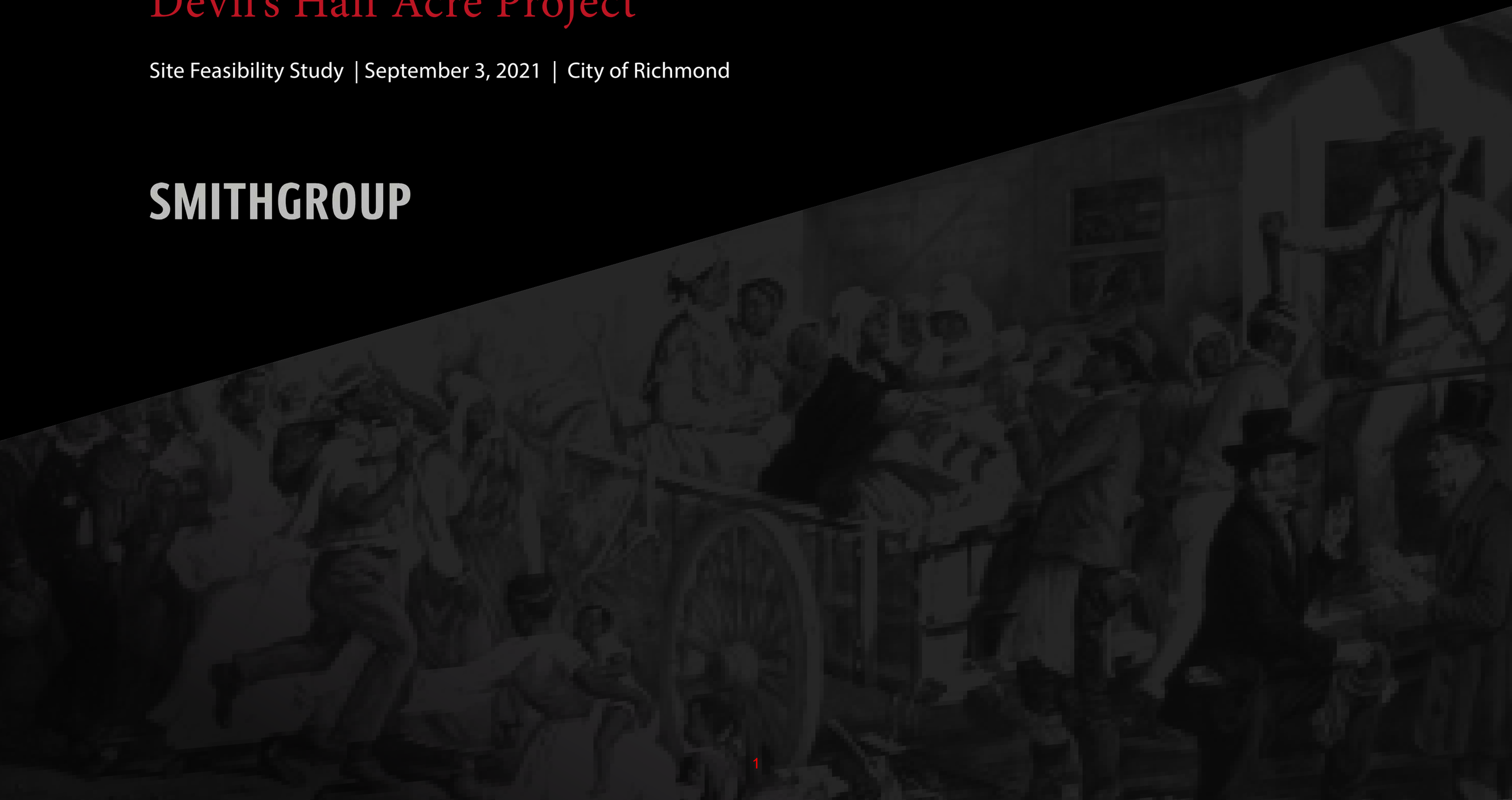
# Lumpkin's Slave Jail Site /
# Devil's Half Acre Project

Site Feasibility Study | September 3, 2021 | City of Richmond

SMITHGROUP



# CONTENTS

# EXECUTIVE SUMMARY

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Lumpkin's Slave Jail/Devil's Half Acre Project
Site Information Study and Report
September 3, 2021

**This is a challenging and encumbered site.**

It is a historical record of layers upon layers of infrastructure, infill, overlays, and development. The purpose of this report was to analyze site information, coordinate updated information and requirements, and outline mitigative strategies for constraints. In addition, this report shows technically and diagrammatically what can be built on this site, where, and examples of similar projects that have achieved positive results.

**Yet there is a reason for all the challenges outlined in this report.**

The heart of the slave trade was established at one of the lowest elevations in Richmond for deliberate reason. Shockoe Creek flooded often, making the land adjacent "less desirable". Evidenced at the Lumpkin's Slave Jail/Devil's Half Acre site, Robert Lumpkin built a wall to separate his own home and business enterprise (tavern, kitchen, hotel) from the flood-prone Creekside where he enslaved hundreds of human captives. And this is not the only site. There are dozens and dozens of others throughout this district.

**Beneath the surface of this parcel, however, is evidence.**

Nestled between the Interstate that tore through the City in the 1950s, beneath the partially deconstructed remnants of the freight-rail industry and adjacent to Main Street Station - a central transportation hub - are a few parking lots and a patch of green. This sits above tangled city infrastructure that was placed here because nothing else was planned for this location. This all encompasses evidence - the archaeological evidence of the truth of slavery. The foundation walls, cobblestones, retaining wall, and artifacts unearthed in 2006-2008 are the reason for this report.

**This is not a typical site study.**

The goal of this report was not to analyze the feasibility of an office building, or parking structure. The goal is not to discover why NOT to build a museum. The challenges outlined and analyzed should not be the starting point.  The goal, for memorialization and acknowledging the importance of both site and history should be to use human ingenuity to overcome the challenges, mitigate the constraints, and reveal the untold, hidden, and covered up story of the enslavement of Africans and African Americans in this district, city, and region. It is to tell the story of the foundation of this country, honestly.

**It is complicated, history is complicated.**

When asked for his perspective about the location of an interpretive center on this exact location, Dr Lonnie Bunch, then founding director of the National Museum of African American History and Culture (NMAAHC) and now Secretary of the Smithsonian Institution, relayed that the NMAAHC had to "manufacture sacred space", but that here, at the Lumpkin's Slave Jail Site / Devil's Half Acre in Richmond Virginia – the citizens of Richmond have "Sacred Space".  It happened here. We have evidence here.

**The Challenge**

When asked what he thought would be the biggest challenge, Dr Bunch stated, "Making people believe this can happen". It was the same for NMAAHC, and we know proposing an iconic institution that reflects the magnitude of the place and its story will be hard work. We know this cannot be the only thing proposed and completed. However, through the mitigation of technical constraints and collaboration we can achieve what the constituents of Richmond requested: a site of memorialization and interpretation that utilizes authentic evidence to tell the story of and the legacies of enslavement, a place that ties to current and future interpretive sites such as the Richmond Slave Trail and African Burial Ground, to provide a place of healing and conversation, and a reflective place at the center of an entire district and city-wide campus of important sites.

**There is no National Museum of Slavery.**

This is the Nation's opportunity to have that unique asset in the City of Richmond – to have the City of Richmond, through the power of its constituents, lead by example and provide a legacy to our next generation.

## The City of Richmond CAN build on this site, and CAN achieve the vision of its community.

# INTRODUCTION

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INTRODUCTION
In 2006, the archeological remains of the infamous Lumpkins's slave jail were unearthed in Shockoe Bottom. This activity built on the foundational work and inception of the Richmond Slave Trail in the years that preceded the archaeological findings. Following initial community consultation work performed by Lord Cultural Resources ("Richmond Speaks), the City of Richmond defined and outlined a request for proposals for architectural teams to submit to provide comprehensive architecture, engineering, museum, archaeological and historic resources, technical, and interpretive services to define the future of the Lumpkin's Slave Jail Site in conjunction with the foundation of a museum.

In 2016, the City of Richmond hired the SmithGroup team that included a multi-disciplinary team of over 10 firms and individual resources in a contract that began at the Pre-Design phase to define a concept, program, and interpretive plan for the Lumpkin's Slave Jail Site/Devil's Half Acre through a community-oriented engagement program. The Schematic Design, Design Development, Bid, and Construction Administration Phases would be completed after the concept was defined, delivered, vetted by the community, and then tested through a financial, organizational, and business planning process for any entity or interpretive element that was defined in the concept. The Pre-Design concept draft encapsulated work done between 2016 and 2018.

The work and report produced in draft form in 2018 and delivered to the City of Richmond in 2019 was the culmination of ongoing invited workshops, individual stakeholder interviews of potential partnering organizations, several small group sessions, multiple on-location conversations, and targeted mini workshops with Richmond Public Schools and Virginia Union University. The resulting conceptual program, conceptual guidelines, and proposed concept was the culmination of the in-person work and engagement, online survey results, voting, City and public feedback at every stage of the approved conceptual process. The process involved several hundred individuals and dozens of stakeholder groups.

In addition, the SmithGroup project team captured information and community desires that were outside of the project scope and delivered those to the City, including the desire for a small area plan, the need for a research council, the need for an interim exhibition, and the wish of the community for a significant and visible action on the part of the City to mark this location, uncover the hidden history of enslavement that is unique to this part of Richmond and the nation and memorialize the stories of countless Africans and African Americans. This included inviting participants of the 9 Acre Memorial Park group to workshops and feedback sessions and recommending on multiple occasions the need for a small area plan that went beyond standard city planning and included a historic, interpretive, and memorial component. Finally, the project team recommended the establishment of the Shockoe Alliance as an avenue to pull the various studies, components of community requests and visions into a

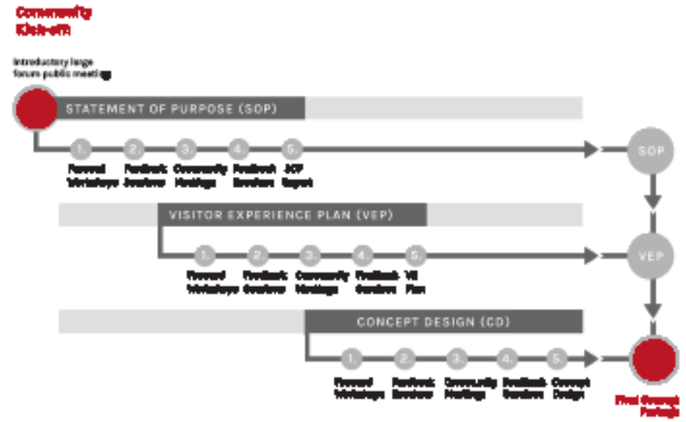



FIG 1: PAGE 12, VOLUME 1 CONCEPT REPORT

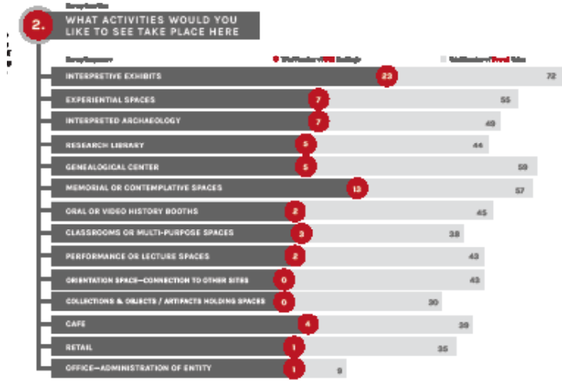




FIG 2: FROM PAGES 40-41, VOLUME 1 CONCEPT REPORT

# INTRODUCTION

The SmithGroup team's process was paused due to additional questions regarding the FEMA analysis of a floodway and additional, revised flood and storm water information that was relayed to the team at the 95% completion point of the Concept Design. This additional information was not resolved and is the purpose for part of this Site Study.

**INTERIM FEASIBILITY PHASE: CURRENT SITE INFORMATION STUDY**

This Site Information Study and Analysis Report details the specific site constraints, opportunities, and infrastructure requirements for the specific parcel of the Lumpkin's Slave Jail Site / Devil's Half Acre. The purpose of this report is to define a buildable site area on the property utilizing new and updated data from the City, define the buildable area of the museum footprint within immovable constraints or restrictions, define approaches to the flood plain and flood way constraints, provide additional and updated civil, archaeological, and structural analysis, define additional massing options, provide recommendations regarding the protection of the under grade archaeology, analyze the feasibility and costs of relocating any infrastructure or constraints, and outline clear options and recommendations.

The study builds upon previous site analysis, adds new information, and updates findings and analysis to demonstrate clear direction for placement of a proposed museum building based upon the program that was vetted via the community and public engagement between 2016 and 2018. The study also showcases, through what is called "blocking and stacking" and massing studies how the community derived program may be situated within the revised buildable area. A redesign of the concept was not be performed, however, the massing studies included in this report provide the CoR options that show the footprint, mass, and height of a revised building and its relationship to the surrounding properties.

The definition of the revised buildable site area, floodplain-floodway updates, archaeological information, utilities analysis, massing/blocking/stacking studies, and ROM (rough order of magnitude) costs will provide options and direction for the museum project and interpretation of the archaeology located at the Lumpkin's Slave Jail Site / Devil's Half Acre as well as provide the City with the integration of new and updated information that was not previously received or that is part of new studies and direction of/by the City of Richmond.

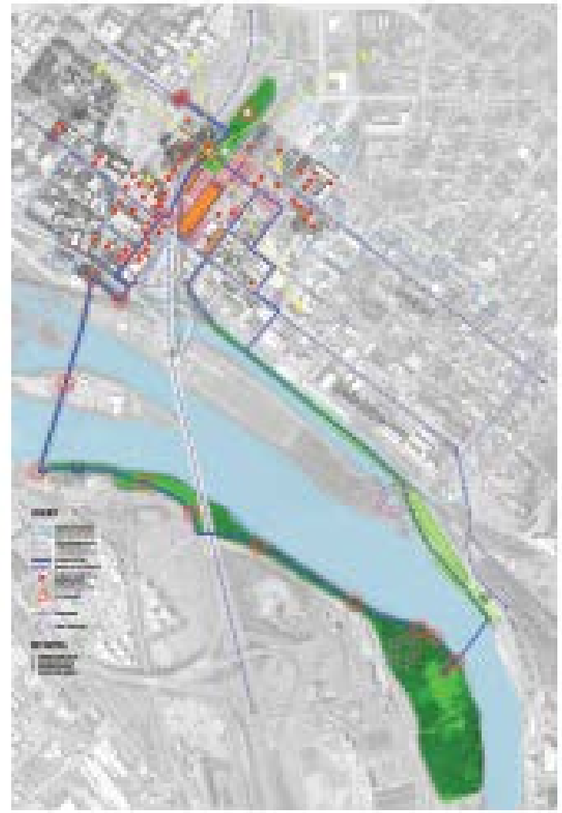


FIG 3 – FROM PAGE 37, VOLUME 1 CONCEPT STUDY

**MUSEUM PROGRAM**

The blocking and stacking and massing studies in this report maintain the community vetted architectural program that was the result of the City supported engagement process of 2018.

This building program defines a museum that is a new typology and a non-traditional center for the much larger story and need for interpretation in Shockoe, connection to the Richmond Slave Trail, and greater connection to the region and nation.  The building program, vetted, and suggested by the community process, during which the public expressed that the building should not simply interpret Lumpkin's jail, but act as a connector and tell the broader story.

The building includes interpretive galleries, support and administrative spaces, community and gathering spaces, a genealogical center, research spaces, community classrooms, and protects and interprets the most important asset and evidence of this history, the archaeological remains of the Lumpkin's jail. The community defined a need for a museum that was different, but also that was significant enough to represent this immense and foundational story in our nation. This new structure would act as a hub, or center for the district, for adjacent and close-by memorials, landscapes, trails, and connected sites of significance and city-wide interpretation of the history of enslavement, and more particularly within the Shockoe slave trade era

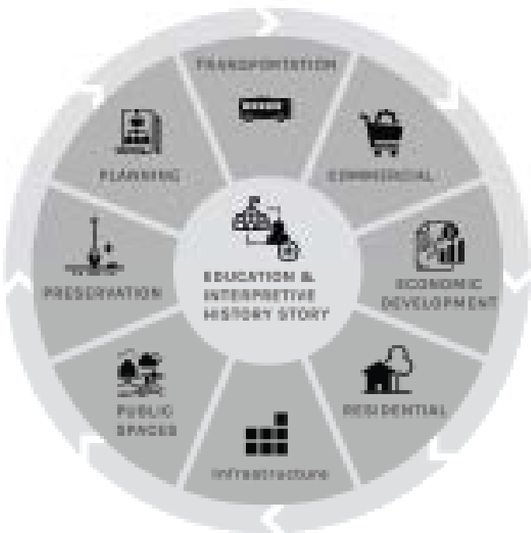



FIG 4 – FROM PAGE 42, VOLUME 1 CONCEPT STUDY

The museum program includes spaces that were direct requests of the public, provides a memorial and interpretive vision of a size and character

# INTRODUCTION
## MUSEUM PROGRAM

### CONCEPTUAL DESIGN PROGRAM

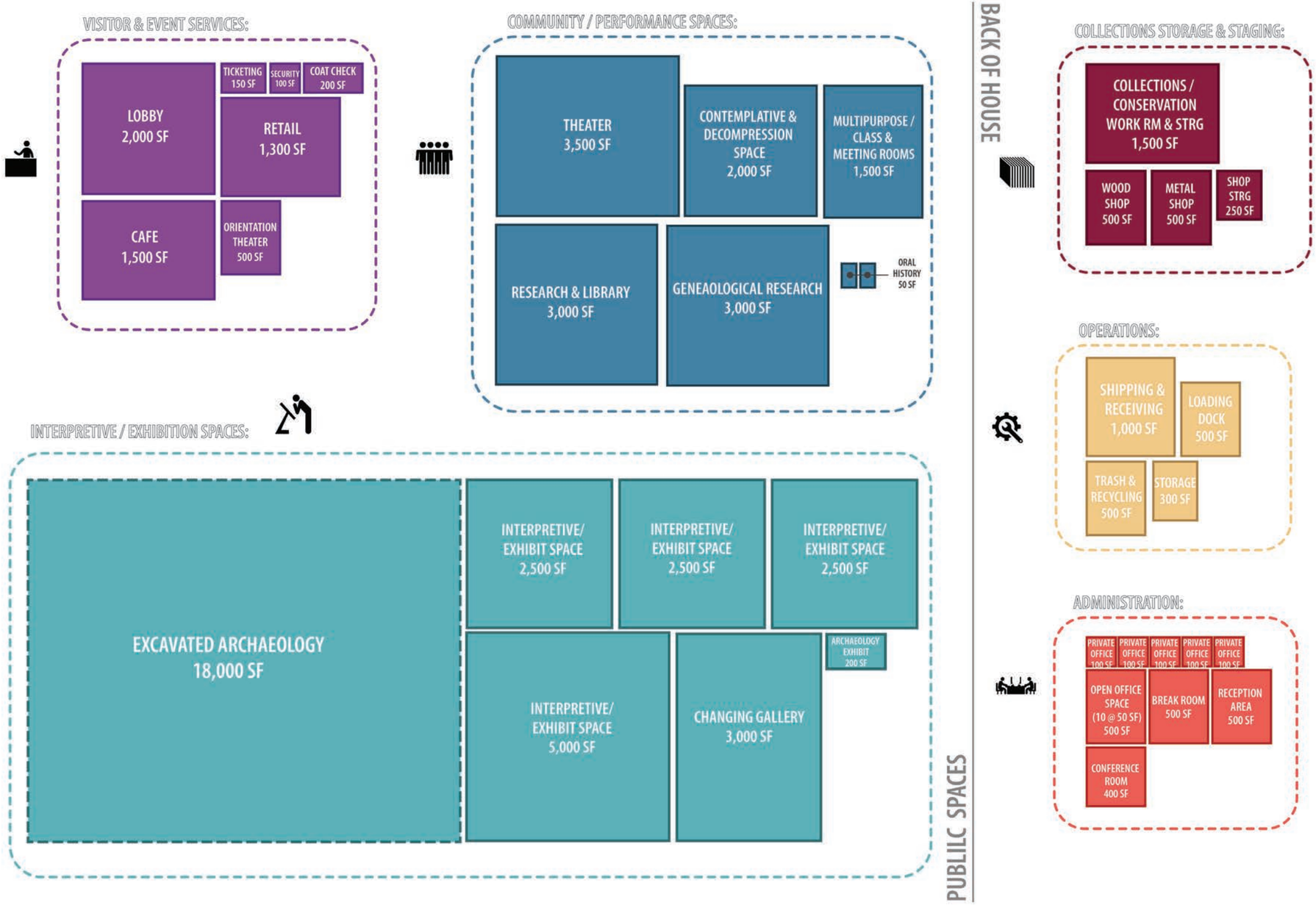
**PRELIMINARY PROGRAM - DRAFT**

| | Qty | Est. SF | Subtotal Est. SF | Activity |
|---|---|---|---|---|
| **VISITOR & EVENT SERVICES** | | | | |
| Lobby | 1 | 3,200 | 3,200 | Will be the main welcoming space for visitors and introduce them to the history and main themes of the museum. |
| Ticketing / Visitor Experience | 1 | 150 | 150 | These spaces serve the basic entry & visitor orientation functions, required for the "museum", in conjunction w/ the lobby. |
| Ticketing Storge | 1 | 50 | 50 | Storage area to serve ticketing functions |
| Coat Check | 1 | 200 | 200 | An area for visitors to store their coats |
| Lockers?? | | | | |
| Security Office | 1 | 100 | 100 | |
| Orientation Space/Theater | 1 | 2,500 | 2,500 | Assembly and orientation for school groups or special groups with greeting podium & multimedia functionality. |
| Look-Out - Go - Out Space | | | | |
| Museum Store & Storage | 1 | 1,300 | 1,300 | Museum shop will support the "Museum Mission", enhance the visitor experience, and provide additional revenue for the "museum". |
| Food - Café | 1 | 2,000 | 2,000 | This space will serve beverages and light fare to visitors throughout the day, at night could possibly open up for after hours special/community events, and provide additional revenue for the "musuem" |
| | | **Subtotal** | **9,500** | |
| **COMMUNITY / PERFORMANCE SPACES** | | | | |
| Theater (Seated-250) | 1 | 3,500 | 3,500 | To be used primarily for lectures/discussion panels, film, music, & performances. |
| Oral or Video History Booth | 3 | 50 | 150 | A private space designed to collect the oral histories of visitors & community members to share the stories of their life, their ancesstors, and/or emotions from visiting this site. Collection can be curated and displayed by the museum. |
| Multipurpose Space / Classroom & Meeting Rooms | 3 | 500 | 1,500 | Educational spaces for groups of students or community related fuctions. This space provides a flexible learning space or expansion for Studios and/or Workshops. |
| Research & Library | 1 | 4,000 | 4,000 | Special Collections/Rare Books Library/Archives (activity is Historic Research Space), Library Space(s) |
| Geneaological Research | 1 | 2,125 | 2,125 | Space for visitors to research their geneaology. |
| Contemplative & Decompression Space/ Curated Leave behind Sacred Space | 1 | 2,000 | 2,000 | A quiet space with seating area(s) providing a place for respite, and emotional decompression. Visitors will also be able to leave behind objects, writings, etc as remembrances and tributes to ones ancestors and others. These functions similarly mirror those that currently happen at the African Burial Ground. |
| | | **Subtotal** | **13,275** | |

