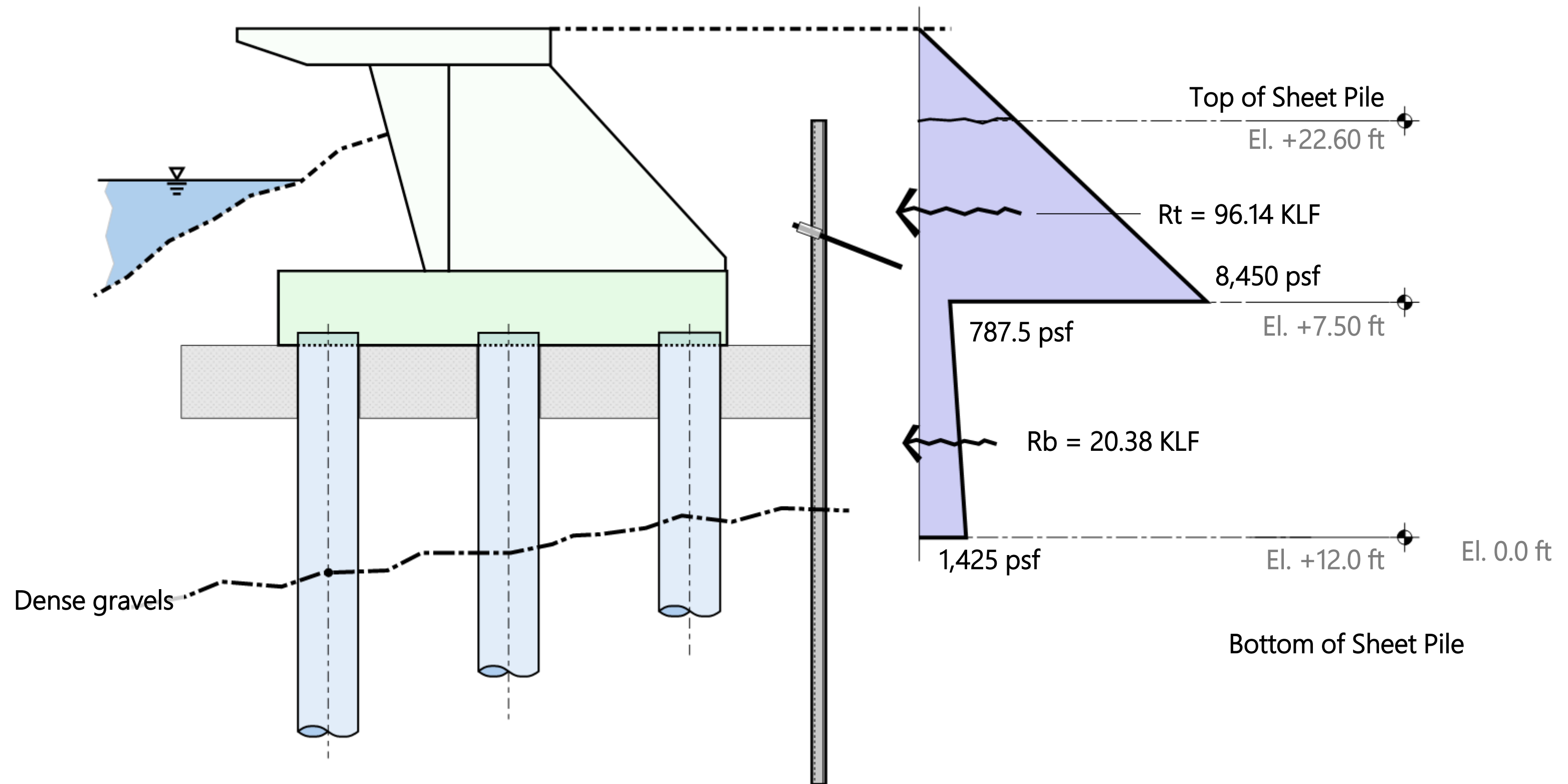
DRILLED SHAFT SECTION

SCALE: 3/4" = 1'-0"

SUBSTRUCTURE PROFILE



LATERAL SPREAD DESIGN





DESIGN FOR SEISMIC LATERAL SPREAD



- + 10's of feet of movement
- + Load based v. deformation based approach
- + No ground improvement due to sewer and property line
- + Load based approach using cofferdam and high capacity gravel
- + 36 tieback anchors 300 kips each on 4 ft centers