### CONCEPTUAL DESIGN PROGRAM (CONTINUED)

| | | | | |
|---|---|---|---|---|
| **GALLERY / EXHIBITION SPACES:** | | | | |
| Excavated Archaeology | 1 | 18,000 | 18,000 | Excavated archaelogical site to be viewed and experienced by visitors. |
| Archaeology - Rediscovering LSJS | 1 | 200 | 200 | Possible exhibit about the arhaeological process & rediscovery of the LSJS for visitors to learn about the proccess of archaeology. |
| Interpretive / Exhibit Space (Large) | 1 | 6,000 | 6,000 | Based on interpretive bucket from VEP. |
| Interpretive / Exhibit Spaces | 1 | 10,000 | 10,000 | Based on interpretive buckets from VEP. |
| Changing Gallery: Visual Artist / Reenactment Space | 1 | 3,000 | 3,000 | Currated space or invited local artist & reenactment / recreation of LSJ space. |
| | | **Subtotal** | **37,200** | |
| **COLLECTION STORAGE & STAGING:** | | | | |
| Collections / Conservation Workroom & Storage | 1 | 2,100 | 2,100 | Collections TBD. This is a multipurpose collection storage space to support the exhibition program and is for the use of curators, researchers and other staff working with collection items on-site, to ensure the safety and security of the collection items. |
| Wood Shop | 1 | 700 | 700 | Carpentry shop to support exhibit spaces. |
| Metal Shop | 1 | 700 | 700 | Metal fabrication shop to support exhibit spaces. |
| Shop Storage | 2 | 500 | 1,000 | Materials Storage Space |
| | | **Subtotal** | **4,500** | |
| **OPERATIONS:** | | | | |
| Shipping & Receiving | 1 | 1,000 | 1,000 | |
| Storage | 1 | 300 | 300 | |
| Trash & Recycling | 1 | 500 | 500 | |
| Loading Dock | 1 | 500 | 500 | |
| | | **Subtotal** | **2,300** | |
| **ADMINISTRATIVE SPACES:** | | | | |
| Private Office Space | 5 | 100 | 500 | |
| Open Staff Office Space | 10 | 50 | 500 | |
| Lounge/Break Room | 1 | 500 | 500 | |
| Conference Room | 1 | 400 | 400 | |
| Reception Area | 1 | 500 | 500 | |
| | | **Subtotal** | **2,400** | |
| | | **Total NSF** | **69,175** | |
| | | **Total GSF** | **96,845** | **140% Gross Factor** |

# INTRODUCTION
## MUSEUM PROGRAM



# EXISTING CONDITIONS

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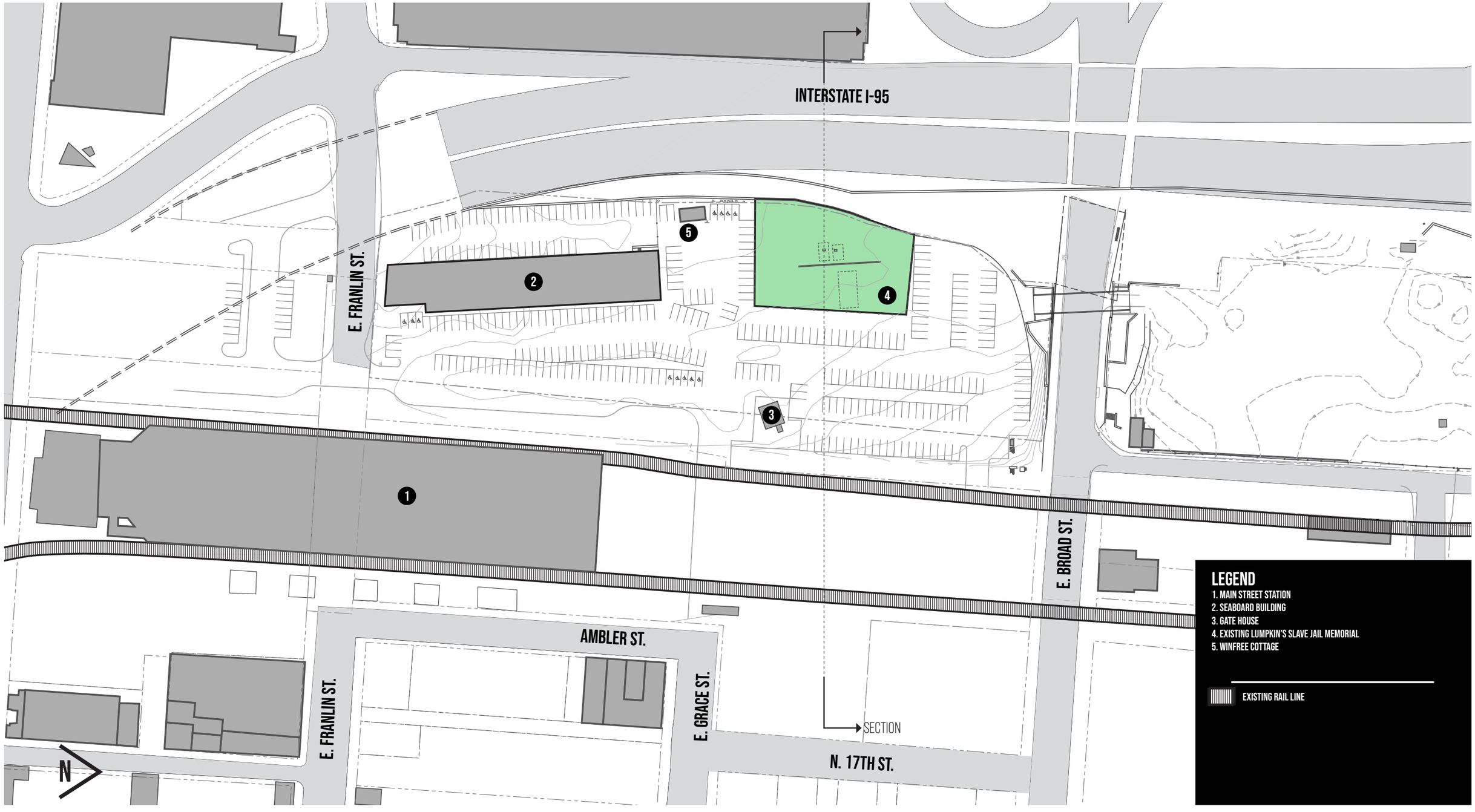
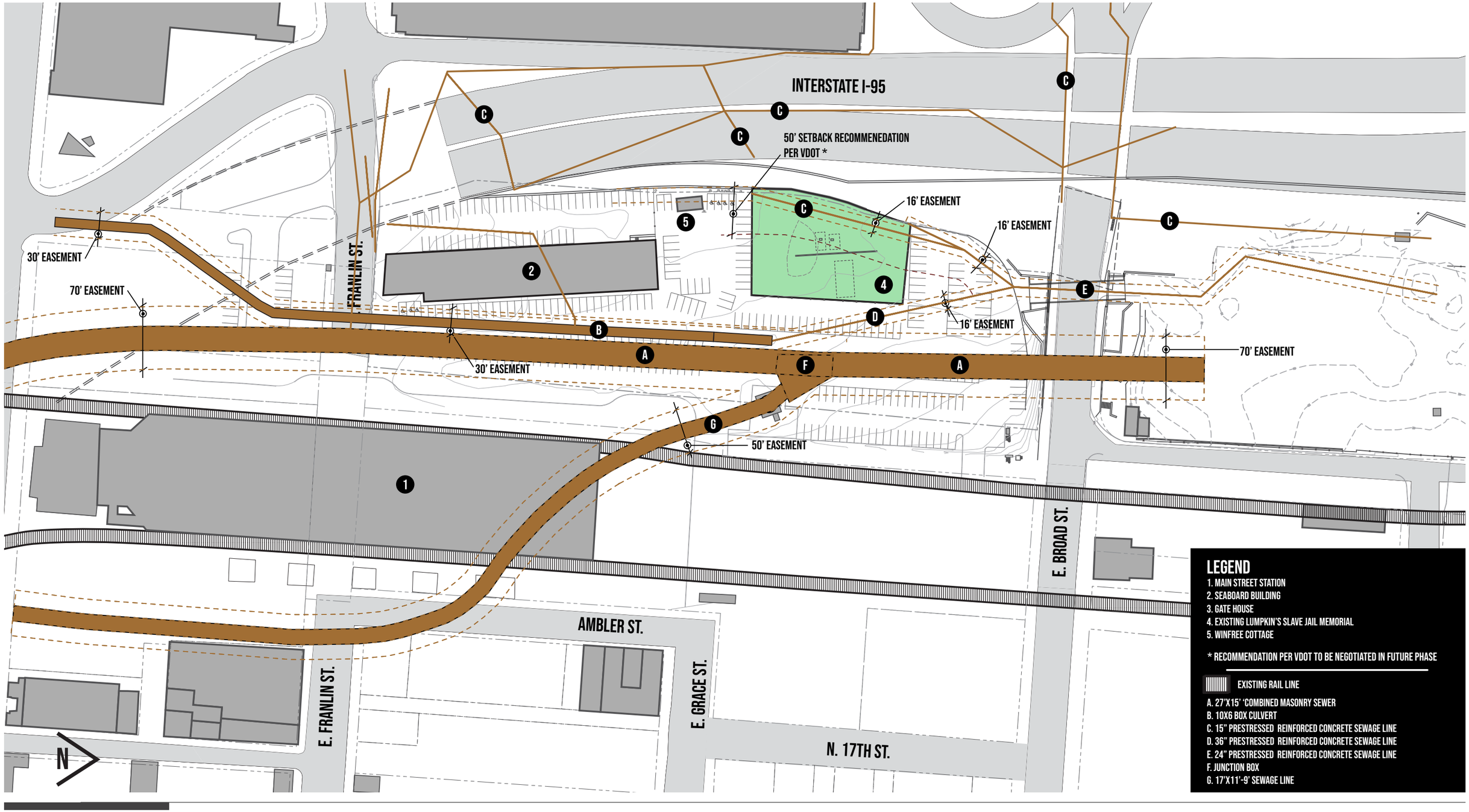
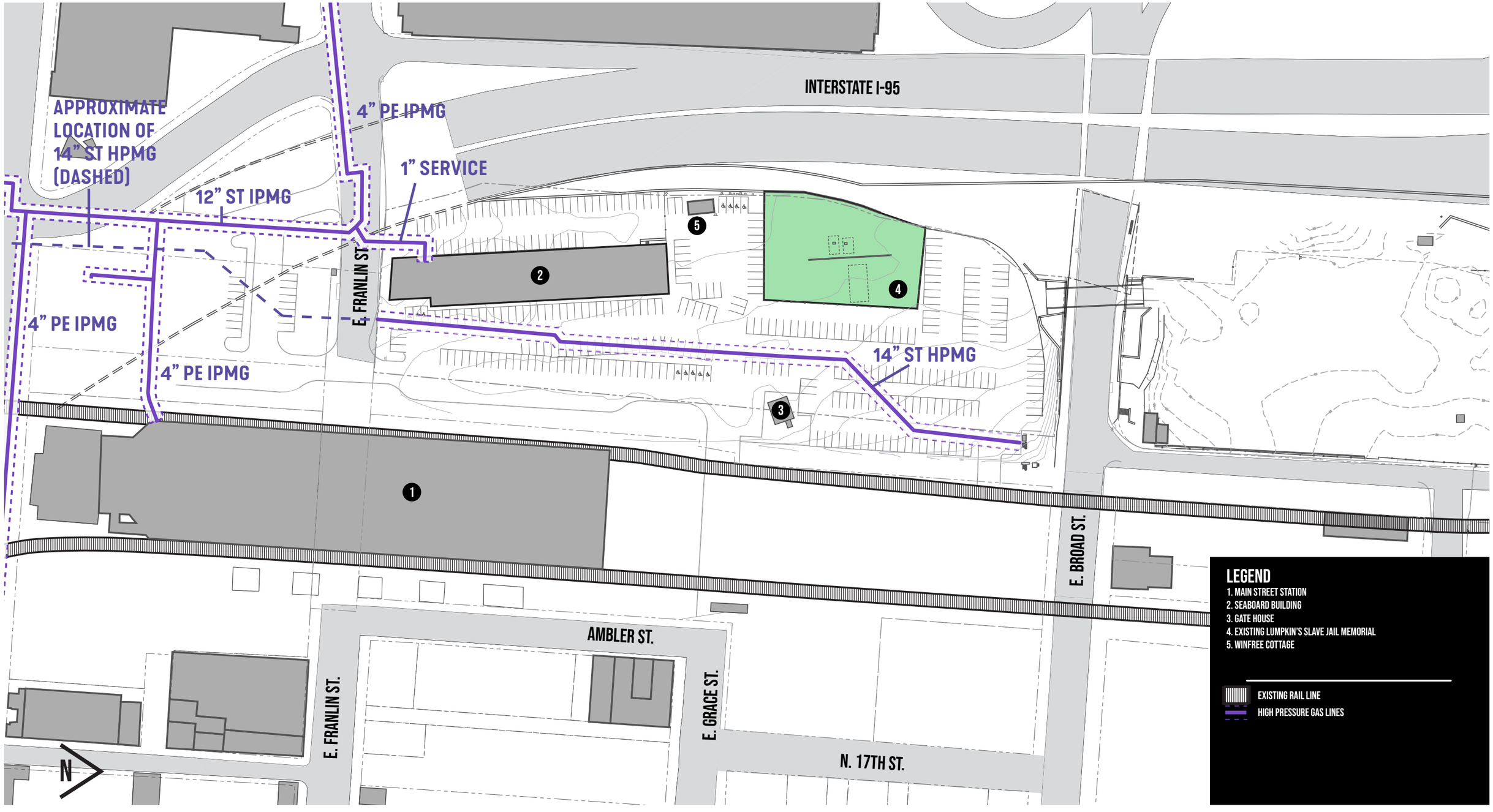
## AT GRADE CONDITIONS



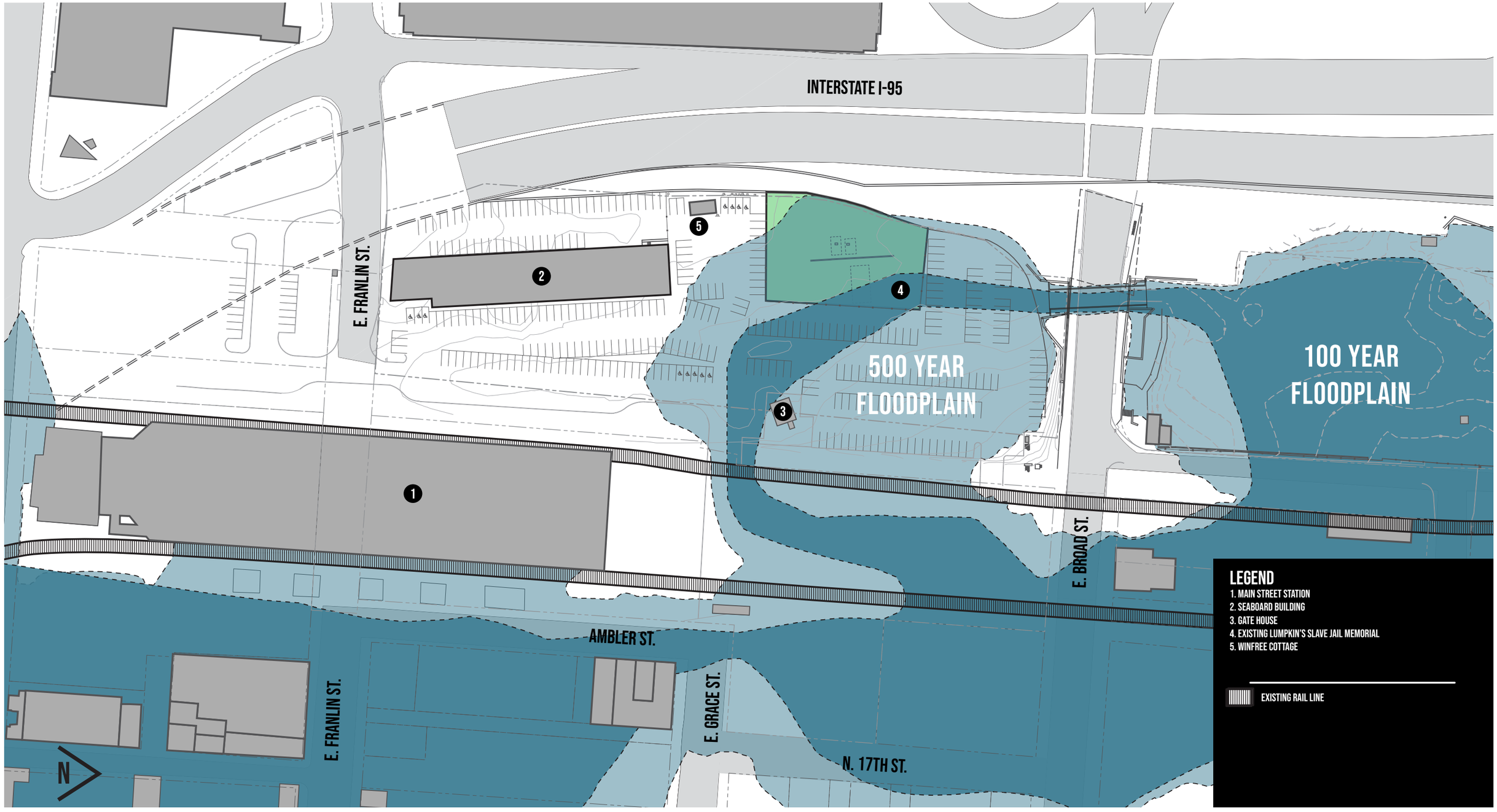
# EXISTING CONDITIONS
## UNDERGROUND UTILITIES



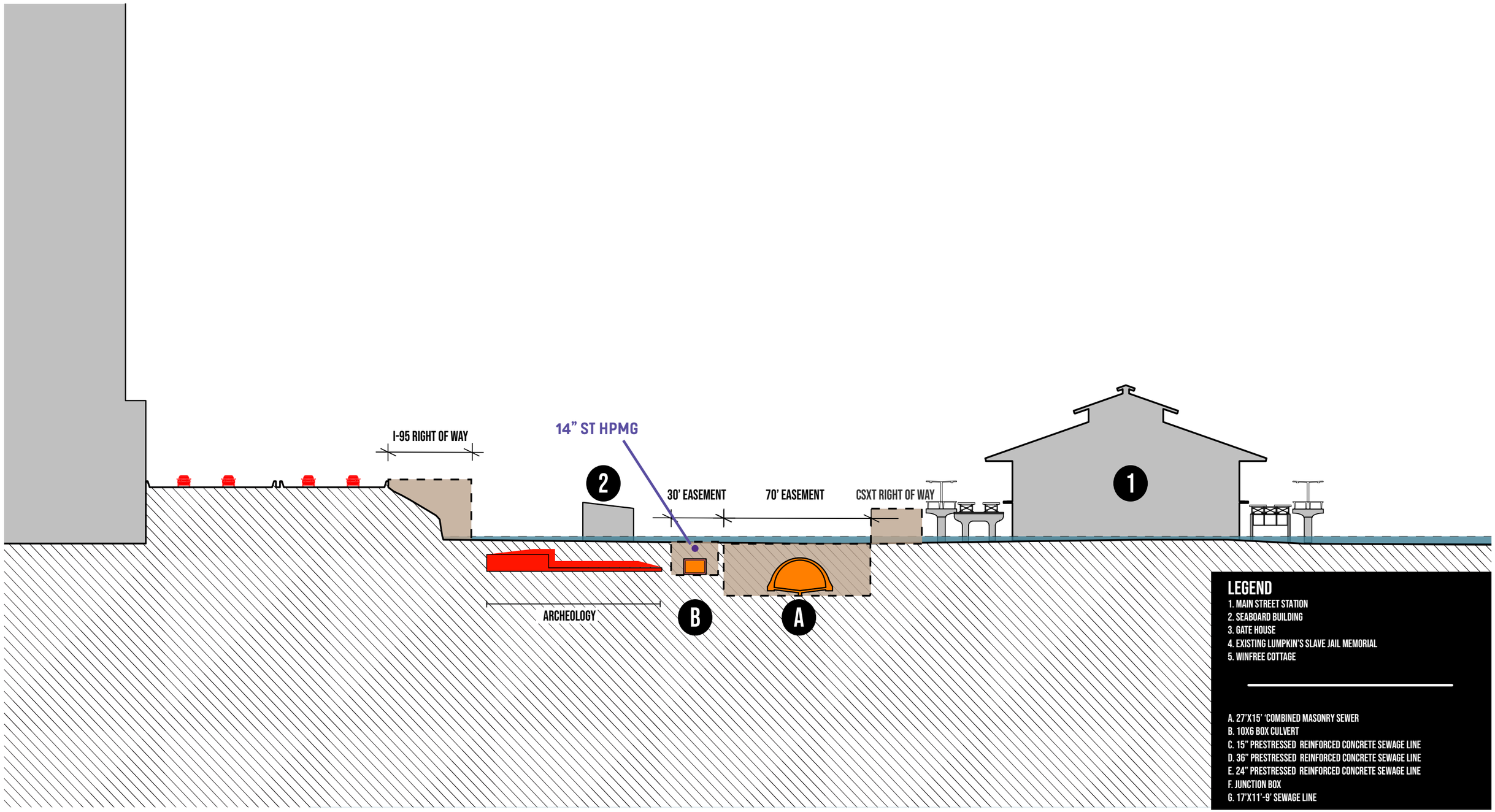
# EXISTING CONDITIONS
## GAS LINE LINES



# EXISTING CONDITIONS
## 100/500 YEAR FLOODPLAINS

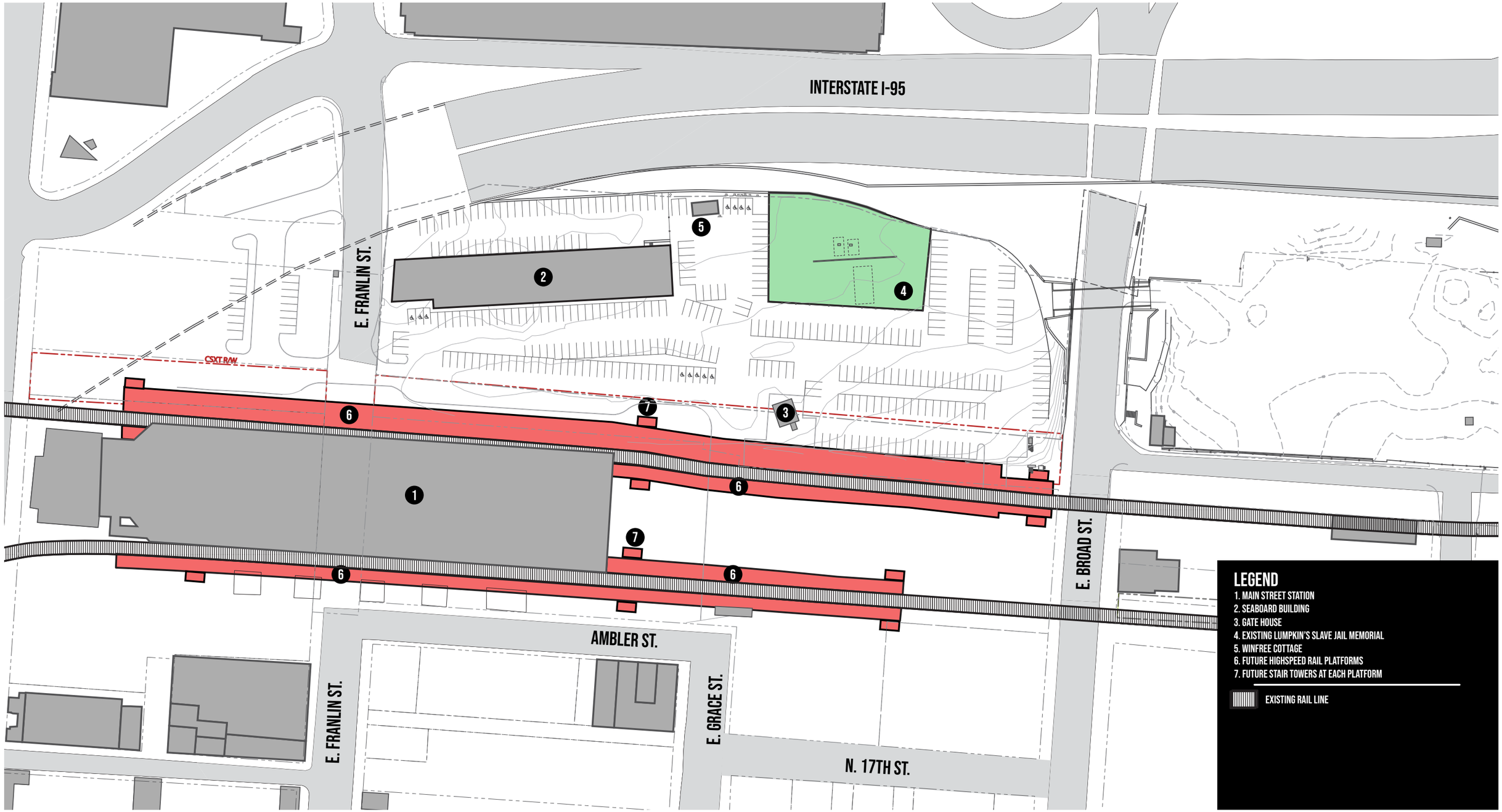


# EXISTING CONDITIONS
## 2D SITE SECTION



# PROPOSED FUTURE WORK

## HIGH SPEED RAIL

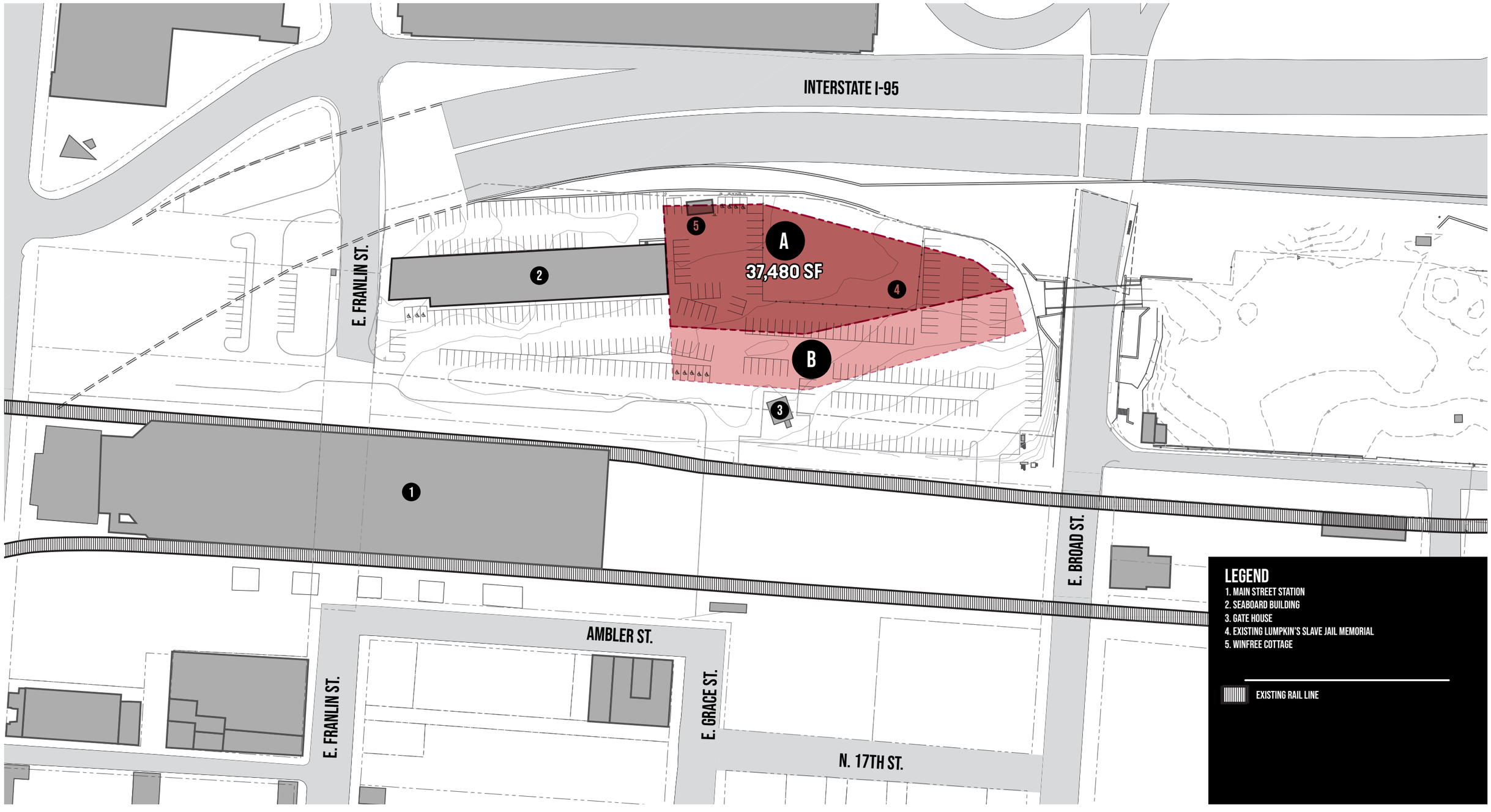


# BUILDABLE AREA BY RIGHT

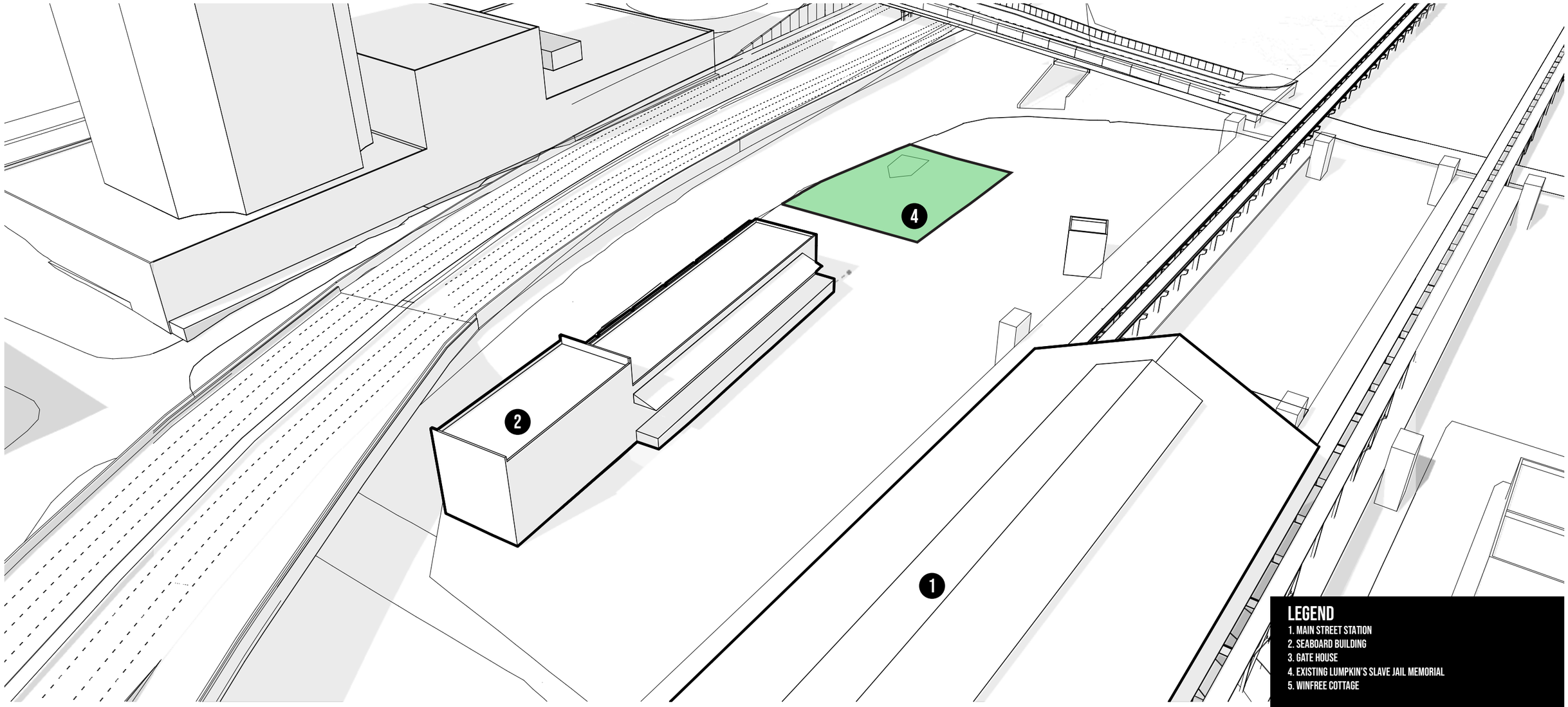
## 2D PLAN

**A** AVAILABLE 2D MASSING ENVELOPE BY RIGHT. DARK RED.

**B** AVAILABLE CANTILEVERED 2D MASSING ENVELOPE BY RIGHT OVER EASEMENTS. TRANSLUCENT RED.



# EXISTING CONDITIONS
## 3D PERSPECTIVE FACING NORTH



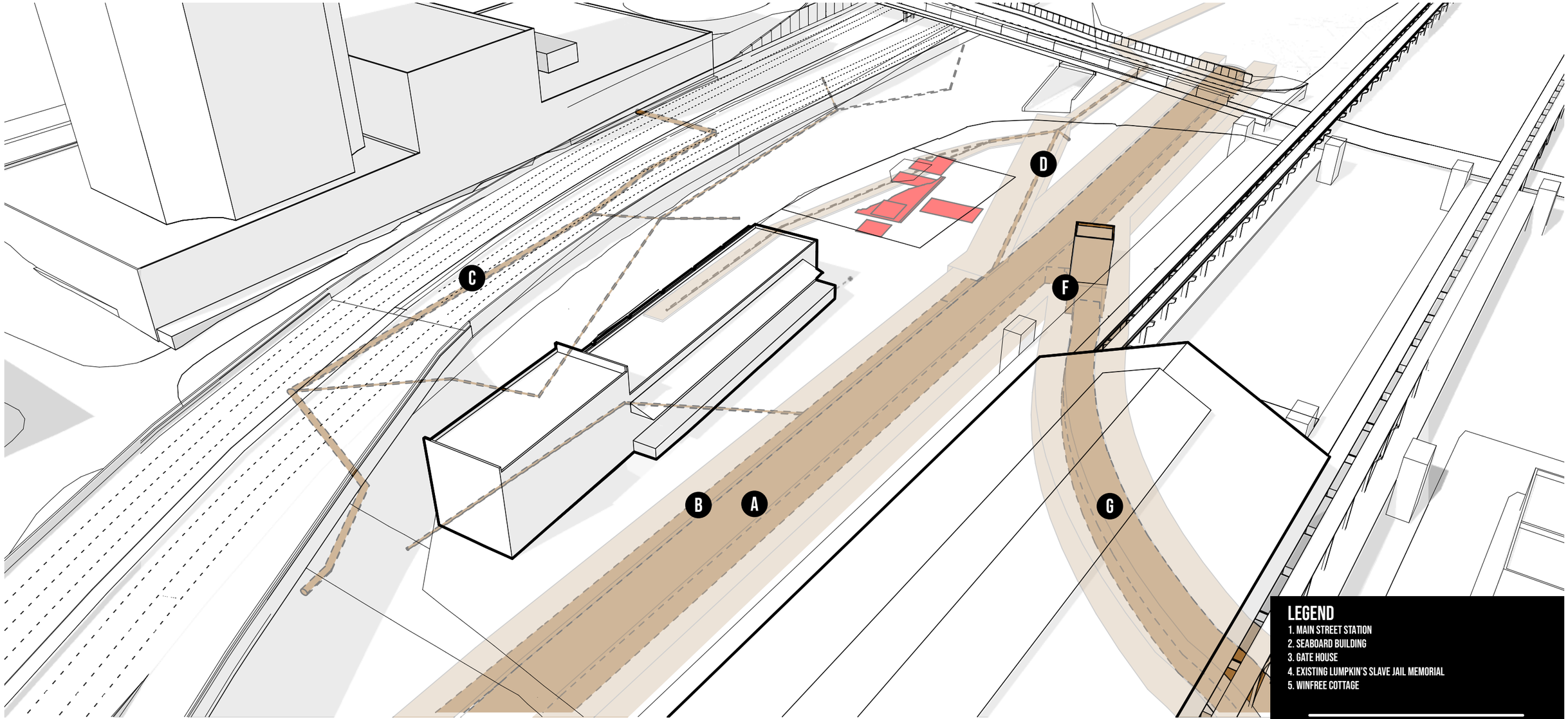

**LEGEND**

1. MAIN STREET STATION
2. SEABOARD BUILDING
3. GATE HOUSE
4. EXISTING LUMPKIN'S SLAVE JAIL MEMORIAL
5. WINFREE COTTAGE

A. 27'X15' 'COMBINED MASONRY SEWER
B. 10X6 BOX CULVERT
C. 15" PRESTRESSED REINFORCED CONCRETE SEWAGE LINE
D. 36" PRESTRESSED REINFORCED CONCRETE SEWAGE LINE
E. 24" PRESTRESSED REINFORCED CONCRETE SEWAGE LINE
F. JUNCTION BOX
G. 17'X11'-9' SEWAGE LINE

# EXISTING CONDITIONS

## UNDERGROUND UTILITIES: 3D PERSPECTIVE FACING NORTH

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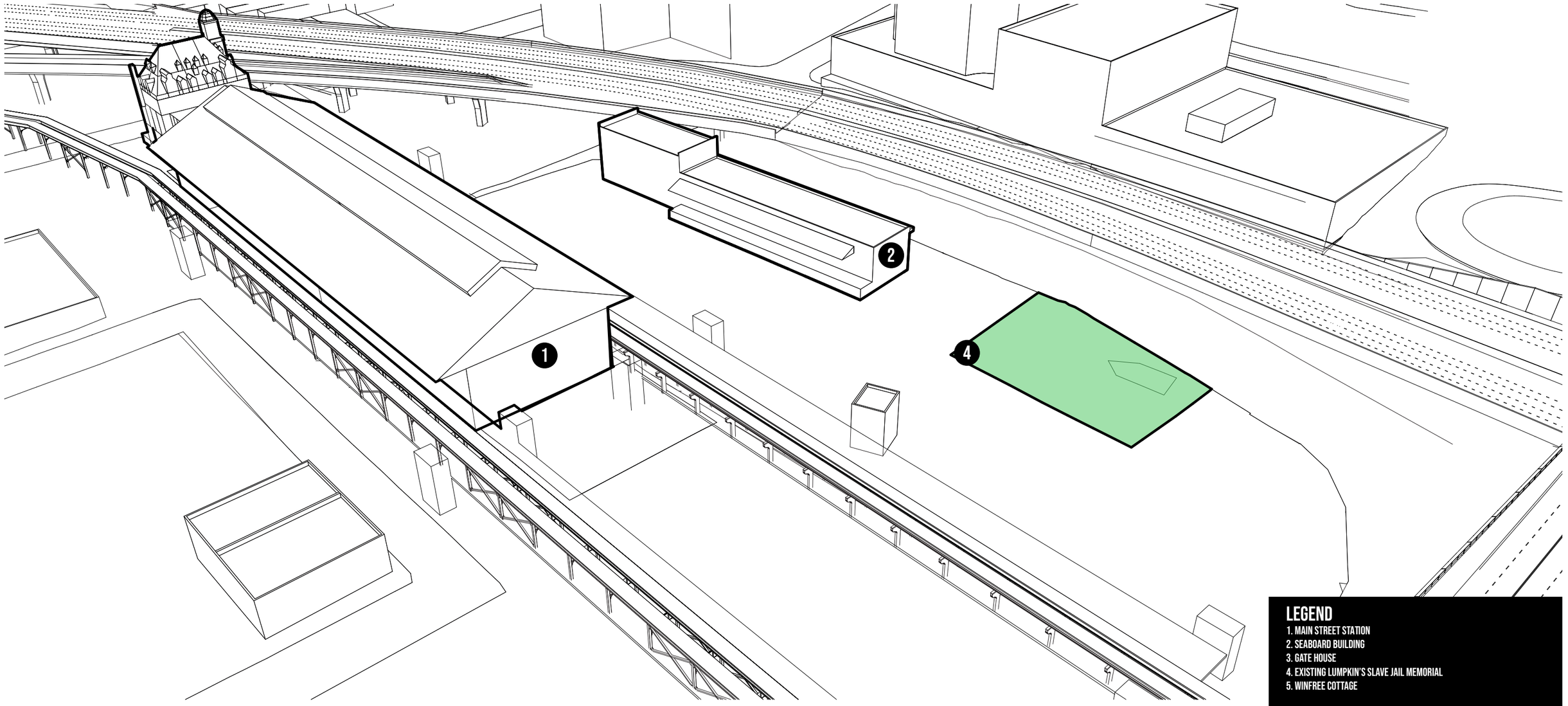
## 3D PERSPECTIVE FACING SOUTH

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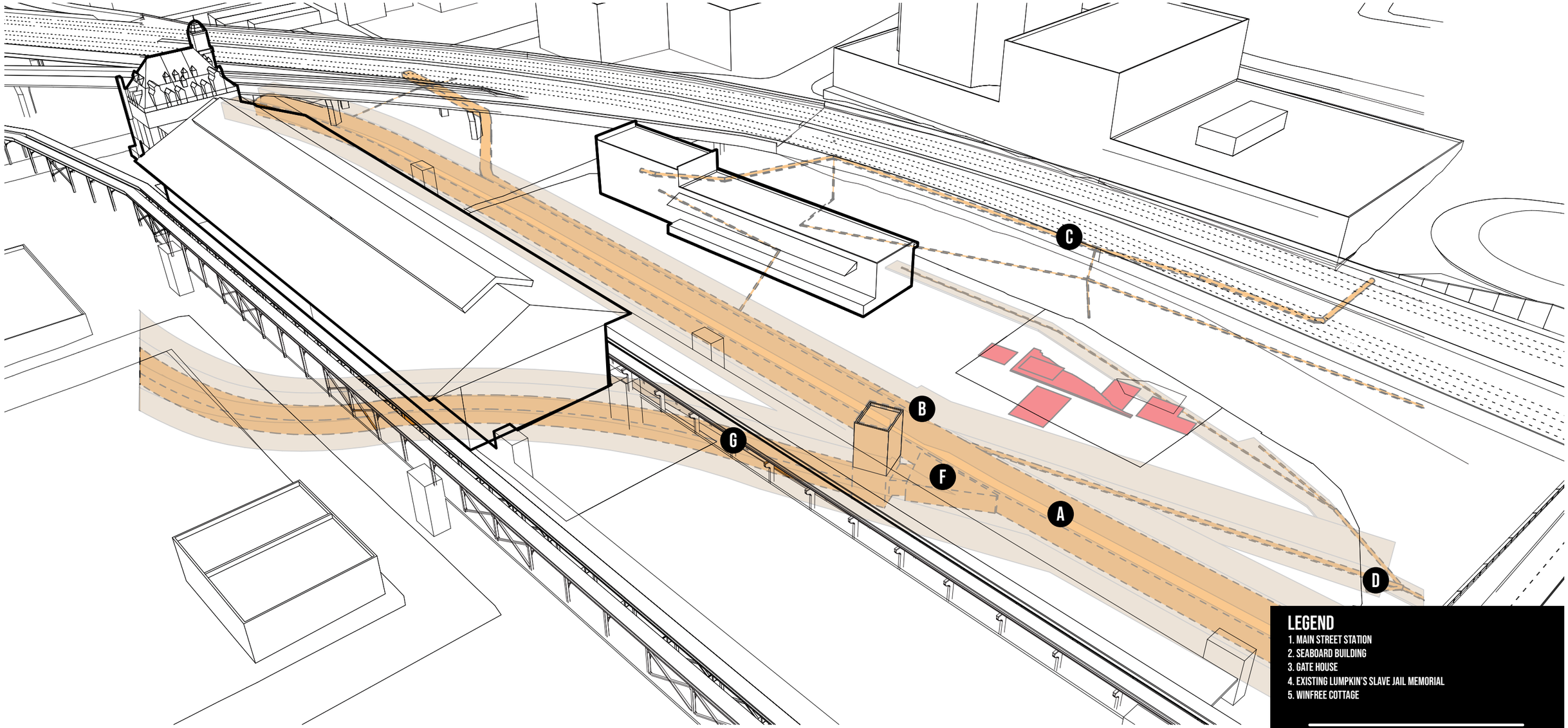