SUBSTRUCTURE CONSTRUCTION





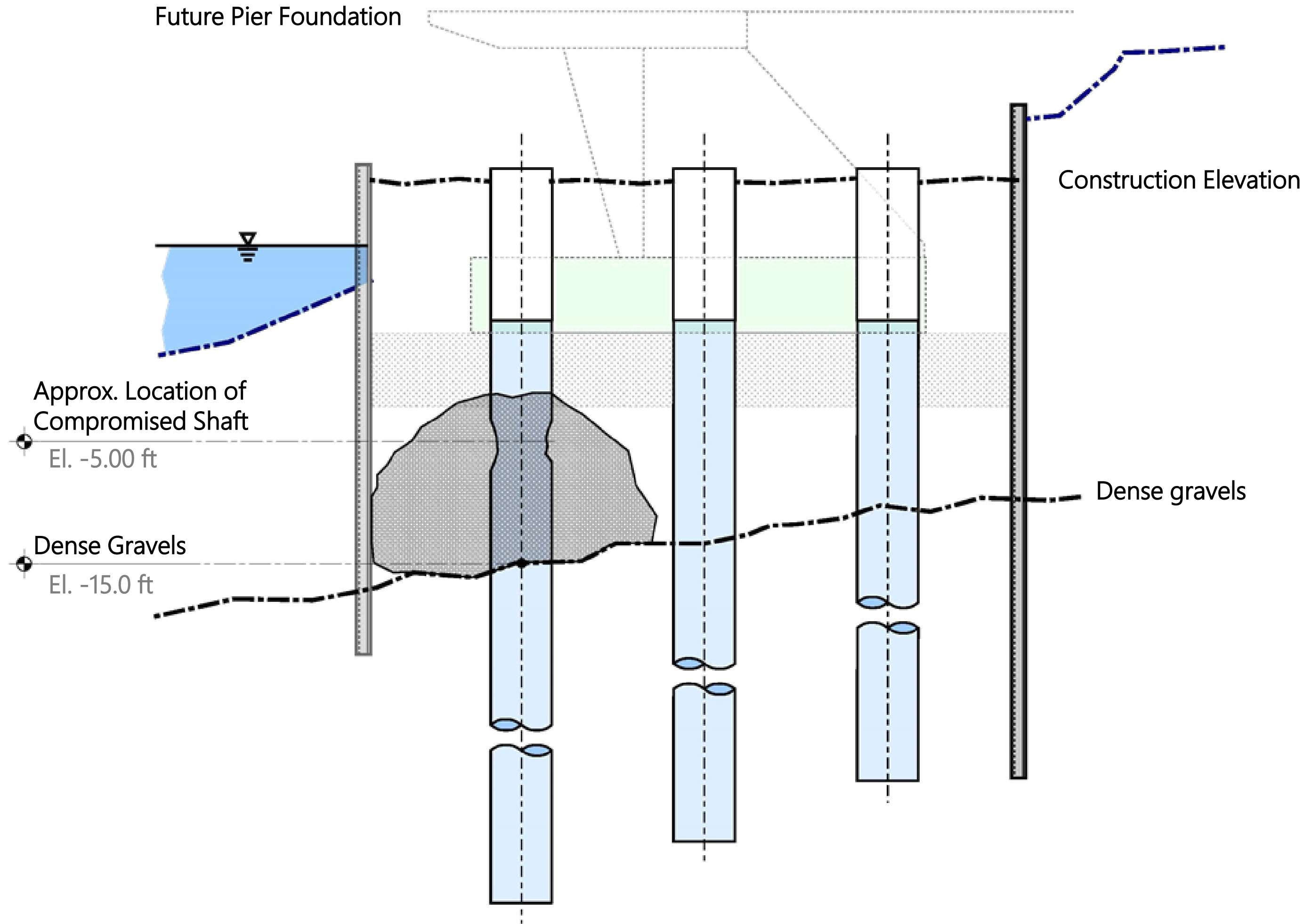
INSTALLATION OF DRILLED SHAFTS



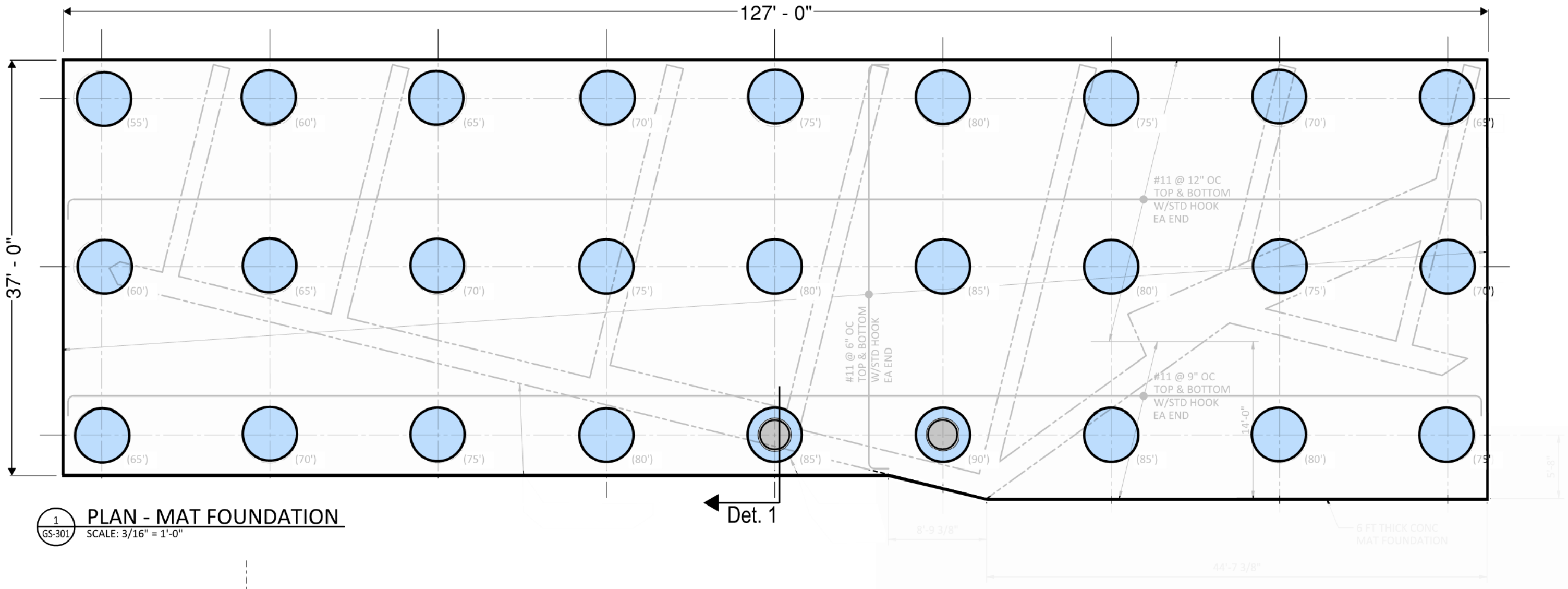
- + 45 to 90 ft long into gravel
- + Installed with full depth temporary casing and full head of water
- + Drill, set cage, place concrete as casing pulled
- + Note the shafts installed near top of cofferdam
- + Crosshole sonic logging