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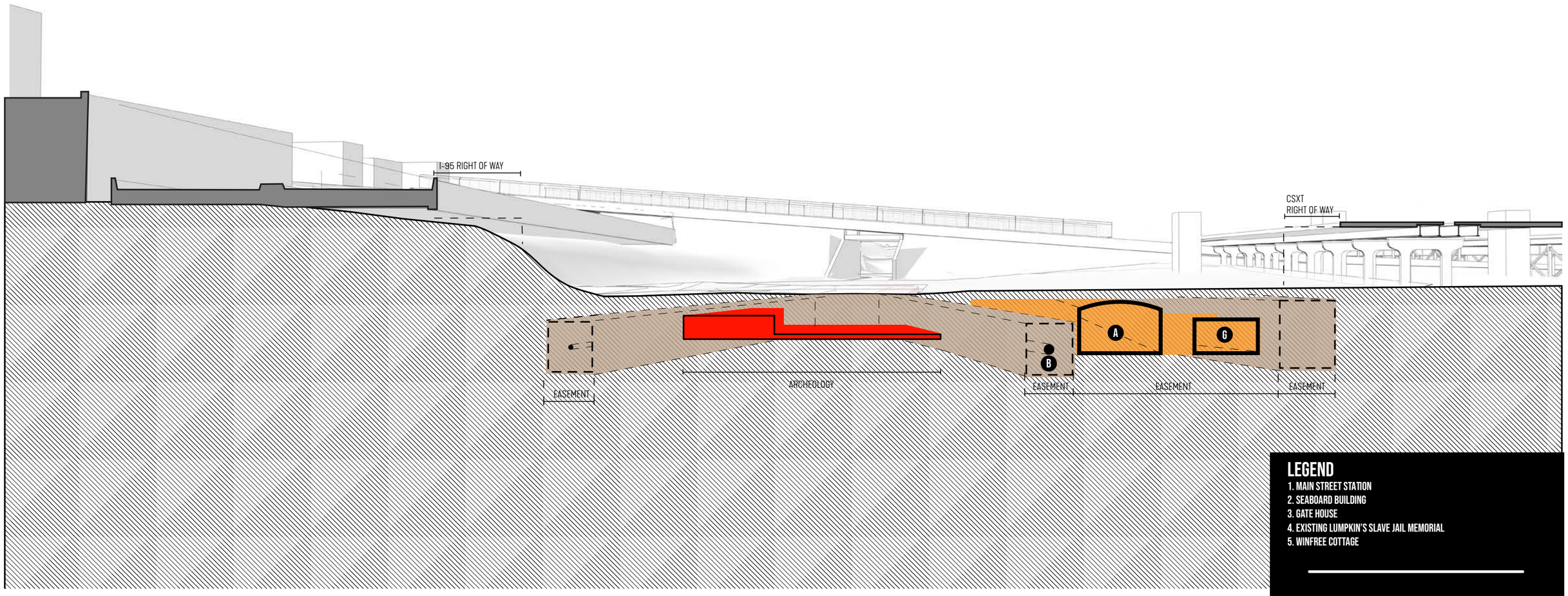
# EXISTING CONDITIONS
## 3D PERSPECTIVE SECTION

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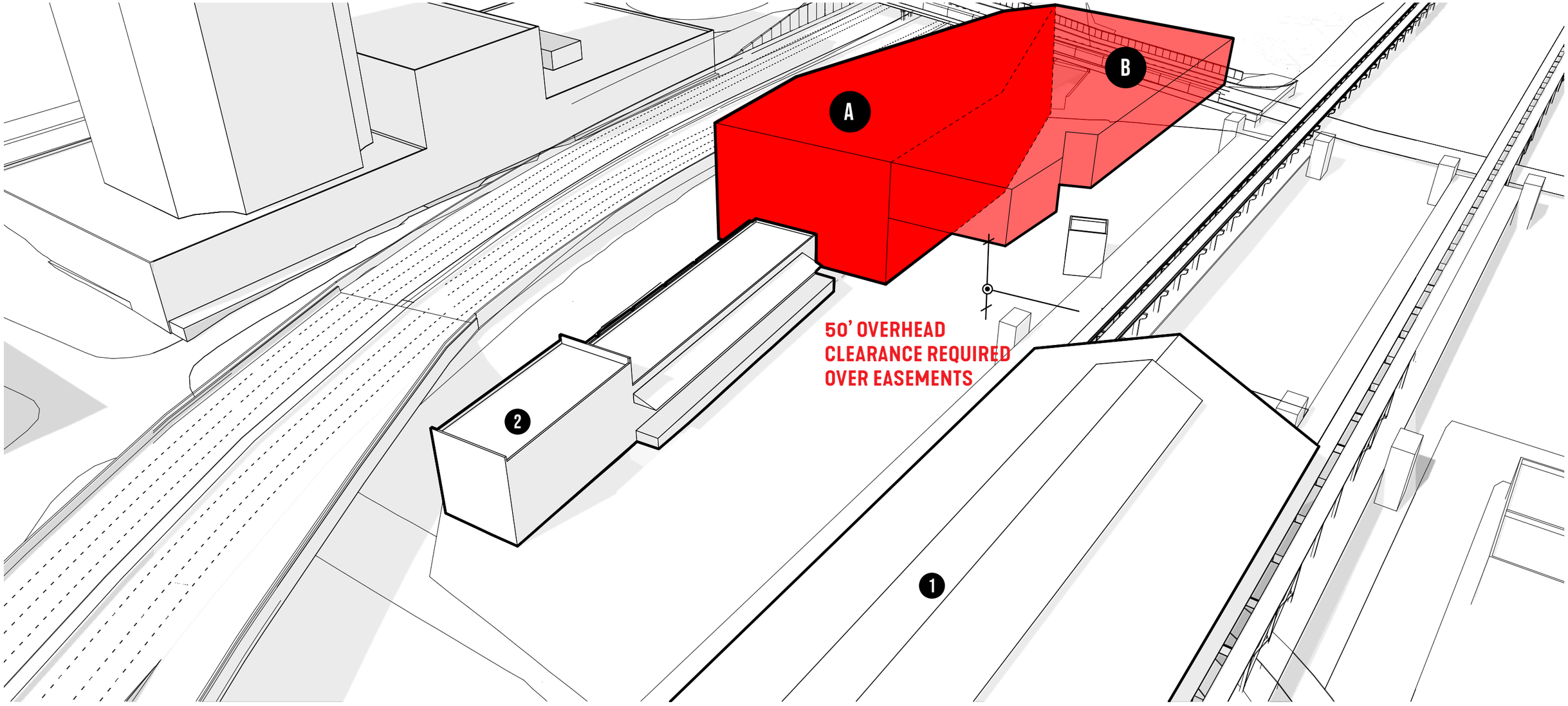
# BUILDABLE AREA BY RIGHT

## 3D BUILDABLE MASS: 3D PERSPECTIVE FACING NORTH




**A** AVAILABLE 3D MASSING ENVELOPE BY RIGHT. (DARK RED).

**B** AVAILABLE CANTILEVERED 3D MASSING ENVELOPE BY RIGHT OVER EASEMENTS. (TRANSLUCENT RED). 50’ OVERHEAD CLEARANCE IS REQUIRED OVER EASEMENTS.

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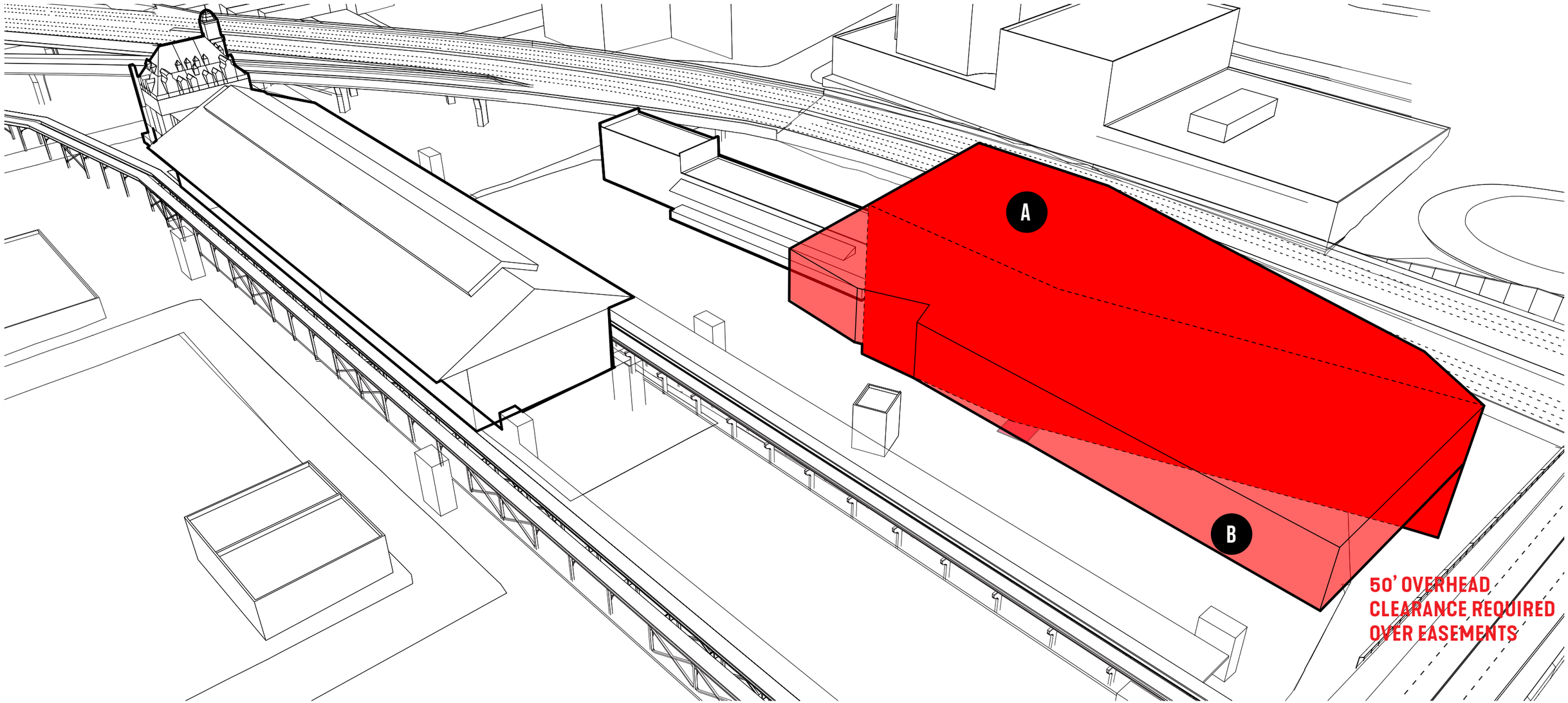


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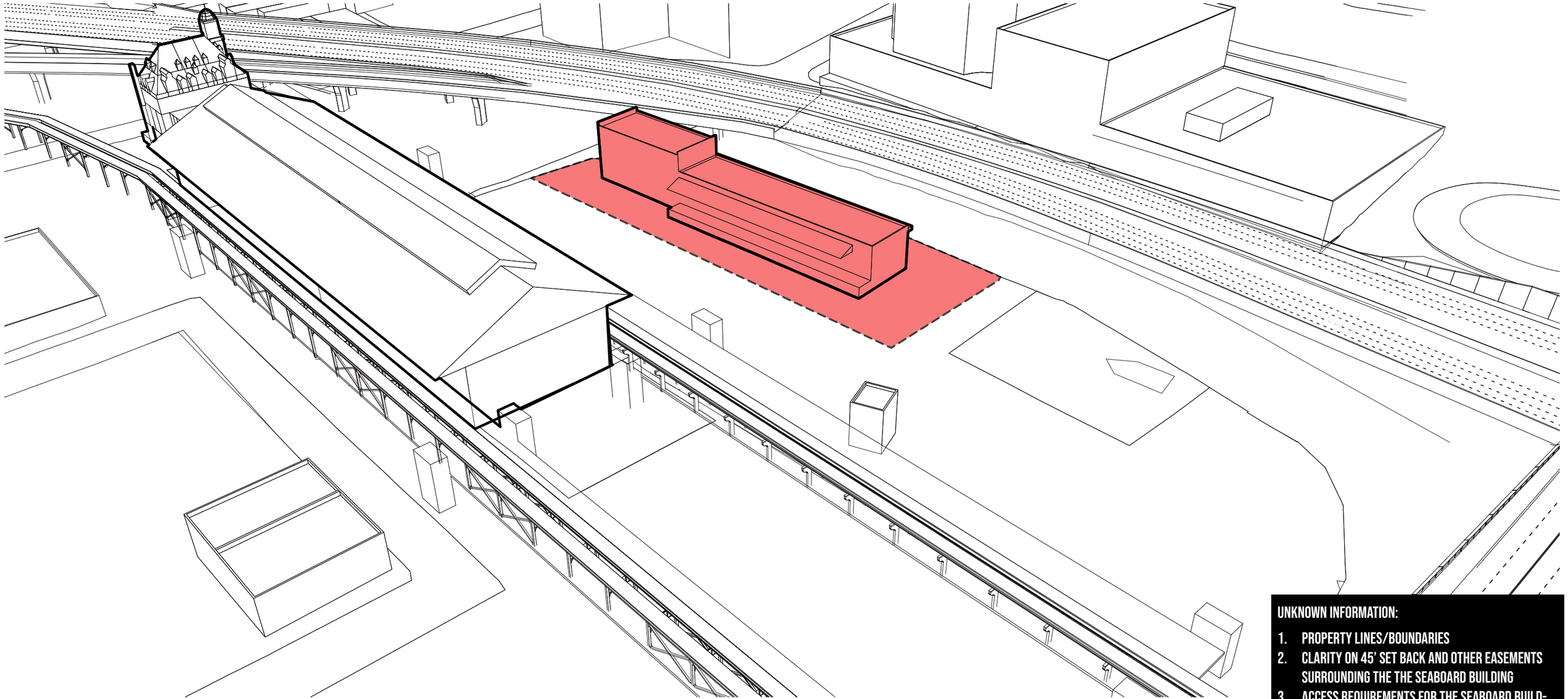
# REQUIRED INFORMATION



**UNKNOWN INFORMATION:**

1. PROPERTY LINES/BOUNDARIES
2. CLARITY ON 45’ SET BACK AND OTHER EASEMENTS SURROUNDING THE THE SEABOARD BUILDING
3. ACCESS REQUIREMENTS FOR THE SEABOARD BUILDING THAT NEED TO BE MAINTAINED
4. CURRENT & FUTURE PROGRAM(S) FOR THE SEABOARD BUILDING
5. ANY EASEMENTS SURROUNDING BROAD STREET

# CASE STUDIES

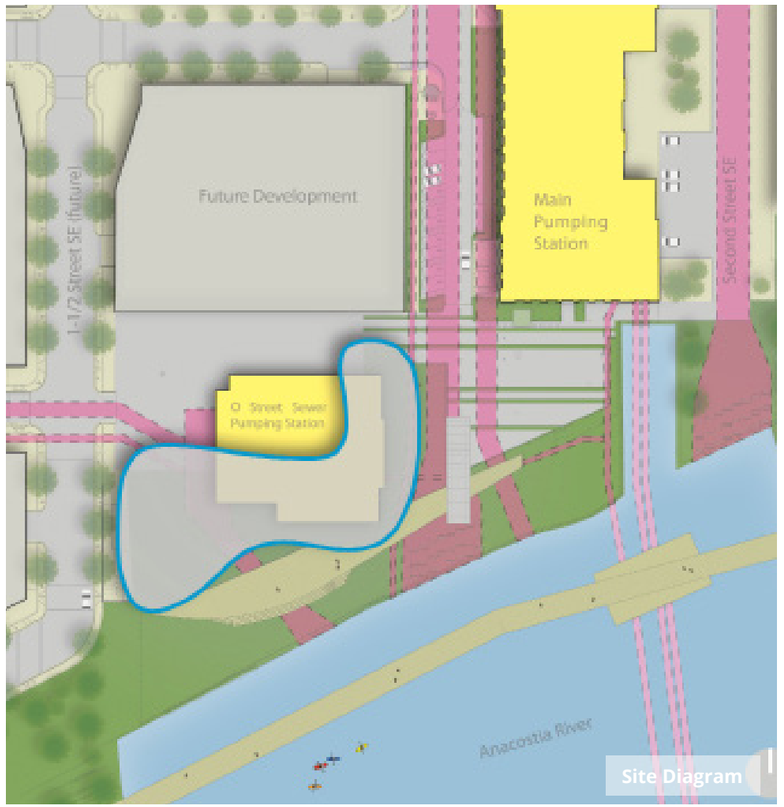
# CASE STUDIES
## DC WATER HEADQUARTS (HQO)

The dc water headquarters is a 150,000 gsf office building built above and encapsulating an operating sewage/storm pump station sited on the bank of the anacostia river. Together, the building and site incorporate state-of-the-art sustainable and resilient design strategies that results in a dynamic workplace. The bold, innovative statement reflects the agency's environmental stewardship. The building's sinuous form and layered skin are carefully shaped by the opportunities and constraints of the site and also informed by computational analytics. The building's north side features punched windows in green cladding recalling the historic use of copper in water transmission. The swouth façade glass curtainwall accommodates views and daylighting. Stepped in areas create shading and a second layer of tinted glass in specific areas reduce heat loads and glare as determined by computational modeling. An innovative sewage heat recovery system heats and cools the building by utilizing waste pumped through the facility below, the first use of this new technology for an office building in the united states. The campus landscape and site design express the flow of water that is captured by a cistern to be used for toilet flushing and irrigation. The project is the result of a design/build design competition. The design/build team utilized numerous innovative tools and processes to design, evaluate, optimize, and facilitate construction of the project.

- The site contains critical underground infrastructure. 70% Of the cities combined storm water and sewage are processed through the pumpstation and associated piping infrastructure before passing on to blue plains for further processing. The areas in pink represent the underground piping infrastructure.

- This Case Study utilized the following techniques which are similar to the constraints of the LSJS/DHA Site:
- 1) Working around and developing a building around and on top of critical historic infrastructure
- 2) Utilizing a foundation system and vibration control to mitigate damage to adjacent infrastructure
- 3) Clash detection software
- 4) Innovative storm water and sustainable water retention and reuse strategies.


❶ O Street pump station
❷ Historicpump station

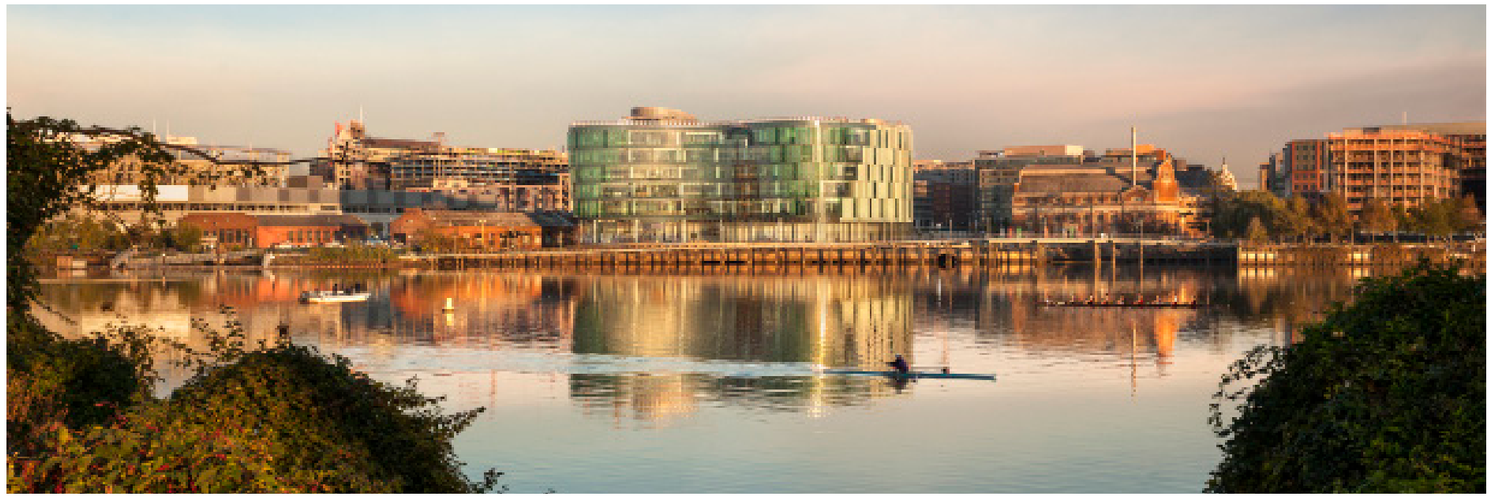



Site Diagram

DC Water HQ

Pumping Station

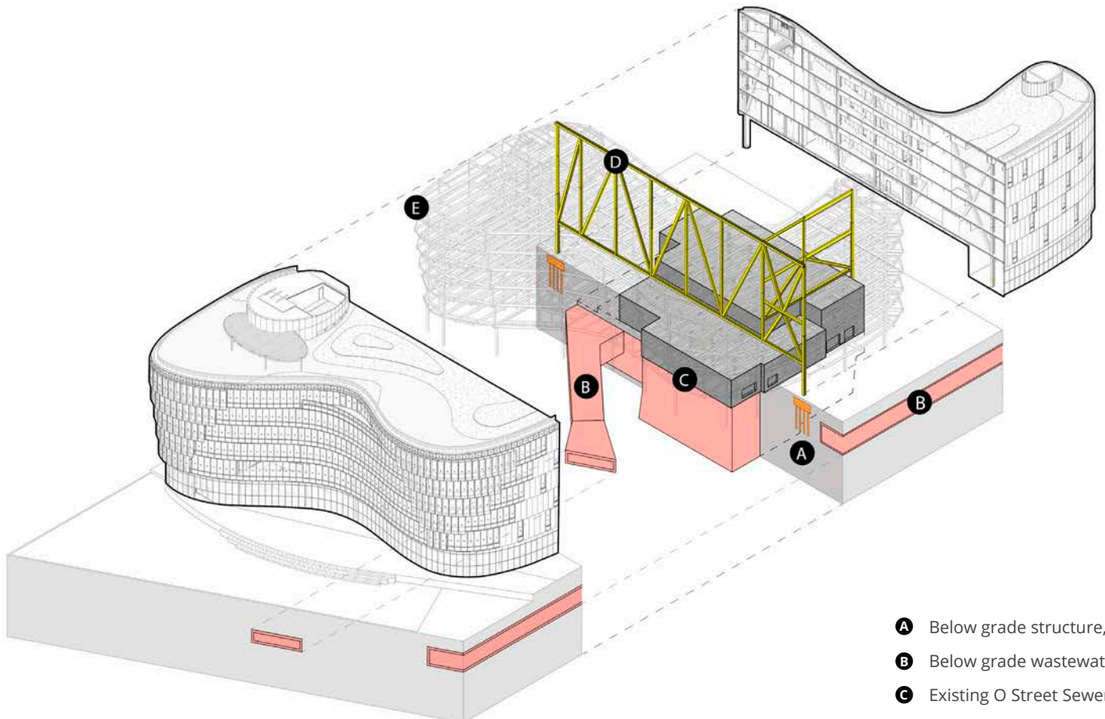
Underground Infrastructure



# CASE STUDIES
## DC WATER HEADQUARTS (HQO) (CONT.)

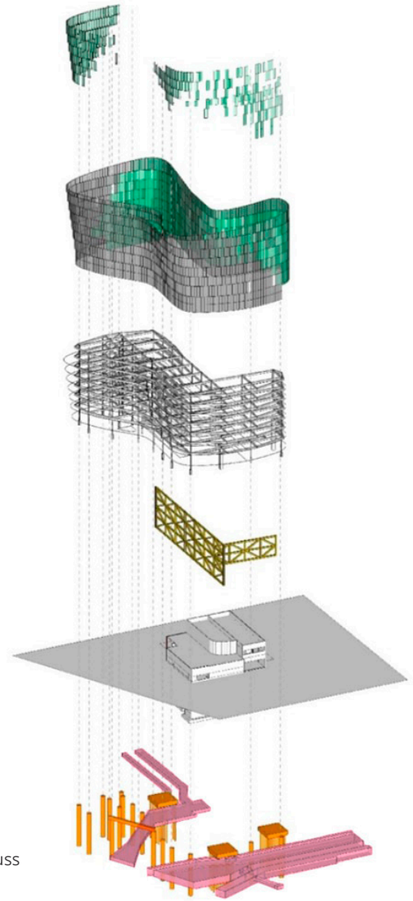
The building spans over an operating pump station and works around an array of below grade obstructions without impacting the operation of the facilities. A 5-story, 200’ long truss and small secondary truss was configured at the back of the building for the portion of the HQ above the pump station. This allowed the remaining structure to be conventional steel framing.

- Foundation systems were auger cast piles to minimize the plan size of each foundation. They were drilled instead of driven to limit vibrations that might impact the infrastructure.
- ground penetrating radar and test pits were selectively done to verify the location and extent of existing underground infrastructure.
- sopishisticated clash detection software was used to document and coordinate fabrication drawings around the pump station and underground infrastructure.

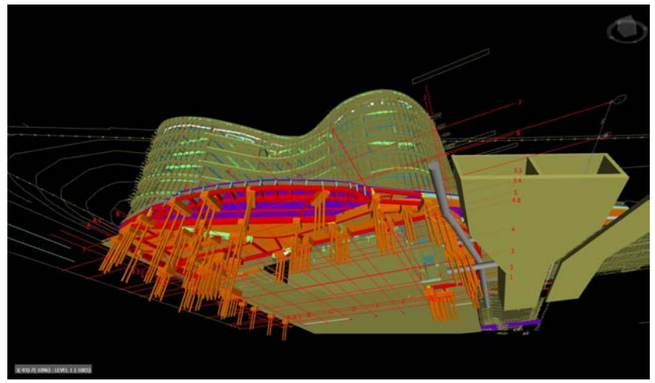


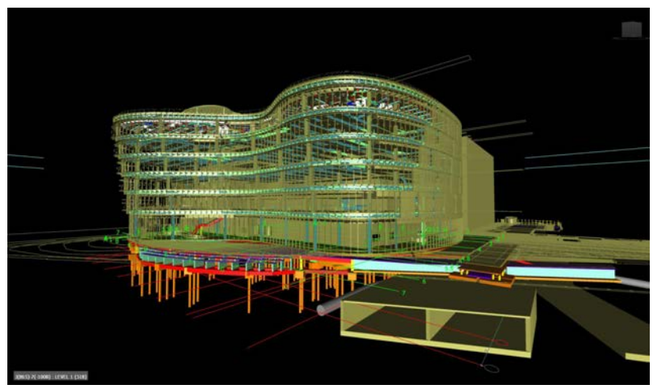

STRUCTURAL DIAGRAM

- **A** Below grade structure, auger cast piles
- **B** Below grade wastewater tunnels
- **C** Existing O Street Sewer Pumping Station
- **D** 200’-long, 5 story main truss and secondary truss
- **E** Conventional steel structure



EXPLODED AXONOMETRIC OF MAJOR BUILDING SYSTEMS OVER EXISTING INFRASTRUCTURE.

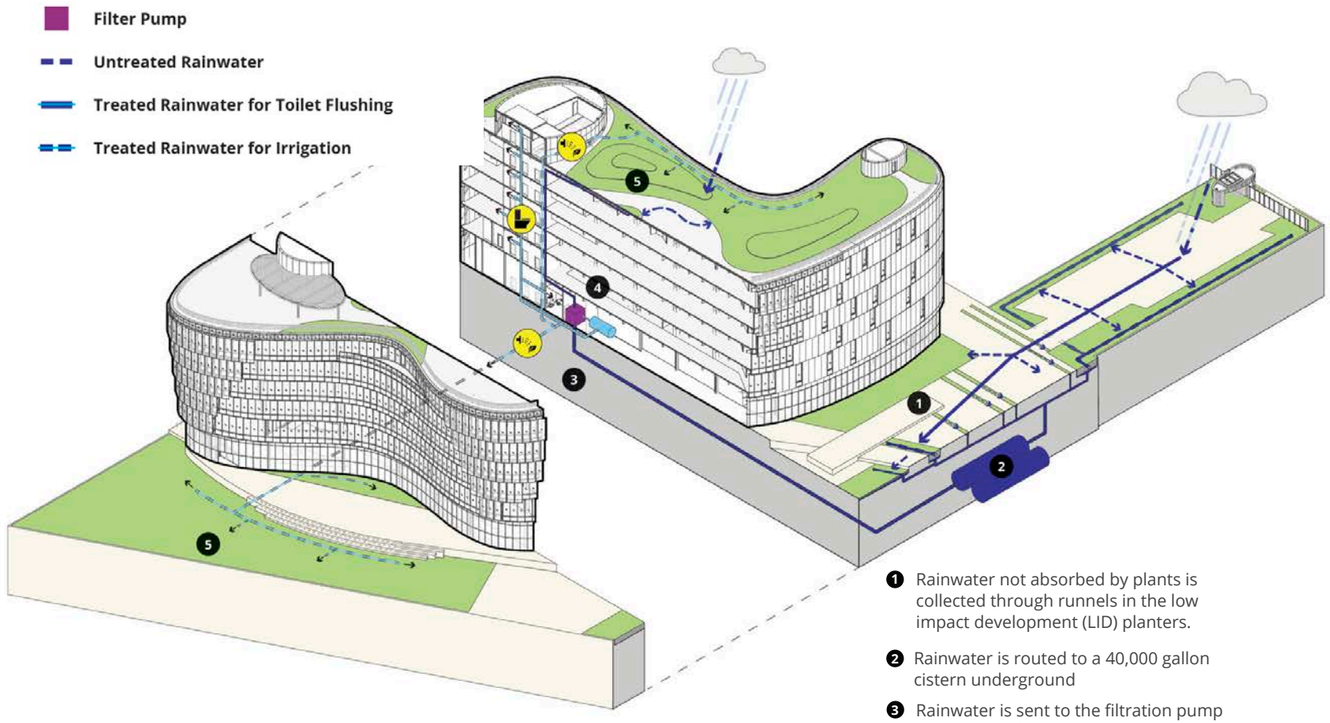




SCREENSHOTS OF CLASH DETECTION PROGRAM

# CASE STUDIES
## DC WATER HEADQUARTS (HQO) (CONT.)

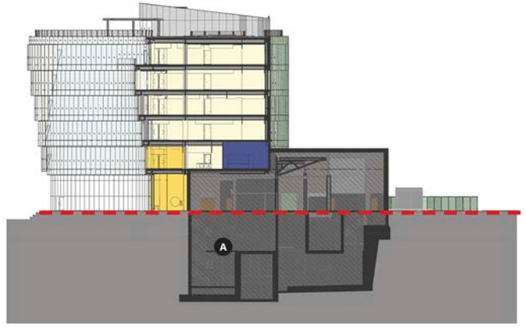
100% of the toilet flushing and irrigation demand for the project is provided by a rainwater harvesting system. A 40,000 gallon cistern located below the autocourt receives rainwater from the site that is pumped to the HQ, filtered, and used toilet flushing and irrigation needs. This results in a 72% reduction of water use for the building compared to a benchmark. LID and bioretention plantings absorb and filter rainwater before it is conveyed to the cistern. Runnels in the autocourt collect the water as it is funneled to the planted zones. A small day tank and pump room with viewing window are located in the building lobby to demonstrate the building's water strategy.




RAINWATER HARVESTING DIAGRAM

1. Rainwater not absorbed by plants is collected through runnels in the low impact development (LID) planters.
2. Rainwater is routed to a 40,000 gallon cistern underground
3. Rainwater is sent to the filtration pump room to be filtered and treated to remove impurities.
4. Treated rainwater is stored in the 1,700 gallon day tank in the lobby.
5. Reclaimed water is used for irrigation and toilet flushing.

- portions of the site had to be raised 3' or more. But the site could not handle the burden of fill due to the fragile nature of the old below grade utilities. In order to raise the site without adding weight to the site, the top 1' of heavy, compacted earth was removed and replaced with +/- 3' of lightweight porous volcanic stone with soil or paving installed above.




*N-S Section Facing West*

Mechanical Room

Site raised 1 foot above 500 Year Flood Plain

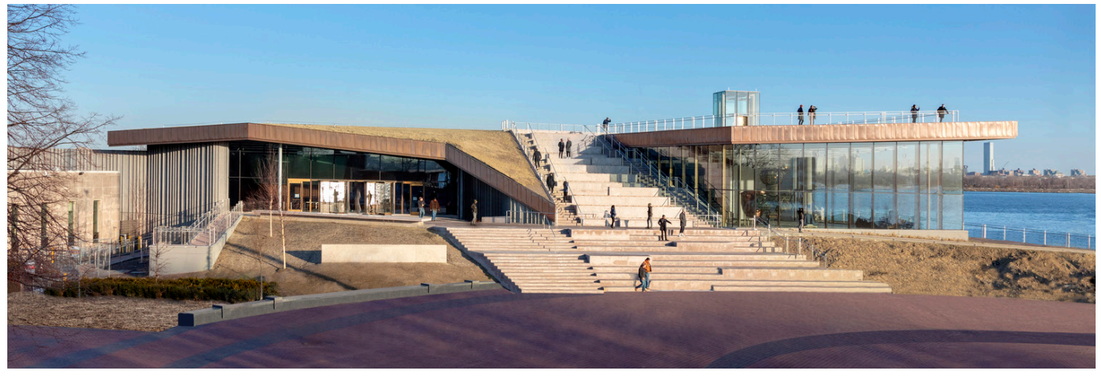
A. Existing O Street Pumping Station

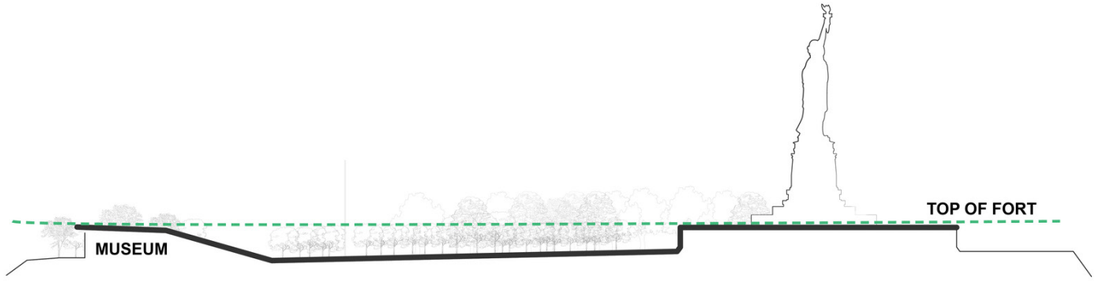
# CASE STUDIES
## STATUE OF LIBERTY MUSEUM: LIBERTY ISLAND, NYC

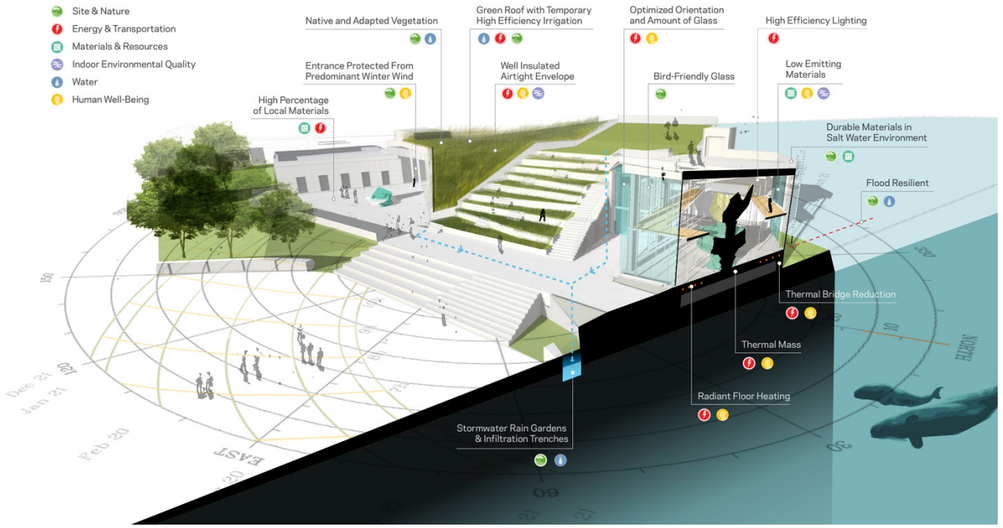
The Statue of Liberty Museum is a garden pavilion on a UNESCO World Heritage Site and home to the Statue of Liberty. It is located at the north end of the formal pedestrian mall on Liberty Island, facing the Statue of Liberty.  The museum anchors the main axis that connects the Museum to the Statue and extends this axis via a sweeping granite staircase that leads to its roof. The visitor experience culminates in a dramatic granite roof terrace that provides unobstructed views of Lady Liberty, the Manhattan skyline, and New York Harbor.

This Case Study utilized the following techniques which are similar to the constraints of the LSJS/ DHA Site:

- The planted roofs incorporate native vegetation that super-insulates the building by capturing and filtering stormwater.
- Around the building, the grounds are planted with native meadow grasses that create a natural habitat for wildlife and migrating birds.
- The building's elevation above the 500- year flood plain prevents damage from extreme weather events, such as Hurricane Sandy, which shut down power on the Island in 2012.





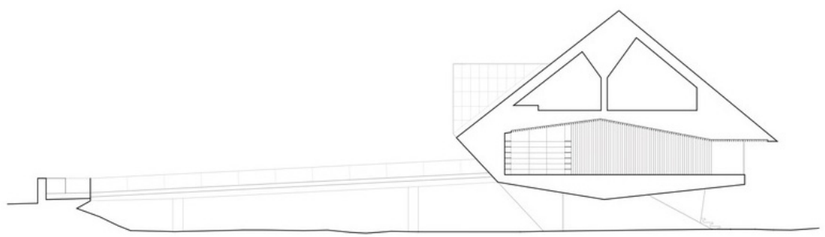



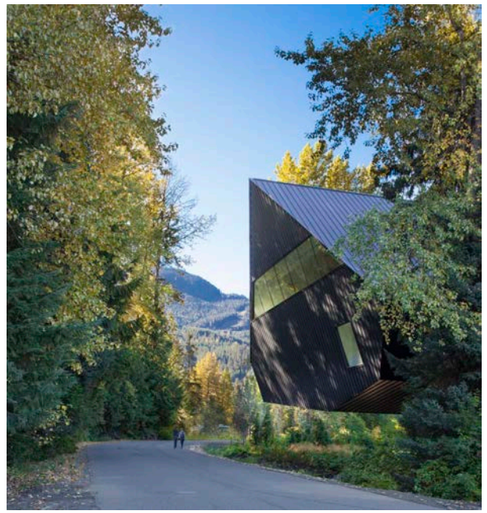

# CASE STUDIES
## AUDAIN ART MUSEUM: WHISTLER, CANADA

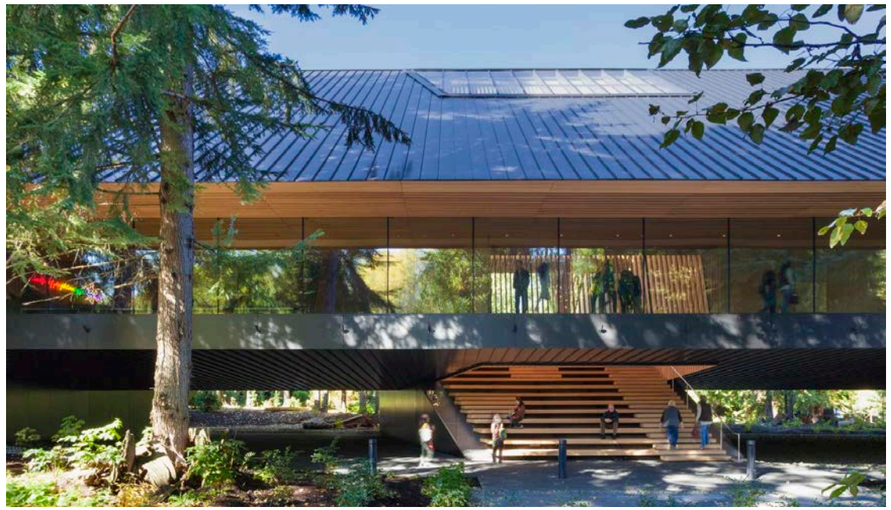
The Audain Art Museum is a 56,000 square foot private museum located in Whistler, British Columbia. It will house Michael Audains personal art collection which traces a visual record of British Columbia from the late l8th century to the present day. It includes one of the worlds finest collections of old First Nation masks, a superb collection of Emily Carr paintings, and works by some of Canadas most significant post-war artists including Jack Shadbolt, E. J. Hughes, and Gordon Smith, as well as works by internationally regarded contemporary artists such as Jeff Wall, Rodney Graham, Stan Douglas and others.  The site is located within the floodplain of Fitzsimmons Creek.  Snowfall averages nearly 15 ft of annual accumulated depth.

This Case Study utilized the following techniques which are similar to the constraints of the LSJS/DHA Site:

- The mass of the building is elevated a full story above the ground and crowned with a steeply sloped roof, containing administration and back-of-house support functions.







# CASE STUDIES
## NEW WHITNEY MUSEUM: MANHATTAN, NYC

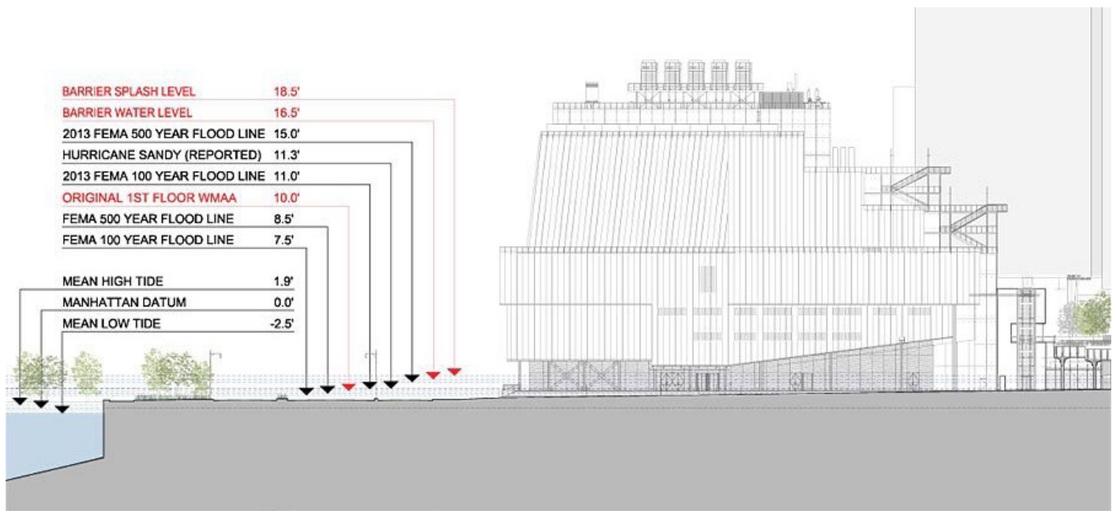
The Whitney Museum is a  80,000 sf Museum of American Art situated in NYC's Meatpacking District.  The location of the  new Whitney is adjacent to the Hudson River and is particularly sensitive to water level rise and storm surge. It sits just 10 ft above sea level on a tight site between the High Line Park and the Hudson River in lower Manhattan. The design features a 18,000-sq-ft, column-free gallery and a glass cable wall system around the lobby, so passersby can see the art and be drawn inside the musum.