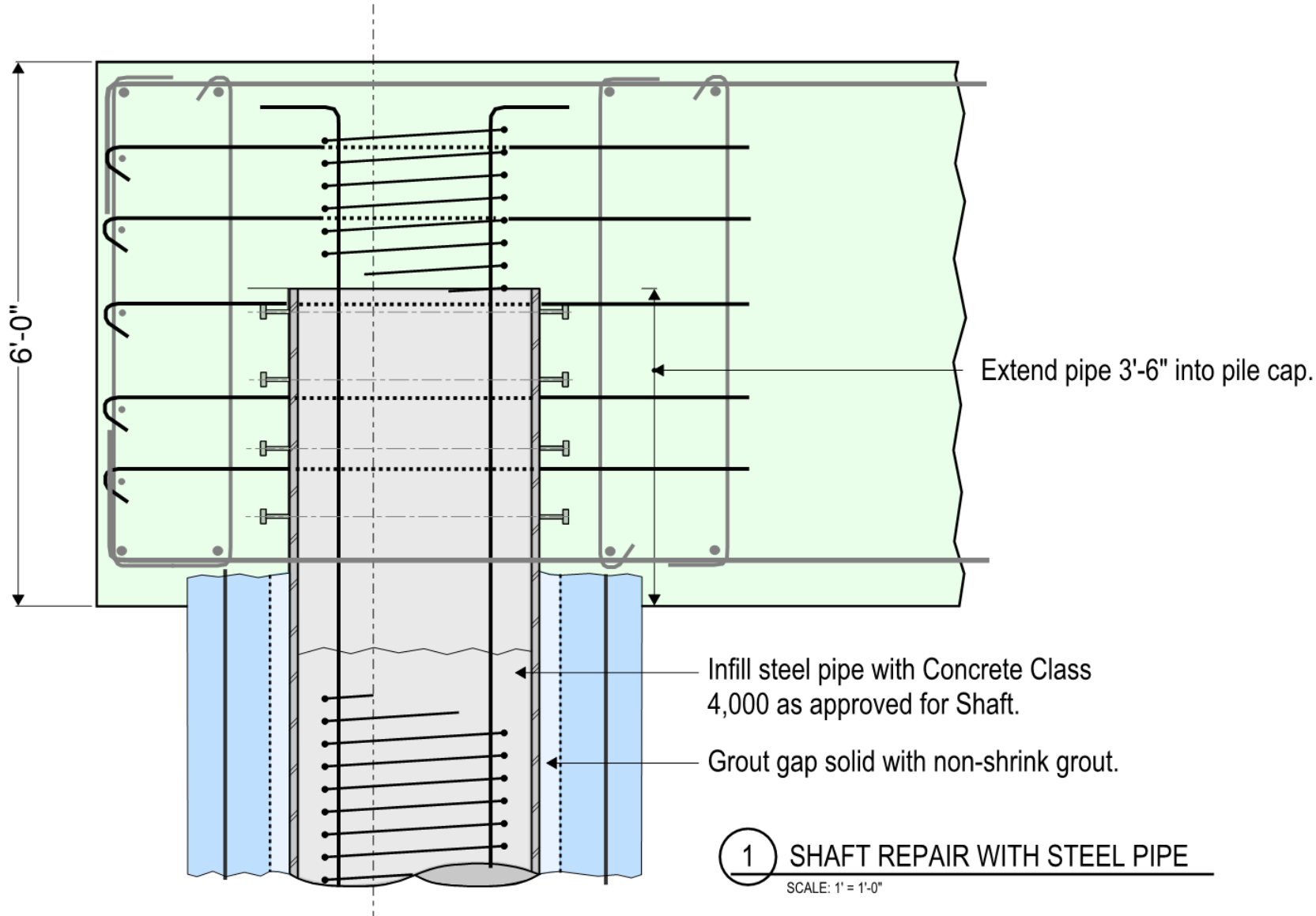
DRILLED SHAFT CONSTRUCTION



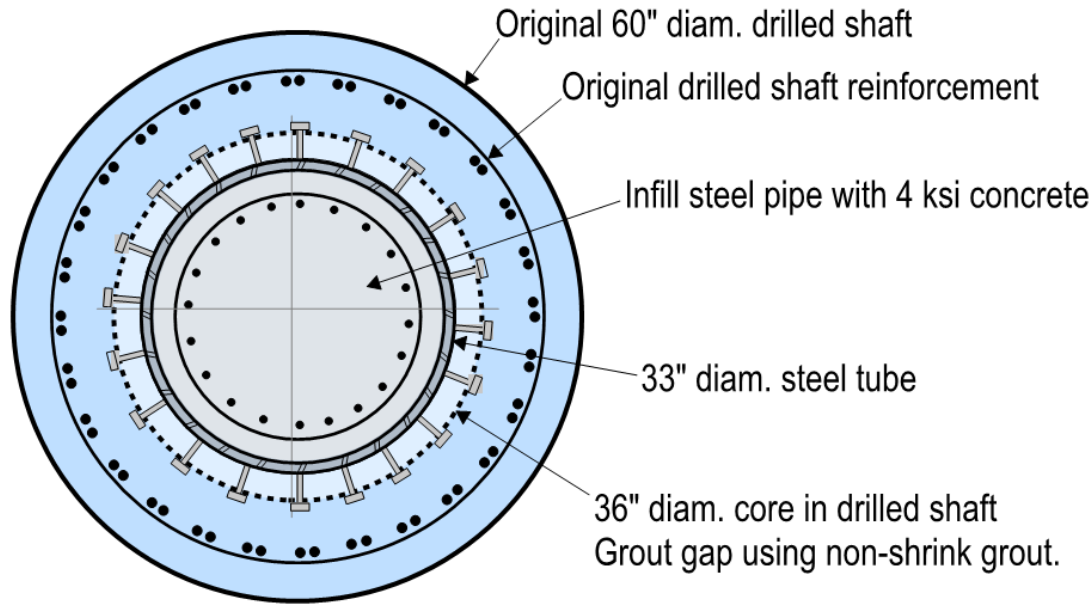
DRILLED SHAFT REPAIR



1 PLAN - MAT FOUNDATION
SCALE: 3/16" = 1'-0"