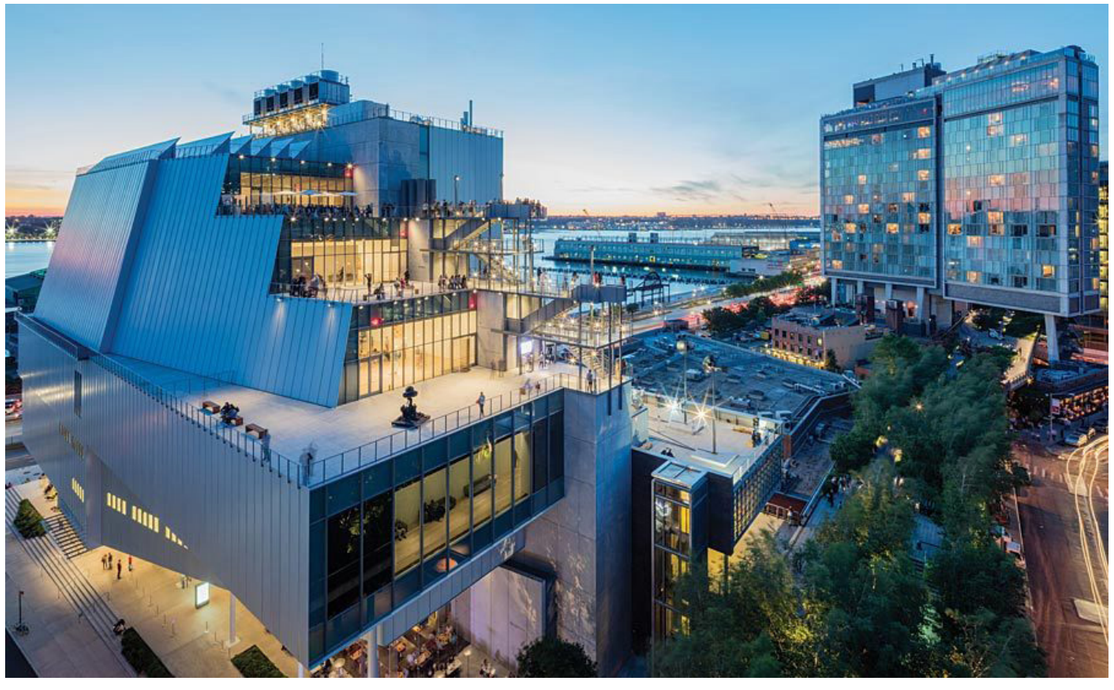
This Case Study utilized the following techniques which are similar to the constraints of the LSJS/ DHA Site:

- Hurricane Sandy had a devasating impact on New York infrastructure, inspriging the design team to re-evaluate flood mitigation strategies and go beyond the FEMA-recommended 13.5 foot elevation for construction on the Whitney site.  Ref Diagram 'A' below.

- All art galleries begin on the fifth floor and extend upward with no permanent gallrey or art storage below level five, ensuring that collections remain above the 16.5-foot protected elevation.

- Concrete penetrations made for electrical conduits, gas service, electrical service and piping are all sealed, maintaining the structure's integrity and shield it from flooding.  Ref diagram below.



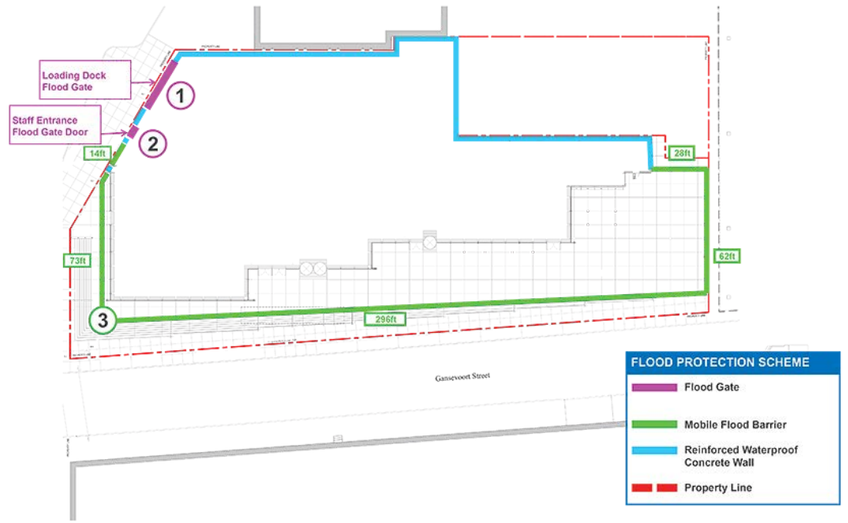



# CASE STUDIES
## NEW WHITNEY MUSEUM: MANHATTAN, NYC (CONT.)

- Staff entrance and loading dock are equipped with floodgates, adapted from battleship technology.

- In the event of a flood, a temporary barrier wall system can be deployed to protect the lobby's large expanses of glass walls from pressurized water. The wall is constructed of a movable post-and-log system that is common in flood-prone Hamburg Germany. In the worst case scenario of a flood water level rise above 16.5 feet elevation, the structure is designed to endure flooding of the lobby level, to deflect the force of any debris impact loads, and to prevent any stray building materials from blowing off the structure and causing damage or injury.

- Instead of the 1,000 gallon fuel oil tank originally planned for the museum, the Whitney's insurance advisors suggested accommodating the largest tank possible. Therefore, the building has a 4,000 gallon tank which provides as much emergency fuel as possible. This will allow the building's systems, particularly the pump system, to run for a far greater duration than originally planned. The team did precise calculations to account for numerous flood event scenarios, including the failure of various functions. For example, if the water pumps should fail, it was determined that roughly 14 inches of water may then flood the basement. Therefore, the placement of all electrical equipment was adjusted to sit 14 inches above the finish cellar floor elevation.




# CASE STUDIES

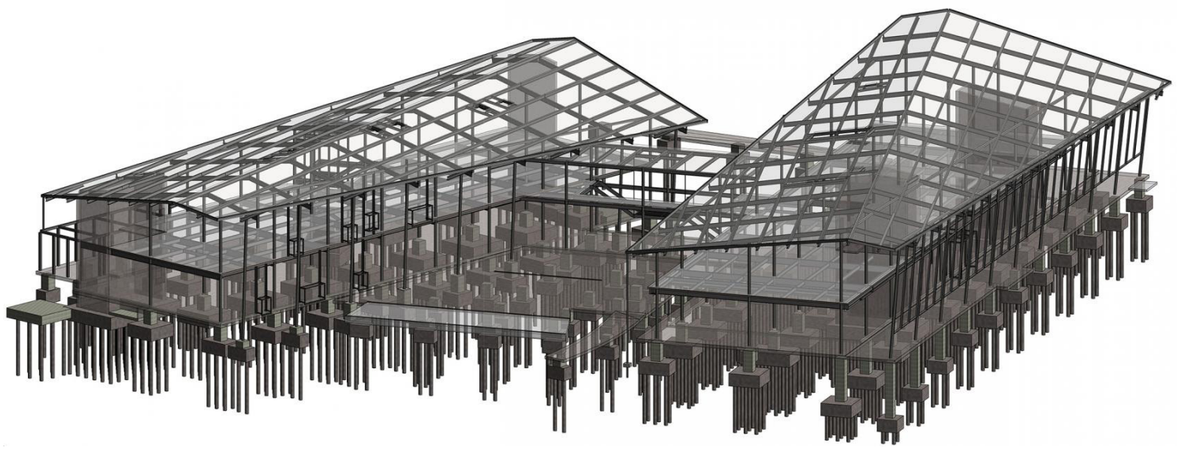
## LOUISIANA CHILDREN'S MUSEUM AT CITY PARK: NEW ORLEANS, LA

The 54,000 sq ft museum is distributed into two linked buildings that are carefully sited on a  8.4-acre World Heritage Site that is home to the world's largest grove of live oaks. During Hurricane Katrina, prior to the museum's erection the site was buried under several feet of water.

This Case Study utilized the following techniques which are similar to the constraints of the LSJS/DHA Site:

- The two-story facility is situated on a raised concrete structure, to increase flood resistance. The building is constructed on piers so that water flows under the building and can recharge the lagoon, unimpeded by building foundations.

- The site is designed to retain up to 3 ft. of water in a regular storm, and the building and site mechanical equipment are elevated 5 ft. above surrounding grade to reduce damage in extreme storm events. Holding rainwater on this site reduces flooding within surrounding neighborhoods.



# CASE STUDIES
## PEREZ ART MUSEUM: MIAMI, FL

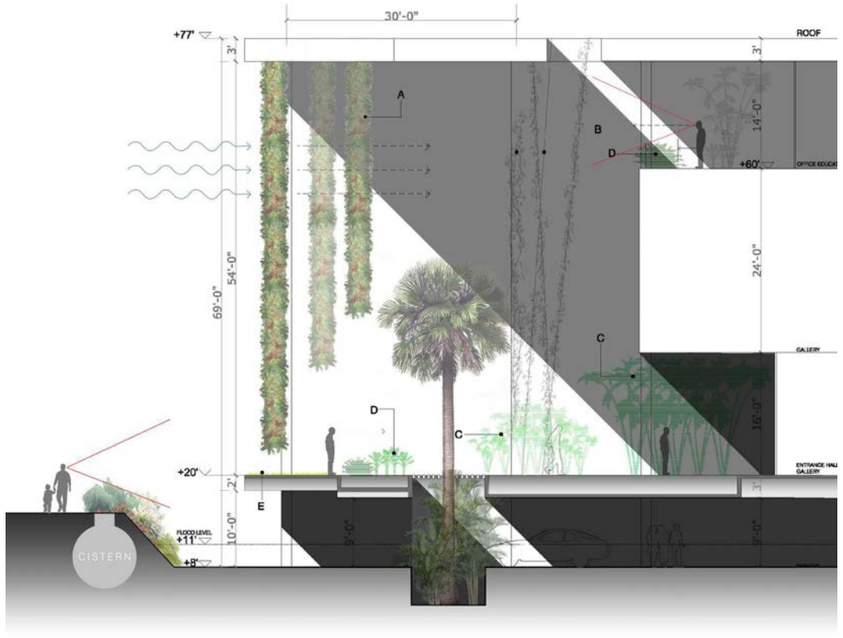
The Perez Art Museum is a 200,000 sq foot, 3- story building  located in Miami Florida on a waterfront site overlooking the Biscayne Bay, near the MacArthur Causeway.  Due to its proximity to the water, the museum is lifted off the ground for the art to be placed above storm surge level. The  space underneath the building is used for open-air parking, exposed to light and fresh air that can also handle storm-water runoff. Rising from the parking level, the stilts supporting the museum platform become columns supporting a shading canopy, which covers the entire site creating a veranda-like public space that welcomes visitors to the museum and the park. Facing the bay, a wide stair connects the platform to the waterfront promenade. The entrance doors of the museum are not only majestic teak, they're 550 pounds each, with a multi-prong pin system that locks the doors in several places to secure them against category-five hurricane winds.  The hanging gardens are designed to withstand a category five hurricane; the plants can easily be replaced if need be, and the architects reinforced the fiberglass tubes with stainless steel armatures, so the mechanical system and irrigation system remain intact.

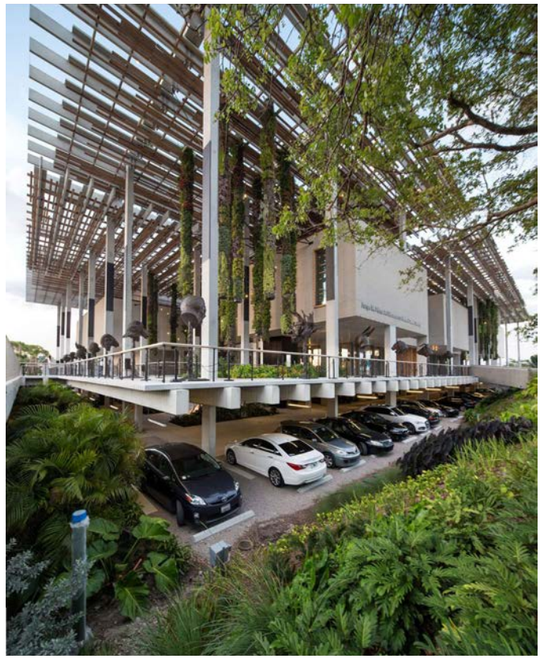
This Case Study utilized the following techniques which are similar to the constraints of the LSJS/DHA Site:

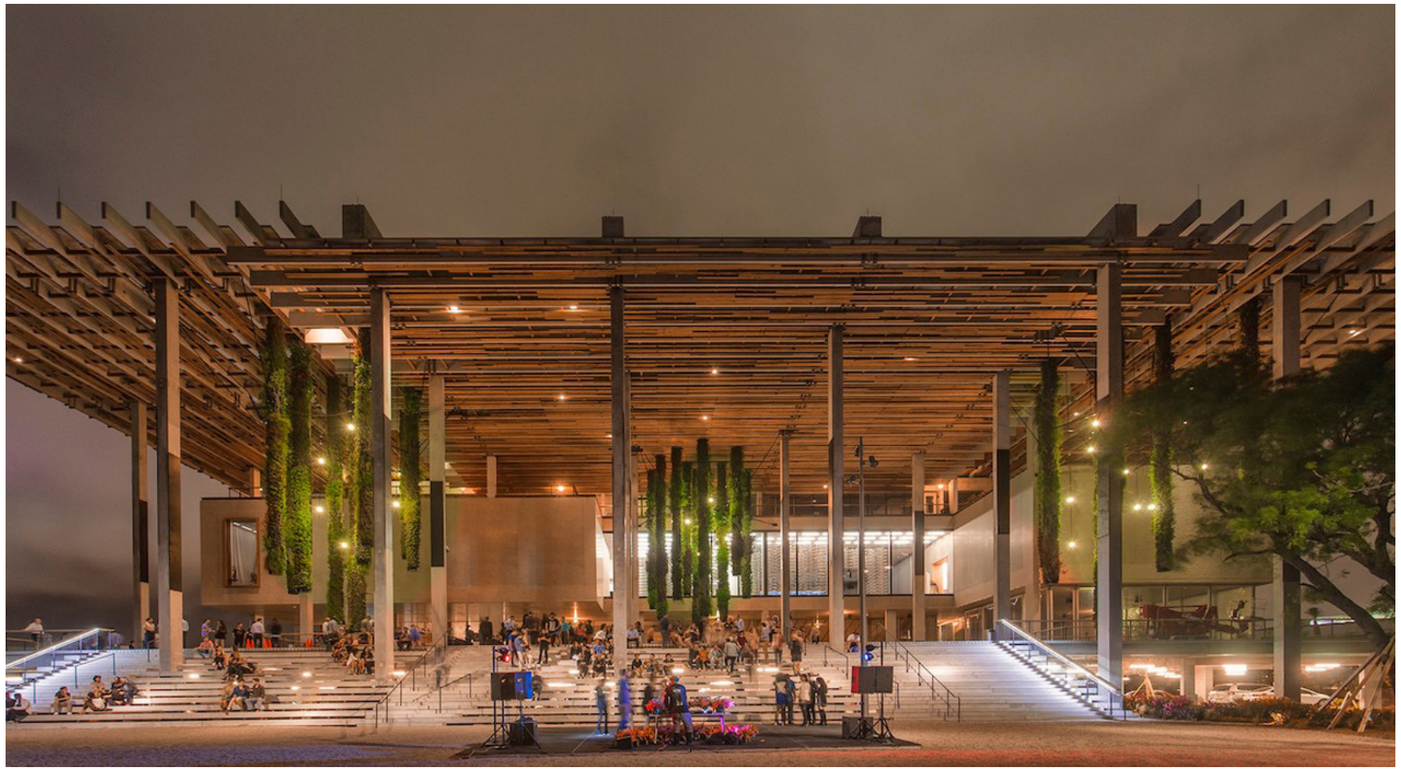
- The first floor of the museum is elevated above the 18-foot high-water mark left by Category 5 Hurricane Andrew in 1992. This elevation also acts as a cushion for projected effects of climate change.

- In cases of extreme rain, storm surge or flooding, gaps in the floors of the patio surrounding the museum allow water to drain into the parking garage, located underneath the museum.

- A power generator on the third floor of the museum ensures electricity to the building even if lower floors are affected by flooding. The generator has enough fuel to sustain the museum for three days, and can be refueled by truck. If roads are blocked, as is often the case after a hurricane, refueling by bargeis also possible due to the waterfront location.





# CASE STUDIES
## 911 MUSEUM & MEMORIAL: MANHATTAN, NYC

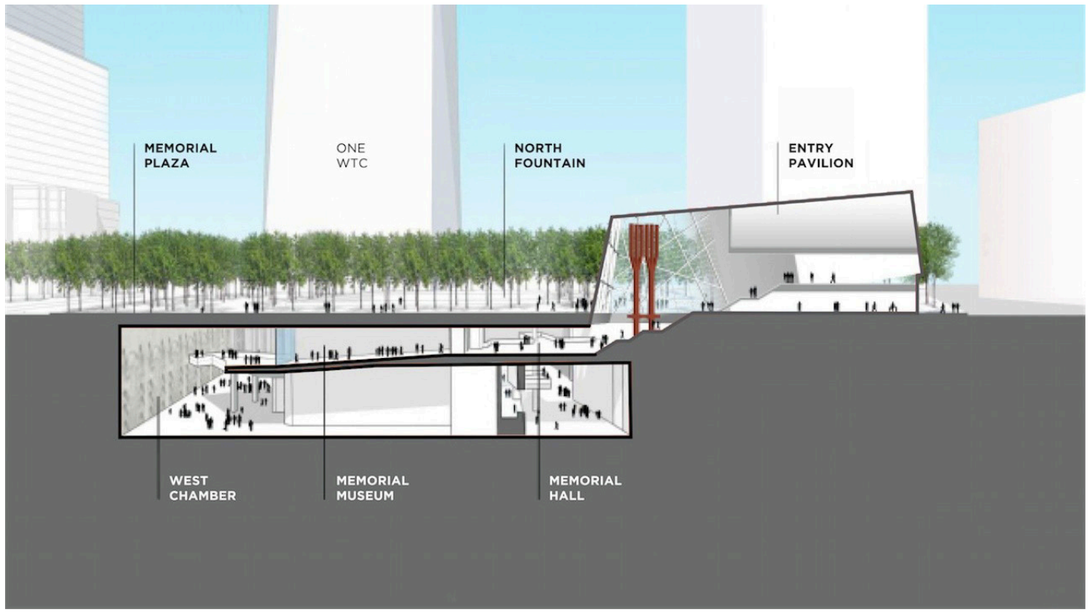
The National September 11 Memorial Museum encloses 110,000 square feet of publicly accessible space. The museum is about 70 feet below ground and accessible through a pavilion. The pavilion has a deconstructivist design, resembling a partially collapsed building (mirroring the attacks), and houses two "tridents" from the Twin Towers. One of the museum's walls is an exposed side of the slurry wall retaining the Hudson River, which remained intact through the September 11 attacks. A portion of the wall was preserved to be made visible in the museum.

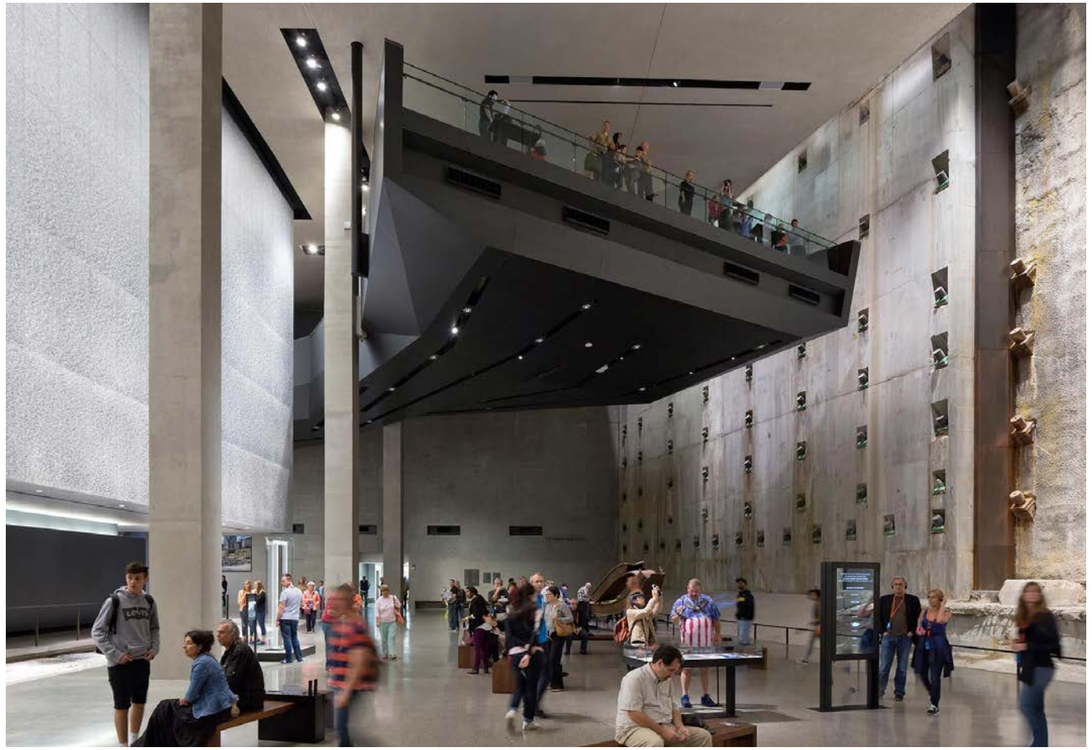
This Case Study utilized the following techniques which are similar to the constraints of the LSJS/DHA Site:

- It was understood that a portion of the memorial was to be constructed in a 100-year flood plain

- In the environmental impact statement of 2004, which acknowledged the flood risk, the Lower Manhattan Development Corporation stated that "because the locational aspect of the event is paramount to the memorial itself, relocating the W.T.C. memorial is not practicable."

- 30 permanent water pumps are used to de-water the soil adjacent to the underground structure.