1 SHAFT REPAIR WITH STEEL PIPE
SCALE: 1" = 1'-0"

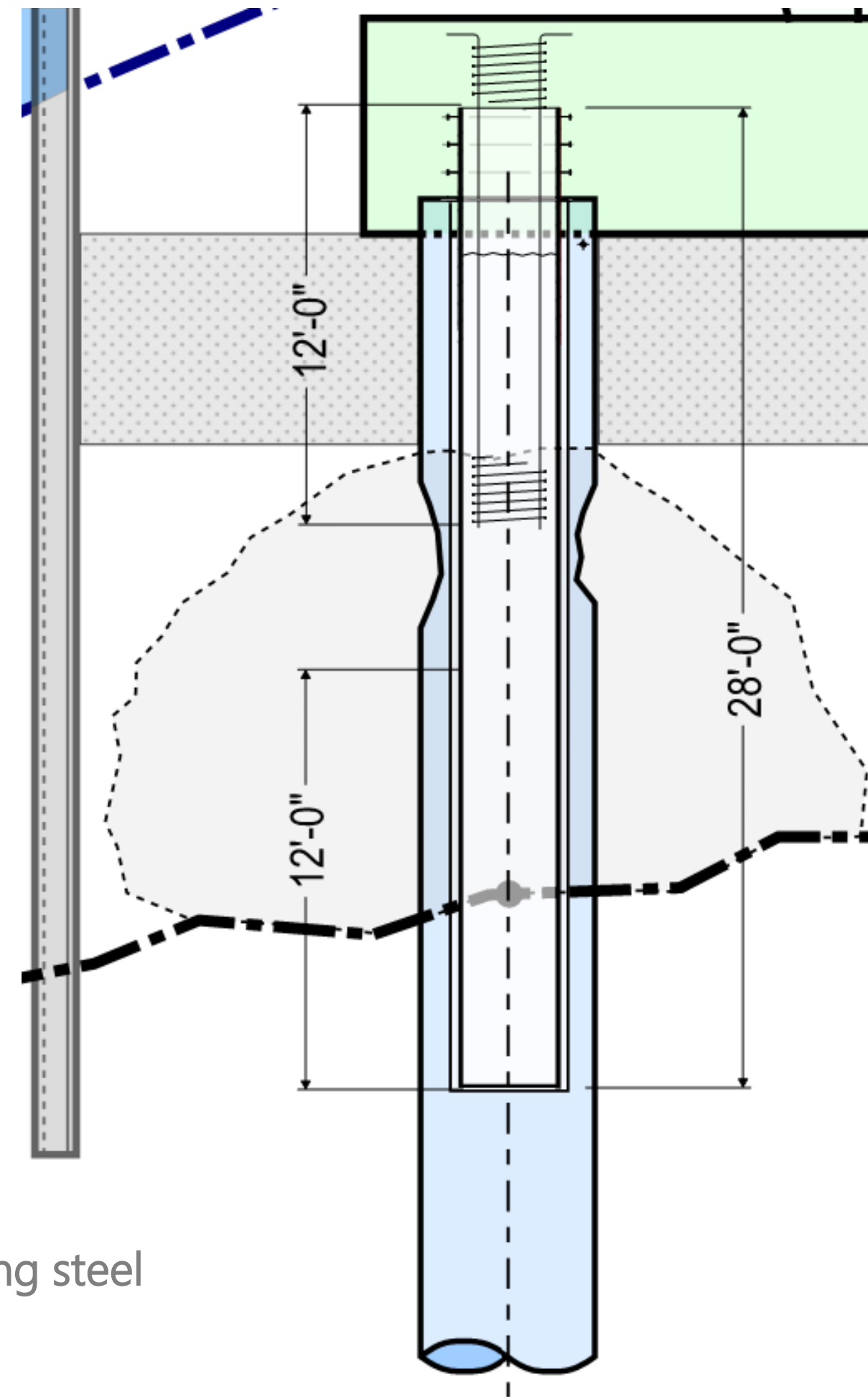


2 PARTIAL PLAN - CONCRETE-FILLED PIPE
SCALE: 1" = 1'-0"



Original shaft reinforcing steel

EMBEDMENT OF STEEL TUBE