# CASE STUDIES

## NATIONAL MUSEUM OF AFRICAN AMERICAN HISTORY: WASHINGTON, DC

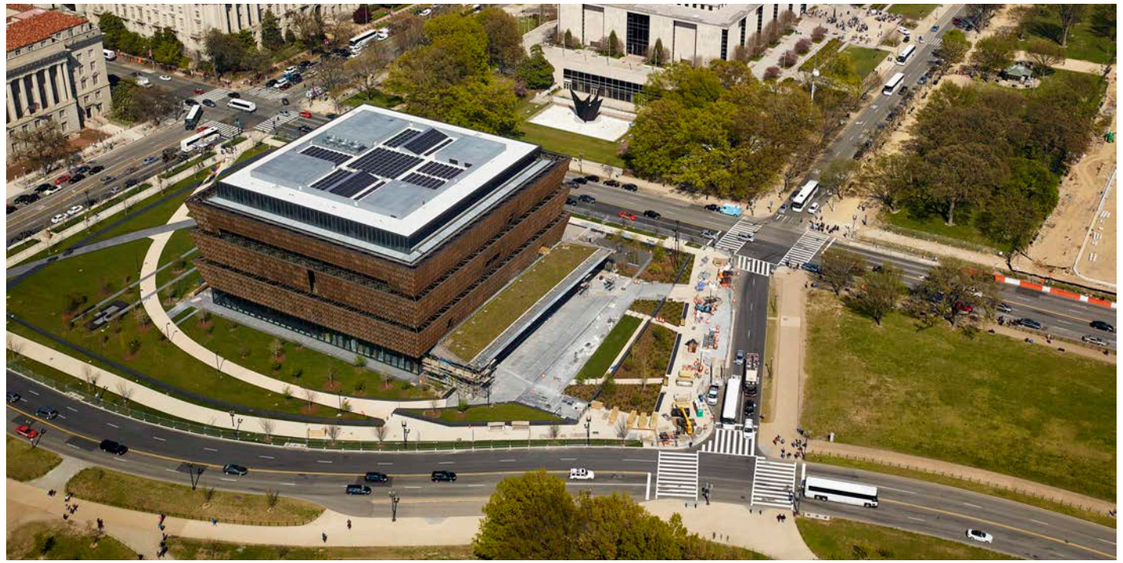
The National Museum of African American History and Culture (NMAAHC) is more than a building. the 408,000 gsf building is a firsthand look at the experiences, objects, and creations of a culture that has been the back-bone of American society since its inception.

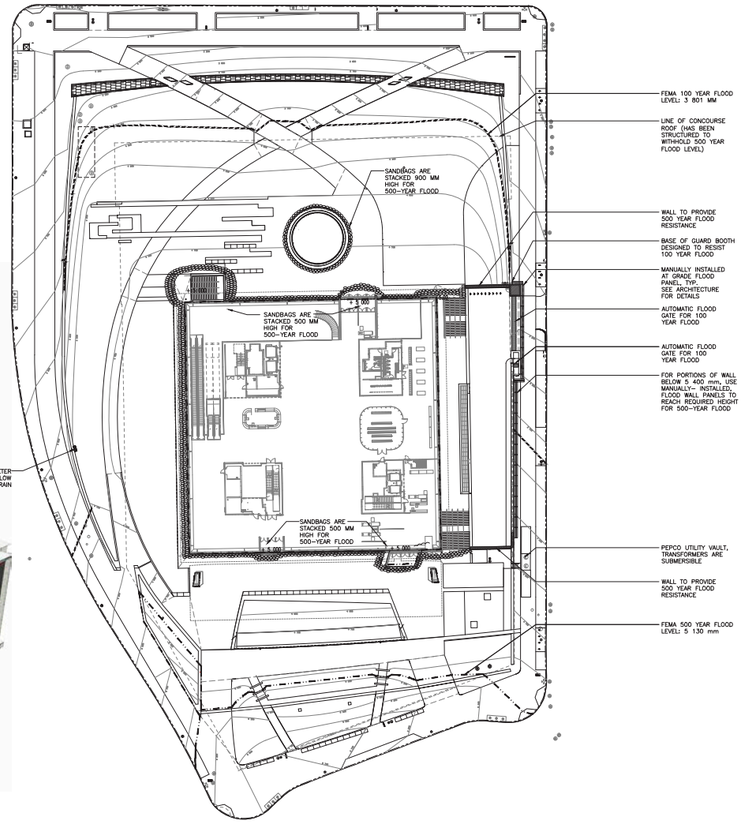
The newest and most stunning addition to the National Mall since the National Museum of the American Indian, the NMAAHC sits between the National Museum of American History and the Washington Monument on the Washington Monument grounds, a stark but refreshing disruption to the more traditional DC architecture. Its site implies a significant piece of American history that has long been overlooked but is now finally being recognized and appreciated.

Like any building project that is to be constructed on the National Mall, an intense process of public and governmental review and input is required. Buildings that become cultural institutions are particularly susceptible to scrutiny, as people are more invested when their histories and cultures stand to be exhibited for the world to see.

This Case Study utilized the following techniques which are similar to the constraints of the LSJS/DHA Site:

- The building sits within the 100 & 500 year flood plains, with 60% of the building below grade and 75’ into the water table.
- To permanently protect the building from the 100 year flood elevation, the first floor was raised a minimum of one foot above said elevation.
- Site walls were designed with elevations higher than the 500 year flood plain to protect the loading dock entrance, which is locat ed below grade, and sandbags are used to protect the building in the event of a 500 year flood.





# CASE STUDIES

## NATIONAL MUSEUM OF AFRICAN AMERICAN HISTORY: WASHINGTON, DC

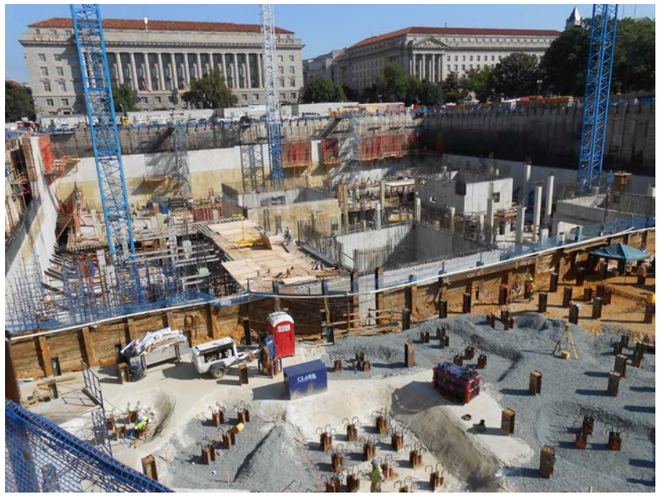
- The below-grade portion of the building houses the central utility plant that serves the entire museum. However, it also contains the loading dock and support spaces, collections spaces, a restaurant, a 350 seat theater, a changing exhibition gallery, and the history galleries with hundreds of priceless artifacts and interactive exhibits. The four-story below-grade section is constructed like a “bathtub” in order to keep water permanently out.

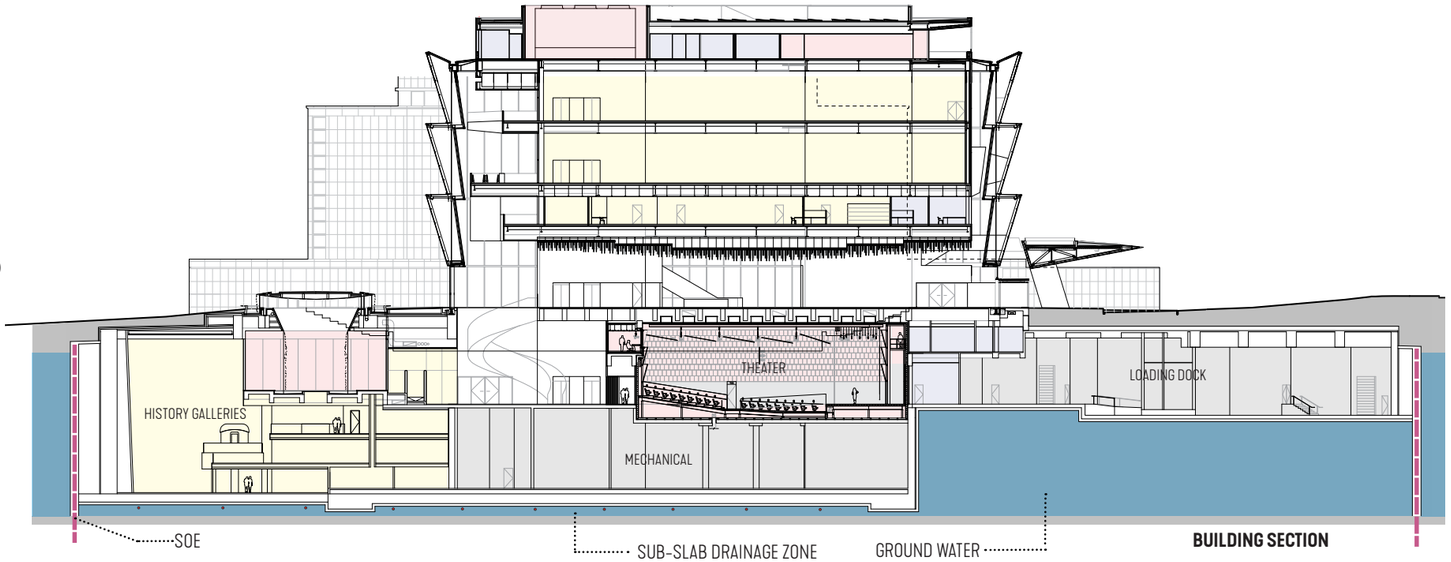
- A support of excavation (SOE) system was engineered and constructed to serve as a ground water management system. the SOE system was designed such that a low permeability structural element will extend from the ground surface to the low permeability decomposed rock and/or rock stratums on site.  The SOE system serves two primary functions; the first function is to allow for excavation and construction of the building. The second function of the wall is to provide a permanent groundwater cutoff between the building and the surrounding area.

- By utilizing a cutoff wall, the volume of groundwater intrusion was greatly reduced to allow for a conventional subdrainage system to prevent hydrostatic uplift of the building. Groundwater seepage that reaches the subdrainage system is pumped into the district of Colombia’s stormwater system for disposal.

- A “belts and suspenders” approach was taken to ensure the water-tightness of the below-grade structure. The foundation walls and mat slab are structurally waterproofed via blindside and self-adhering sheet waterproofing membranes. The “roof” of the below-grade structure has a double roof slab construction consisting of the structural slab protected by a hot-fluid applied waterproof membrane, with a layer of insulation. Then a “protective” roof slab that has a hot-fluid applied waterproof membrane to complete the assembly.

- The site itself is a giant green roof that helps mitigate urban heat island effect and reduces stormwater runoff. The rainwater harvesting system consists of an onsite, 100,000-gallon concrete cistern. Additionally, stormwater is collected via a siphonic roof drain system and site drains that have been strategically placed around the site. The rainwater is treated and serves as the primary supply for toilet flushing, cooling tower make-up (if required), and irrigation.





# CASE STUDY SUMMARY

The proposed museum would utilize many of the strategies and technologies featured in the case studies.

In addition to the base line archaeological survey and documentation process additional ground penetrating radar and test pits would be done where needed to verify and document existing underground infrastructure and archaeology within the zone of influence. The existing sewer infrastructure around the site will be monitored throughout construction. Clash detection software would be used to virtually coordinate the existing conditions with future built conditions throughout the design, fabrication, and construction phases of the project.

One hundred percent of the site's stormwater could be captured, stored and filtered onsite to be utilized for irrigation and toilet flushing purposes. A combination of bioretention ponds and cisterns could be used for storage. Bioretention systems and low impact development landscape features would be utilized to slow, treat, retain, and infiltrate stormwater runoff, mimicking the natural, pre-development hydrology of the site. The grounds would be planted with native plantings to mimic a natural habitat. Intensive, green planted roofs would be utilized to the extent possible not only to insulate the building but also to capture and filter stormwater.
The above grade portion of the building would be elevated a minimum of one foot above the 100 year flood plain to mitigate any potential flooding. The above grade portion of the building could also be elevated a full story above grade on piers (with the exception of a small footprint to account for vertical circulation and service functions).

A temporary barrier wall system would be designed to be deployed in the event of a flood event along with barrier gates at the desired entry points to protect the building from pressurized water and debris impact. Penetrations made for electrical conduits, gas service, electrical service and piping would be sealed, maintaining the structure's integrity and shield it from flooding. Emergency fuel tanks would be oversized to allow the pump system to run for as long as possible in an emergency scenario. Electrical equipment would be located above the base flood elevation but in cases where this is not possible a concrete barrier would be constructed to provide perimeter protection as needed.

The below grade portions of the building would be minimized to the extent that the archaeological remains of the Lumpkin's Jail Site be unearthed and exposed to be made accessible for interpretive purposes and properly protected from flood and environmental damage. The below grade portion of the building would be constructed as a "bathtub". The walls of the below grade structure would be a double wall system consisting of a slurry wall and foundation wall. The slurry wall or Support of Excavation system (SOE) would be erected as the outer wall, extending above the base flood elevation, and extending down to competent rock to serve as a ground water penetration management system. A secondary foundation wall would serve as a structural wall and an additional waterproof barrier to minimize seepage into the site. An under slab sub-drainage system would be designed to collect any seepage that manages to penetrate the double wall perimeter to prevent hydrostatic uplift. The roof of the below grade structure would be a double roof consisting of a structural slab with waterproofing and insulation and a protective roof slab with waterproofing.

The strategies outlined above are in alignment with the most technologically forward, contemporary museum projects that have been designed to mitigate the effects and impact of severe weather. Severe Weather is and will be a permanent reality for the foreseeable future throughout the world, but designers are rising to the occasion to produce resilient strategies and technologies to endure these changes.

# STRUCTURAL REPORT

# STRUCTURAL REPORT

Silman

Structural Engineers

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## Feasibility Narrative

INTRODUCTION

Lumpkin's Jail was a slave-trading complex in the Shockoe Bottom district of Richmond. Located just three blocks from where the state capitol building sits today, the "devil's half acre" was in use from the 1830s through the Civil War. The site is located between I-95, Main Street Station, Broad Street to the north, and E. Franklin Street to the South. In 2006, archaeologists began an investigation, which led to the discovery of the original jail building buried nearly fifteen feet below ground (putting the archaeology approximately eighteen feet below the base flood elevation). An interpretative museum is envisioned to tell the story of the slave trade and contain within the museum the foundations of the Lumpkin's jail building, Lumpkin's bar/tavern building, and a retaining wall are proposed to be permanently exposed.

STRUCTURAL DESCRIPTION

Substructure and Archaeology

The site's location and the depth of the archaeology presents several unique challenges. The site is located within a FEMA floodway requiring the future museum to be designed for flood loading. There are several challenges with the support of excavation and foundations that will require careful consideration and sequencing to permanently expose the archaeology within a water-tight museum. During the 2006 archaeology, one such challenge that was encountered was the water table. An updated geotechnical investigation was undertaken in 2021 by Schnabel Engineering and a Preliminary Geotechnical Engineering Report was issued on June 16, 2021, to provide input on the feasibility of permanently exposing the archaeology on site and developing a museum.

In this report, water table readings were provided on Table 4 and 5 and the locations of the monitors are shown on Figure 2. It is our understanding that monitoring of the water table will continue for one year to better understand the design water table and determine a final design water table. The readings indicate water levels as close as 7 feet (elevation 22) from the current surface. As noted above, flood waters will also present a challenge.

Based on Schnabel's 2021 report, a cutoff slurry wall is feasible for the proposed excavation of the archaeology to allow for a permanent excavation to expose the archaeology. A slurry wall is required to permanently expose the archaeology which is located below the water table. The slurry wall will need to extend above the base flood elevation and extend down to competent rock and be designed to resist flood and scour conditions as shown in Figure 1. Schnabel's 2021 report notes that rock varies between 30 to 46 feet below the existing grades on the side. Based on the depth of the excavation, it is anticipated that the slurry wall will require permanent tie backs. Permanent tie backs will require corrosion protection. It is understood from follow-up correspondence with Schnabel, that the rock present at this site is excellent quality and that seepage into the proposed basement within the slurry walls will be minimal. A sub slab drainage system is recommended to collect any seepage through the slurry wall.

A review of the of the right of way conditions, easements, utilities, and the existing sewer will be required to determine acceptable locations for the permanent tiebacks and to determine the agencies that are required to review and approve the permanent tiebacks. Coordination and approval from VDOT will for tie backs, specifically tie backs that will extend below the existing I-95 embankments. Those tie backs will need to be evaluated for any future modification of the I-95 embankment. It is our understanding that vibration monitoring and monitoring of I-95 embankment will be required. Additionally, monitoring of adjacent historic structures may also be required.

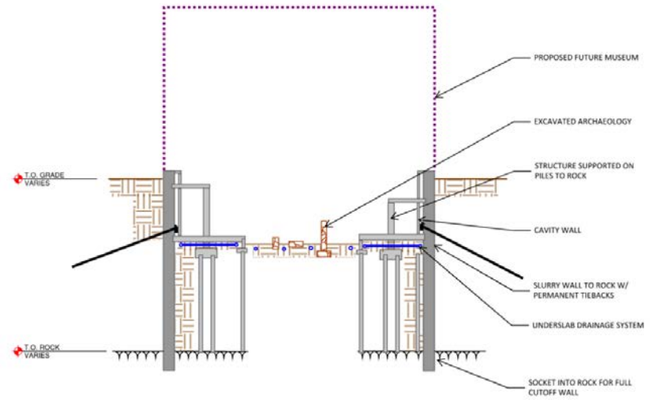


Figure 1: Concept Section showing Slurry Wall around proposed excavation of archaeology

The proposed museum anticipates larger spans and high loading based on the use of the building. Further discussion for museum is described in the next section. Based on the

# STRUCTURAL REPORT

known depths of fills on the site and the anticipated column loading, deep foundations will be required. The selection of the deep foundation system will need to account for any requirements for the historic sewer. Additionally, since the slurry wall will need to extend down to rock and will serve as a support for the museum, the column foundations should also extend to rock to avoid any differential settlement. It is anticipated a drilled pile deep foundation system will be used to reduce ground borne vibration that may affect adjacent buildings, 1-95 structures, and archaeology.

When the archaeology is exposed in the future, the existing elements will be reviewed to understand their condition and a determination will be made as to whether they will remain as they are found or restored. For items like walls, if they are fully exposed, an analysis of the walls will be performed based on its existing condition to determine if restoration is required for structural stability.

Superstructure

Building massing has been developed in this study based on a number of site constraints as shown and described in the Architecture narrative. It is anticipated that the proposed museum will have large open gallery spaces requiring large structural spans, specifically at areas above the location of the archaeology proposed to be exposed for viewing. Large floor to floor heights typical of museum buildings are also expected. While structural systems will be further explored in subsequent design phases, it is anticipated that a steel framed structure will be utilized to allow for large open spaces. Additionally, steel structures are common in Richmond.

It is anticipated that the superstructure of the new building will consist of wide flanged columns supporting composite steel framing and trusses. The long spans will likely require plate girders or full height story trusses. A transfer level above the area of the archaeology will be required to avoid columns and foundations within this area. The exterior steel columns with steel wind girts will be required to brace the exterior curtainwall system back to the floor diaphragms.

Lateral System

While lateral system options will be studied further in the next design phase, it anticipated that steel braced frames will be utilized due to the large spans and large open spaces.

Flood and Resiliency

Based on the FIRM map shown in Figure 2, provided to Silman by Greening Urban, the site is located in an AE zone. It is understood that the site is within a floodway and a hydraulic analysis will be required to determine the loading on the structure and determine if the proposed building will have on an effect on the flood elevation. As noted in the Stormwater Analysis narrative, the conditions at the site suggest that no-rise will occur with the placement of a new building given the proposed stormwater management practices. The flood loading is dependent on the building massing. The flood loading will be determined in subsequent design phases based on the final building size. Design flood conditions established in the future design phase should account for resiliency through consideration of future changes in hydrological conditions. See the Stormwater Analysis narrative for further discussion of detention structures in the proposed Stormwater Plan options.

To prevent water infiltration, the building envelope will be required to prevent and resist flood conditions. A slurry wall will be utilized below the flood elevation to resist ground water and flood waters. If areas like loading docks are proposed to penetrate the slurry wall below the flood elevation, additional flood walls will be required. Waterproofing systems will be an important part of the strategy to maintain a watertight envelope. A secondary interior cavity and liner wall is anticipated adjacent to the slurry wall to provide a humidity-controlled environment. Since slurry walls are not watertight, it is typical for water to seep through and as previously noted a sub slab drainage system has been recommended.

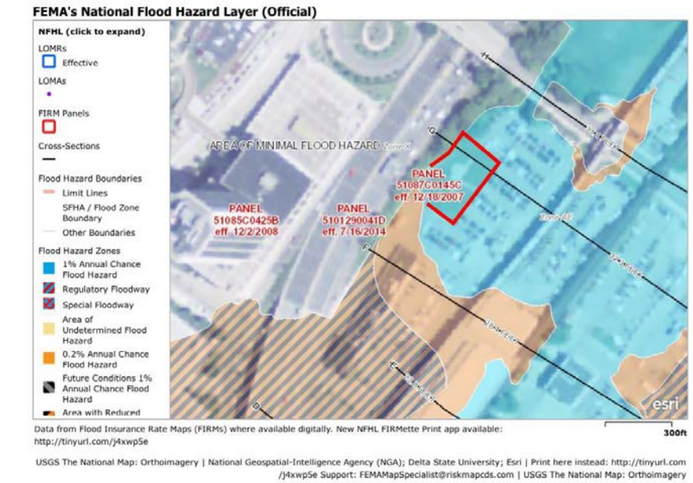


Figure 2: FIRM map from FEMA provided to Silman by Greening Urban

# STRUCTURAL REPORT

Site Constraintsi

As previously noted, the proposed building massing was developed as part of this feasibility study taking into account a number of site constraints. There is an existing historic sewer that runs through the site that is one of the main site constraints outlining the extents of the proposed building. While the site has been used as a parking lot that has likely seen truck loading, the maximum surcharge loading has not been provided by the City of Richmond to be listed as a constraint. It is understood that there is an upper limit to the maximum surcharge loading within the zone of influence of the sewer. It will be important to understand what that limit is in a future phase prior to construction to understand that maximum surcharge loading during construction that is allowed within the zone of influence of the sewer to determine when bridging over the sewer will be required. Tiebacks will require coordination with existing utilities, the sewer, and with the I-95 embankment. It is our understanding that vibration monitoring and monitoring of I-95 embankment will be required. Additionally, monitoring of adjacent historic structures may also be required. Any vibration limits will also need to be established as well as any requirements for installation of the deep foundations. Given the proximity of the I-95 embankment to the site, a condition assessment of the cribbing is recommended as noted in the Civil Narrative. Any repairs or reinforcement to the cribbing should occur prior to the commencement of this project.