THE FOUNDATION ENGINEER'S DREAM

- + Retaining walls
- + Driven piles (temporary)
- + Sheet piling (temp & permanent)
 - + Cofferdam & tremie seal
- + Drilled shafts
- + Micropiles
- + Ground anchors

VANCOUVER WATERFRONT PARK

Open September 2018





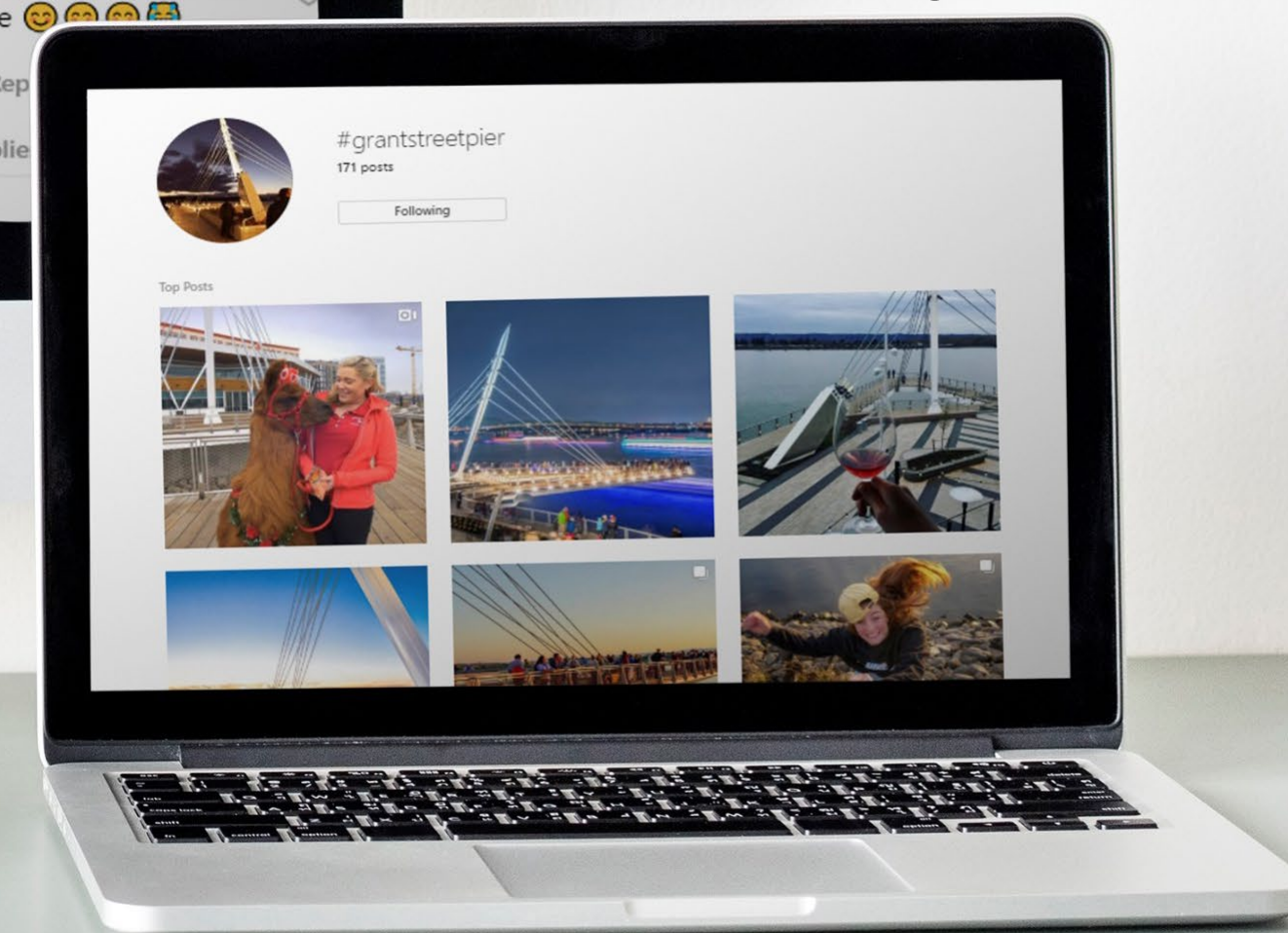
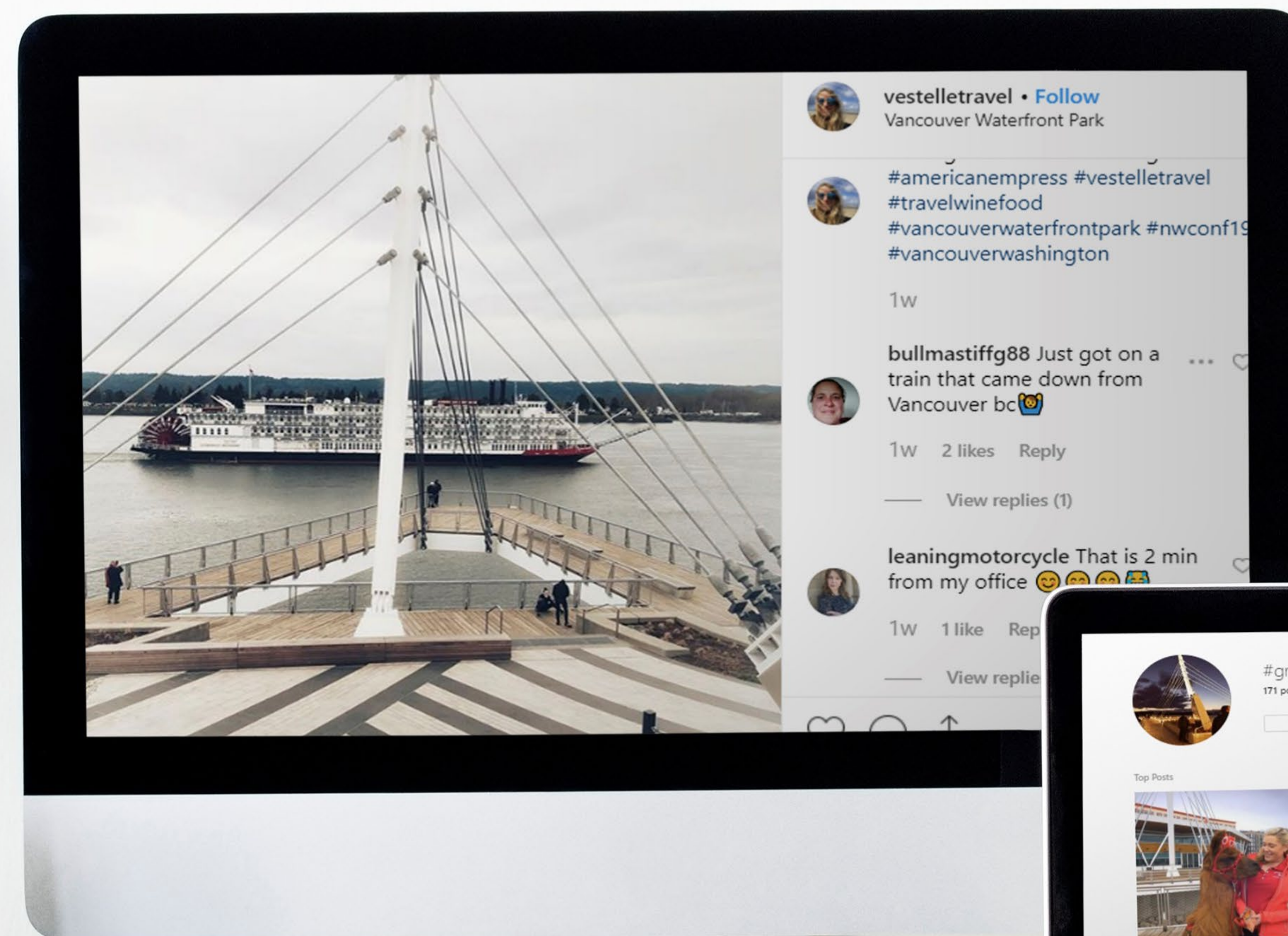
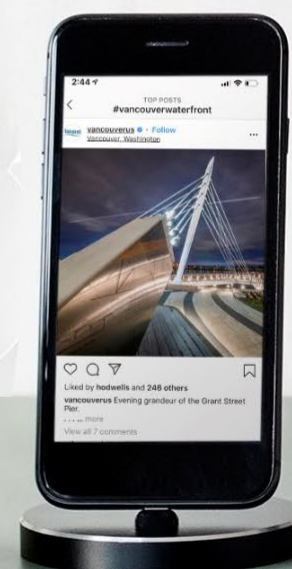
GRAND OPENING





SOCIAL MEDIA PRESENCE

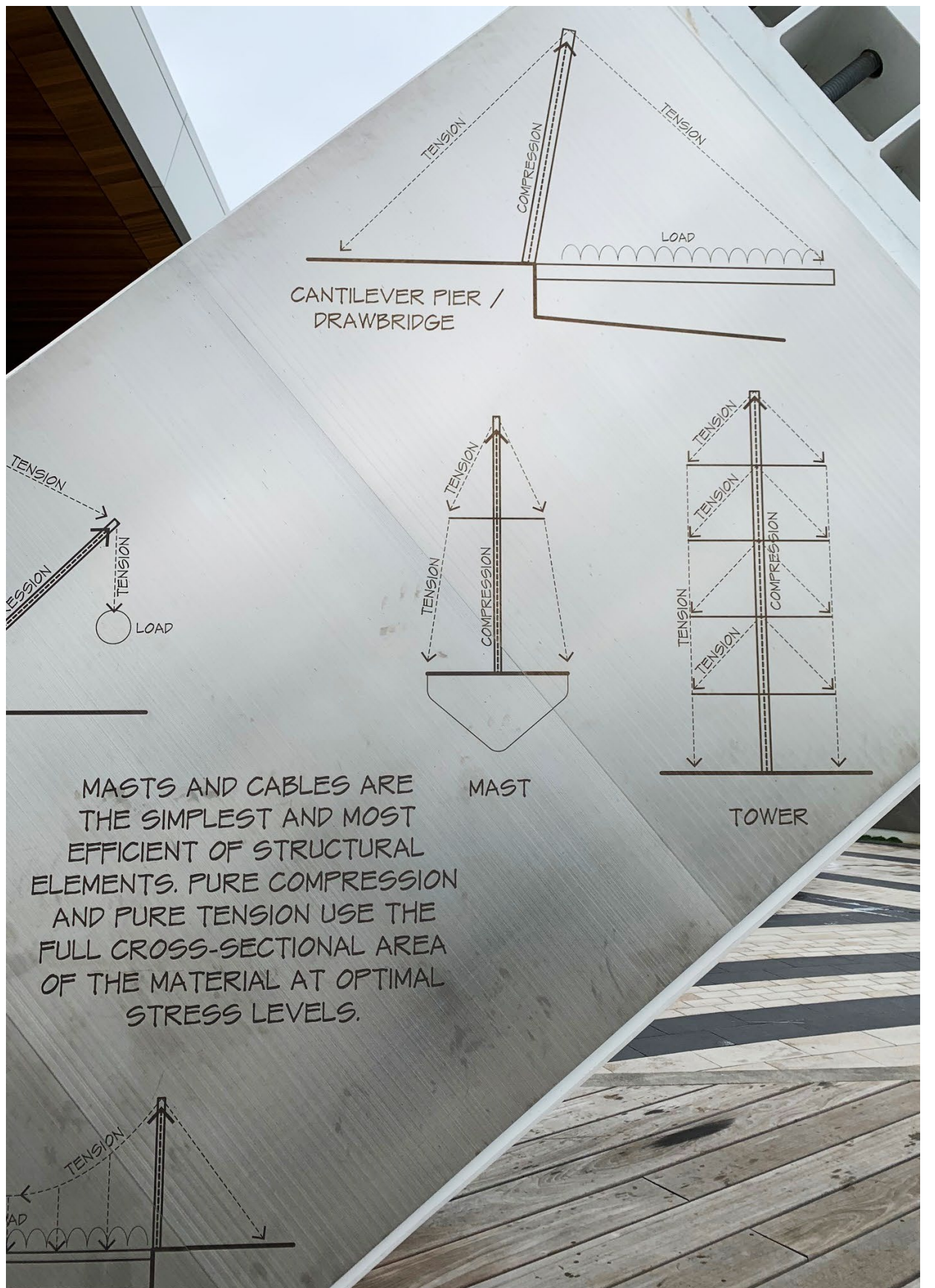
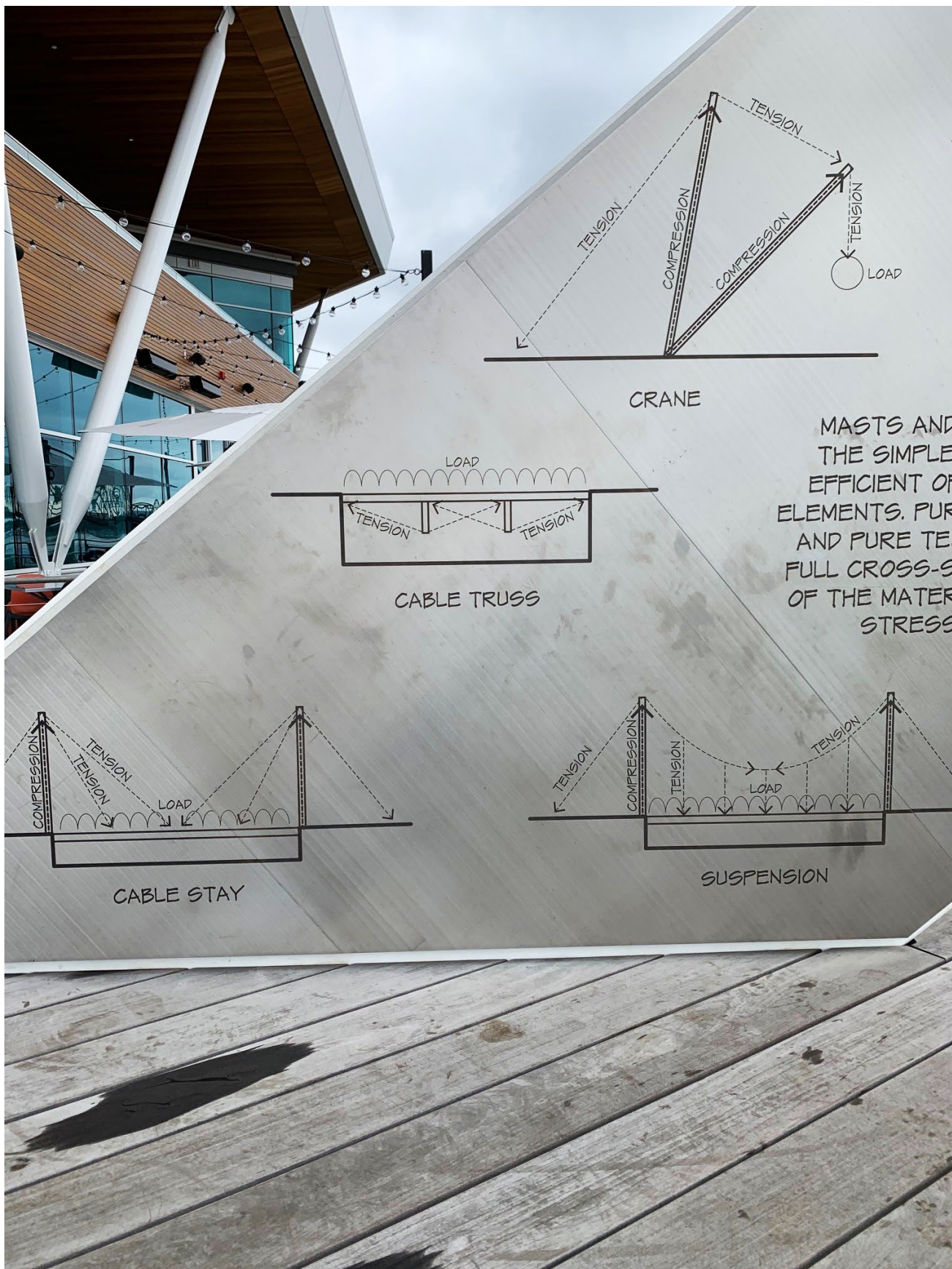
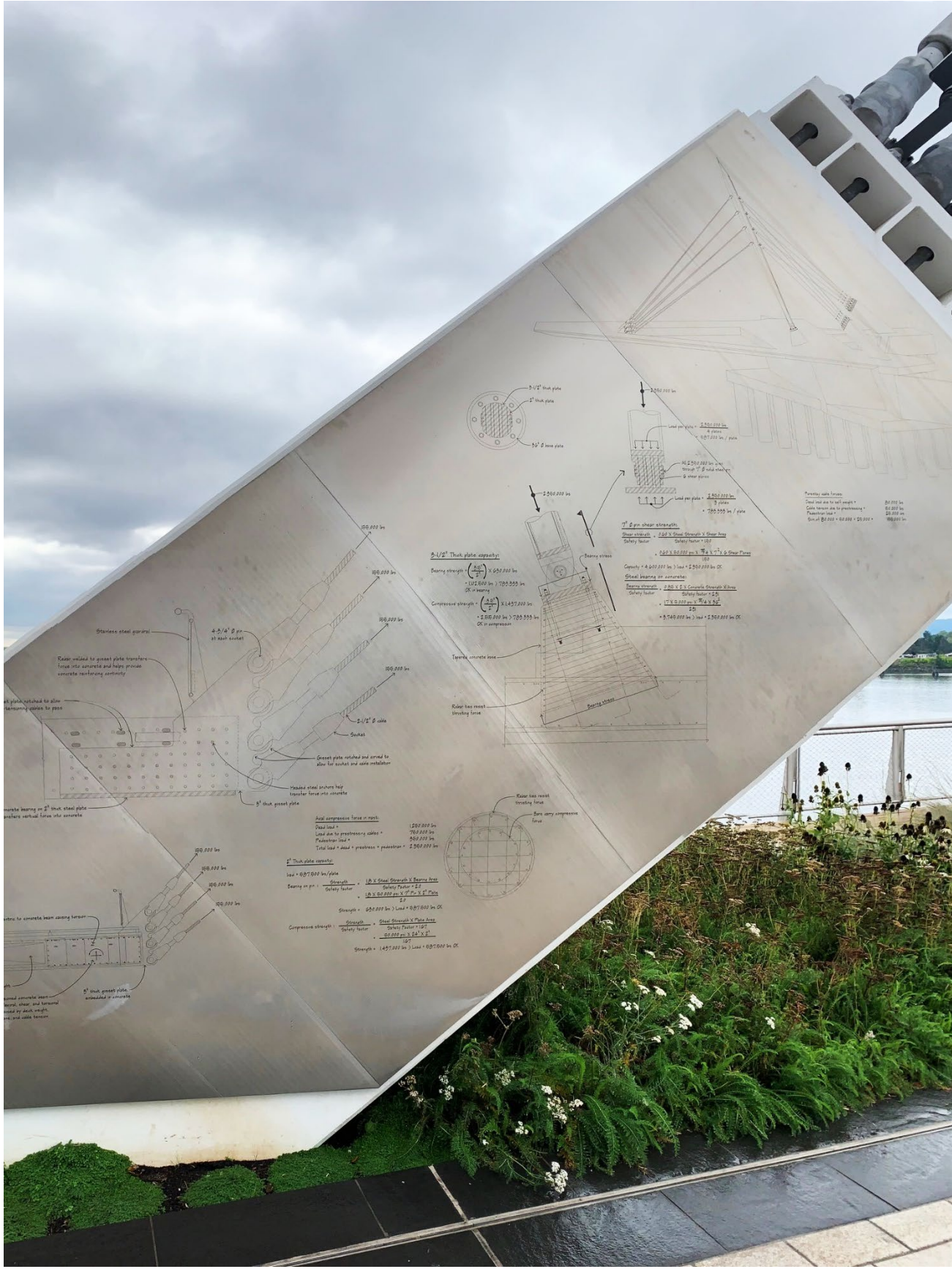
#grantstreetpier
#vancouverwaterfrontpark



WATER FEATURE







WATERFRONT PARK

VANCOUVER