FUTURE STUDIES

- Geotechnical Investigation and Analysis- As seen in the preliminary findings of this study and the Schnabel geotechnical report, further studies and recommendations are required based on the final chosen design. The main required recommendations are listed below once the project is further developed:
    - Final recommendations for building foundations and site retaining walls
    - Final recommendations for permanent support excavation/slurry wall with permanent tiebacks to include required global stability analysis for temporary and permanent conditions
    - Final recommendations related to constructing within a floodway once building size is determined
    - Sub slab/foundation drainage system requirements, which will require special requirements at the proposed exposed archaeology within a museum. A further analysis of the cutoff wall design should be investigated with the various City of Richmond agencies having jurisdiction to determine quantity and proper location of tiebacks.
    - Further investigation to better profile of the rock layer capable of having the deep foundations achieve adequate support and bearing. It will also be important to understand the depths to which the cutoff walls will need to extend to limit seepage into the site.
    - Perform additional testing to determine Soil Site Class. Per Schnabel Preliminary Geotechnical Report dated June 16, 2021, a Soil Site Class C may be attainable by utilizing geophysical methods to collect of shear wave velocity data.

- Hydraulic Analysis-- As seen in the preliminary findings of this study, further studies and recommendations are required based on the final chosen design. The main required recommendations are listed below once the project is further developed:
    - Determine Design Flood Elevation-Currently this cannot be determined until a final building design has been determined. According to the Kimberly-Horn report, the base flood water surface elevation (NAVD 88) for the sections where the museum building will be located (sections D and E for Shockoe Creek) are between 25.26' to 25.58' (with floodway).
    - Determine flood loading. This will be determined based on final building size and is also contingent on which stormwater option described in the Stormwater Analysis narrative is chosen.
    - Define flood conditions for the museum and other flood requirements- This will be determined based on final building size and is also contingent on which stormwater option described in the Stormwater Analysis narrative is chosen.

- Excavation/Archaeology/Conservation of Ruins-The following design items will be determined in future phases based on the final chosen design and future investigations:
    - Once full excavation is undertaken, it will be necessary to assess the condition of the historically important retaining walls to assure structural stability

# STRUCTURAL REPORT

- Based upon the observed and yet to be observed fluctuations in the water table, determine what impact this will have on the foundations of the building and the preservation of the archaeology
- It should be determined whether a secondary interior cavity and liner wall are required inside the slurry wall to maintain a humidity-controlled museum environment to protect the archaeology. If it is deemed the best solution, an interior cavity and liner wall would facilitate waterproofing of the lower level.
- Determination of allowable loading over existing utilities, particularly the 27' wide combination sewer. This needs to be determined to understand construction related loading conditions.

STRUCTURAL DESIGN GUIDELINES

Applicable Codes & Standards

The project will be governed by the following codes:

- 2018 International Building Code (IBC)
- 2018 Virginia Uniform Statewide Building Code (VUSBC)

The following standards will be followed as specified by the governing codes:

- ASCE 7-16 Minimum Design Loads (and Associated Criteria) for Buildings and Other Structures
- ASCE 24-14 Flood Resistant Design and Construction
- ACI 318-14 Building Code Requirements for Structural Concrete
- TMS 402-2016 Building Code for Masonry Structures
- NDS-2018 National Design Specification (NDS) for Wood Construction with 2018 Supplement
- AISC 360-16 Specification for Structural Steel Buildings
- ASCE 41-16 Seismic Evaluation and Retrofit of Existing Buildings

Structural Loads

The loads presented below assume the structure is Risk Category III (ASCE 7-16, Table 1.5-1)

Live Loads

The following values are specified by the applicable codes and standards:

| **Occupancy or Use** | **Live Load** | |
|---|---|---|
| | **Uniform *(psf)*** | **Concentrated *(lbs)*** |
| Assembly Areas | 100 | |
| Corridors – First floor | 100 | 2000 |
| Corridors Above 1st Floor | 80(1) | 2000 |
| Library – Reading Room | 60(1) | |
| Mechanical Areas | 150(2) | |
| Office | 50(1) | 2000 |
| Roofs – Ordinary | 20 | |
| Stairs and exit ways | 100 | 300 |
| Storage – Heavy | 250 | |
| Storage – Light | 125 | |

Specific Notes

(1) plus 15 psf partitions

(2) Used in absence of actual weight of mechanical equipment

Snow Loads

The following loads and parameters are specified by the applicable codes and standards:

- Ground Snow Load (ASCE 7-16, Figure 7-1) $p_g$ = 20 psf
- Terrain Category/Surface Roughness Category (ASCE 7-10, §26.7) B
- Exposure Factor (/ASCE 7-10, Table 7-2) $C_e$ = 1.0
- Thermal Factor (ASCE 7-10, Table 7-3) $C_t$ =1.0
- Importance Factor (ASCE 7-10, Table 1.5-2) $I_s$ = 1.1

Wind Loads

- Basic Wind Speed *(by jurisdiction)* V = 120 mph
- Wind Directionality Factor (ASCE 7-10, Table 26.6-1) $K_d$ = 0.85
- Exposure Category (ASCE 7-10, §26.7) B
- Gust Effect Factor (ASCE 7-10, §26.9) G =0.85
- Enclosure Classification (ASCE 7-10, §26.10) Enclosed
- Internal Pressure Coefficient (ASCE 7-10, Table 26.11-1 $GC_{pi}$ =±0.18

Seismic Loads

The seismic parameters dependent on soil shall be confirmed by a geotechnical engineer. The seismic force-resisting system has been assumed as Steel braced frames for Steel not specifically detailed for Seismic Resistance (See lateral discussion above).

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- Soil Site Class D*
- Short Period Mapped Spectral Accel. *(USGS)* $S_s$ = 0.234 g
- One Second Period Mapped Spectral Accel. *(USGS)* $S_1$ = 0.055 g
- Short Period Design Spectral Acceleration $S_{DS}$ = 0.249 g
- One Second Period Design Spectral Acceleration $S_{D1}$ = 0.088 g
- Seismic Design Category (ASCE 7-10, §11.6) B
- Seismic Importance Factor (ASCE 7-10, Table 1.5-2) $I_e$ =1.25
- Response Modification Coeff. (ASCE 7-10, Table 12.2-1) R = 3

  * Per Schnabel Preliminary Geotechnical Report dated June 16, 2021, a Soil Site Class C may be attainable by utilizing geophysical methods to collect of shear wave velocity data.

Flood Loads

- Flood Zone (FEMA FIRM) AE [(1)]
- Design Flood Elevation To be determined[(2)]
- Flood Design Class (ASCE 24-14 Table 1-1) 3
- Flood Loading on structure To be determined[(2)]

Notes:

(1) See Figure 2

(2) This cannot be determined until a final building design has been determined

# CIVIL REPORT

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## STORMWATER ANALYSIS

Stormwater Management Practices – Runoff Retention Analysis

*Introduction*

Two stormwater management layouts were considered (Option 1 and Option 2) and analyzed to determine the stormwater runoff captured for both the 10-year and 100-year storms. Each stormwater management layout option approached runoff capture via similar approaches – the use of a retention basin, green roof, pervious pavement, and cistern – but with varying layouts and sizes, as detailed in the table below (example images of stormwater facilities in Appendix C):

Stormwater Management Practices by Proposed Volume Captured

| Stormwater Management Practice | Option 1 | Option 2 |
|---|---|---|
| Drainage Area 1 Detention Basin | 11,610 cf | 21,636 cf |
| Drainage Area 1 Forebay | 1,110 cf | 7,938 cf |
| Drainage Area 1 Pervious Pavement | - | 4,822 cf |
| Drainage Area 2 Green Roof | 9,960 cf | 9,960 cf |
| Drainage Area 2 Cistern | 3,342 cf | 3,342 cf |
| Drainage Area 3 Pervious Pavement | 3,560 cf | 3,560 cf |

The sizes of these proposed stormwater management practices are expected to change based on a more finalized site and building layout. In addition, some of the proposed stormwater management practices are not constrained by site layout (cistern and pervious pavement, for example) and could be, if necessary, expanded if additional stormwater capture was needed (calculations provided in Appendix D).

*Option 1 – Stormwater Retention and Site Discharge*

10-year 24-hour rainfall Event (P): 5.07 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-development runoff (cf/storm) | 46,821 | 14,372 | 7,737 | 68,930 |
| BMP retention volume (cf) | 12,720 | 13,302 | 3,560 | 29,582 |
| Post-development runoff (cf/storm) | 34,101 | 1,070 | 4,177 | 39,348 |

## STORMWATER ANALYSIS

| | | | |
|---|---|---|---|
| Site Peak Discharge Post-Development | Q (in) 2.73 | A (sq mi) 0.00620 | Total Site Post-Development Peak Discharge (cfs) 12.70 |
| Site Peak Discharge Pre-Construction | Q (in) 4.78 | A (sq mi) 0.00620 | Total Site Pre-Construction Peak Discharge (cfs) 22.25 |

100-year 24-hour rainfall Event (P): 8.4 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-project runoff (cf/storm) | 79,052 | 24,732 | 13,063 | 116,848 |
| BMP retention volume (cf) | 12,720 | 13,302 | 3,560 | 29,582 |
| Post-development runoff (cf/storm) | 66,332 | 11,430 | 9,503 | 87,266 |

| | | | |
|---|---|---|---|
| Site Peak Discharge Post-Development | Q (in) 6.06 | A (sq mi) 0.00620 | Total Site Post-Development Peak Discharge (cfs) 28.17 |
| Site Peak Discharge Pre-Project | Q (in) 8.11 | A (sq mi) 0.00620 | Total Site Pre-Project Peak Discharge (cfs) 37.72 |

The data above details the effects of the proposed stormwater management practices, listed in the *Introduction*, compared to the existing site conditions for both the 10-year and 100-year storm events. These calculations (and those for Option 2) were performed following the *Urban Hydrology for Small Watersheds – TR-55* methodology as presented by the Natural Resources Conservation Service.

For both the 10-year and 100-year storm events it is clear that the stormwater management practices reduce both post-development storm runoff (cubic feet per storm) and post-development peak discharge (cubic feet per second):

# CIVIL REPORT

## STORMWATER ANALYSIS

| | Option 1<br>10-year storm event | 100-year storm event |
|---|---|---|
| Pre-Project Runoff (cf/storm) | 68,930 | 116,848 |
| Post-Development Runoff (cf/storm) | 39,348 | 87,266 |
| Site Peak Discharge Pre-Development (cfs) | 22.25 | 37.72 |
| Site Peak Discharge Post-Development (cf/storm) | 12.70 | 28.17 |

*Option 2 – Stormwater Retention and Site Discharge*

10-year 24-hour rainfall Event (P) 5.07 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-development runoff (cf/storm) | 47,077 | 14,129 | 7,737 | 68,943 |
| BMP retention volume (cf) | 34,396 | 13,302 | 3,560 | 51,258 |
| Post-development runoff (cf/storm) | 12,681 | 827 | 4,177 | 17,685 |

| | | | |
|---|---|---|---|
| Site Peak Discharge Post-Development | Q (in)<br>1.23 | A (sq mi)<br>0.00620 | Total Site Post-Development Peak Discharge (cfs)<br>5.71 |
| Site Peak Discharge Pre-Construction | Q (in)<br>4.78 | A (sq mi)<br>0.00620 | Total Site Pre-Construction Peak Discharge (cfs)<br>22.26 |

## STORMWATER ANALYSIS

100-year 24-hour rainfall Event (P) 8.4 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-project runoff (cf/storm) | 79,483 | 24,314 | 13,063 | 116,860 |
| BMP retention volume (cf) | 34,396 | 13,302 | 3,560 | 51,258 |
| Post-development runoff (cf/storm) | 45,087 | 11,012 | 9,503 | 65,602 |

| | | | |
|---|---|---|---|
| Site Peak Discharge Post-Development | Q (in)<br>4.55 | A (sq mi)<br>0.00620 | Total Site Post-Development Peak Discharge (cfs)<br>21.18 |
| Site Peak Discharge Pre-Project | Q (in)<br>8.11 | A (sq mi)<br>0.00620 | Total Site Pre-Project Peak Discharge (cfs)<br>37.73 |

Option 2, with greater detention basin and forebay volume than Option 1, potentially provides greater stormwater runoff capture and significantly-reduced peak discharge rates.

| | Option 2<br>10-year storm event | 100-year storm event |
|---|---|---|
| Pre-Project Runoff (cf/storm) | 68,943 | 116,860 |
| Post-Development Runoff (cf/storm) | 17,685 | 65,602 |
| Site Peak Discharge Pre-Development (cfs) | 22.26 | 37.73 |
| Site Peak Discharge Post-Development (cf/storm) | 5.71 | 21.18 |

# CIVIL REPORT

## STORMWATER ANALYSIS

HEC RAS No-Rise Analysis

*Introduction*

A preliminary study was performed at the Lumpkins Slave Jail site to determine the impact of new development in the area generally bounded by Interstate-95, East Broad Street, Richmond Main Street Station, and East Main Street.

The flood plain in this area was divided into 34 sections, each 100-feet apart, approximately 800 feet wide. The analysis focused on both the existing, "base case", conditions of the site as well as the impact of the Small Building footprint placed at the location of the proposed Slave Jail Museum and surrounding features (landscaped area, cafe, etc.).

The flood plain analysis also considered the site with future high speed rail lines running to Main Street Station. Analysis considered potential flood runoff from beyond (northeast of) East Broad Street by taking into consideration a previous flood plain analysis by Kimberly-Horn.

*Methodology*

The project site area was divided into 34 sections with the most upstream section aligning with Cross Section K of the May 15, 2020 *Floodplain and Floodway Analysis (Draft)* provided by Kimberly-Horn. This alignment was used as a baseline maximum flow input of 5,288.00 cfs to be applied to the upstream (Section 34) end of this flood analysis.

The analysis performed using this input data, and comparing base-case and Small Building scenarios, shows that it is feasible to construct in this area. The volume displacement created by the Small Building is compensated for by the eastward expansion of the flood plain area (as the western side of the flood plain is bounded by the Interstate-95 embankment).

Further, as shown in the preliminary stormwater management plans and discussed in the preceding section, the various stormwater retention practices in all three scenarios (Options 1, 2, and 3) result in reduced post-development stormwater runoff (cubic feet per storm) and reduced peak discharge rates (cubic feet per second).

*Preliminary Conclusion*

Based on the preliminary information provided, the proposed construction is feasible within the flood plain with the result of no-rise in flood elevation. The various proposed stormwater retention practices, along with the natural spillage of unbounded runoff described below, are intended to compensate for any rise caused by volume displacement of the proposed buildings. In addition, various site features and modifications, such as rip rap armored overflow swales, pervious concrete (Option 2), and the relocation of the existing 36-inch PRC storm drain, have also been proposed in the three Preliminary Stormwater Plan Options to further reduce on-site discharge rates and direct flow to both the existing underground stormwater vault and a proposed underground sand filter.

## STORMWATER ANALYSIS

Site Analysis Conclusion

The project site has been analyzed with consideration given to stormwater retention practices as well as modeling using HEC RAS software (see Appendix B for Existing and Small Building cut sections). Two Preliminary Stormwater Plan Options have been provided (see Appendix A for site layouts) with varying levels of runoff capture and retention practices proposed. There remains flexibility in design, if needed, to increase or modify the level of runoff retention practices (such as cistern size or underground sand filter system vault size) in order to capture more stormwater.

Some stormwater retention practices, such as the green roof system and detention basin, are expected to be modified as the site layout is finalized. The green roof system area (30,000 square feet) was proposed based on the building footprint but it is assumed that rooftop mechanical systems (elevator equipment, HVAC, etc.) will be placed so that the green roof layout will be modified. It is also understood that the parking area surrounding the proposed building may be modified in such a way that could impact design of the retention basins.

It will also be imperative, for the final analysis of the proposed building's impact on the flood plain, for the finished floor and basement (and, therefore, depth of excavation) to be established. Proposed utilities, including electrical and sanitary sewer, connecting to the building will also have to be established.

Based on the information provided, the proposed building will not result in a rise in flood elevation due to:

- The capture of stormwater runoff in the proposed detention basins and forebays.
- The capture of stormwater by the green roof system.
- The capture of stormwater in the proposed pervious pavement facilities.
- The redirection of stormwater runoff to an above-ground cistern.
- The direction of both upstream overflow (via the 36-inch PRC storm drain – existing and modified) and detention basin overflow (via armored rip rap swale and overflow drain) to the existing underground stormwater vault.
- The spillage of remaining, unbounded stormwater runoff to areas within the existing floodplain.

The proposed green roof system aims to not only counteract displacement of the proposed building but also serves to compensate for the existing impervious surface (street-level parking) on the site. The proposed detention basins and forebays aim to capture upstream flow that travels through the Broad Street tunnel before it reaches the building while the various overflow swale and pervious concrete designs are to direct overflow to either the existing underground vault or proposed underground sand filter.

Additional roof runoff is proposed to be redirected to the 25,000 gallon cistern for use in a purple pipe system. The intent of this design is to minimize stormwater runoff from the building footprint to the greatest extent possible by storing, rather than allowing overflow to surrounding impervious surface, any runoff not absorbed by the green roof system. Both the underground cistern and underground sand filter vault can be modified to maximize storage capacity after finalization of the building design and site layout.

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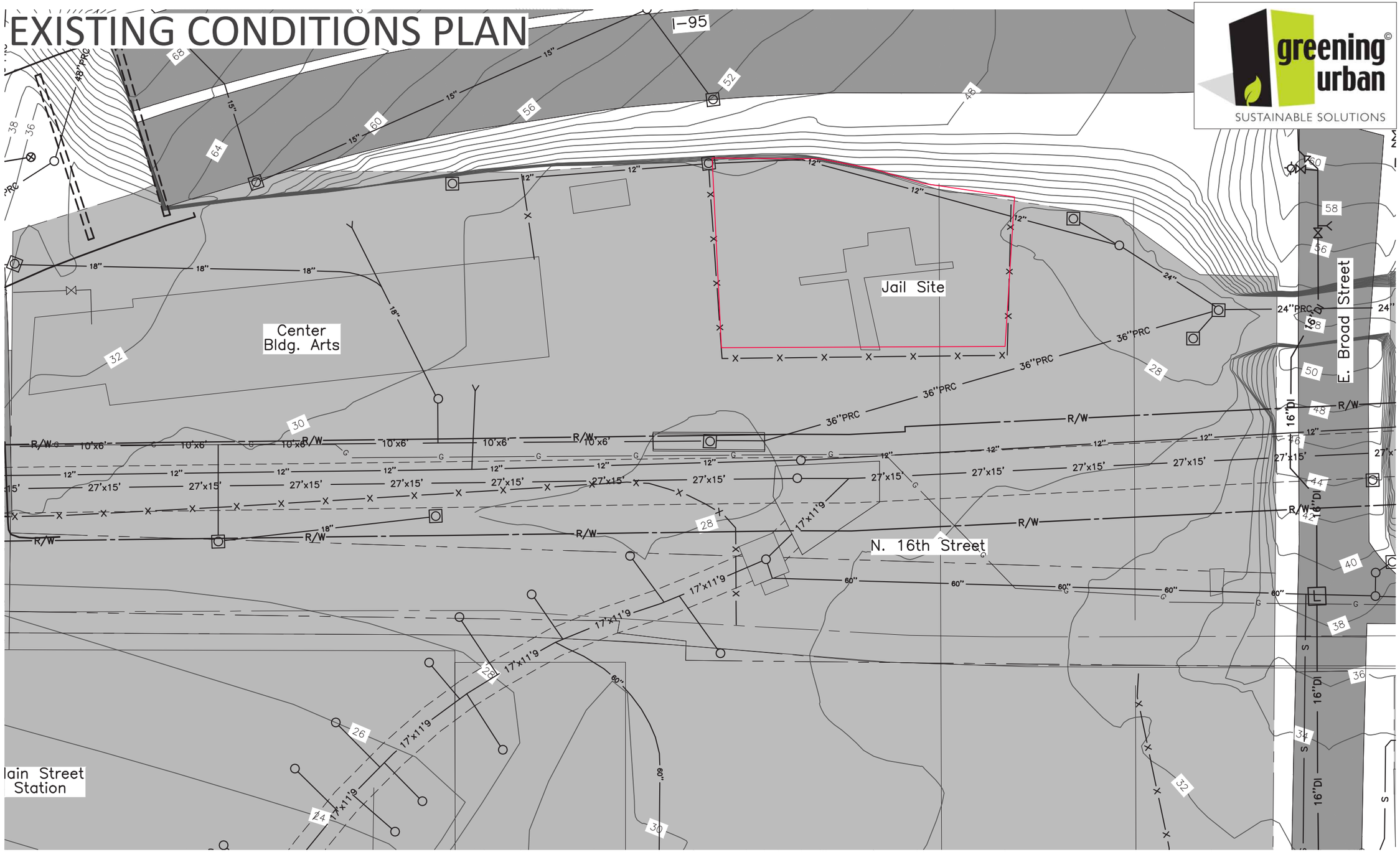
## EXISTING CONDITIONS PLAN



# CIVIL REPORT

## PRELIMINARY STORMWATER PLAN

OPTION 1 - EXISTING STORM SEWERS TO REMAIN

greening urban
SUSTAINABLE SOLUTIONS

22' Wide, 4,450 SF Permeable Concrete Drive

D.A. 3
19,211 SF

D.A. 2
37,474 SF

30,000 SF Vegetated Roof System

6" PVC Overflow Pipe

Jail Site

Seaboard Building

2,415 SF Retention Basin

18" PVC Overflow Pipe

25,000 Gallon Cistern for Purple Pipe System, Location to be Determined

10'x65' GRATE

Conc. Overflow Structure

185 SF Conc. Bounded Forebay

Flood Overflow

8' Wide, Rip Rap Armored Overflow Swale

D.A. 1
116,253 SF

CSXT RAIL

MAIN STREET STATION

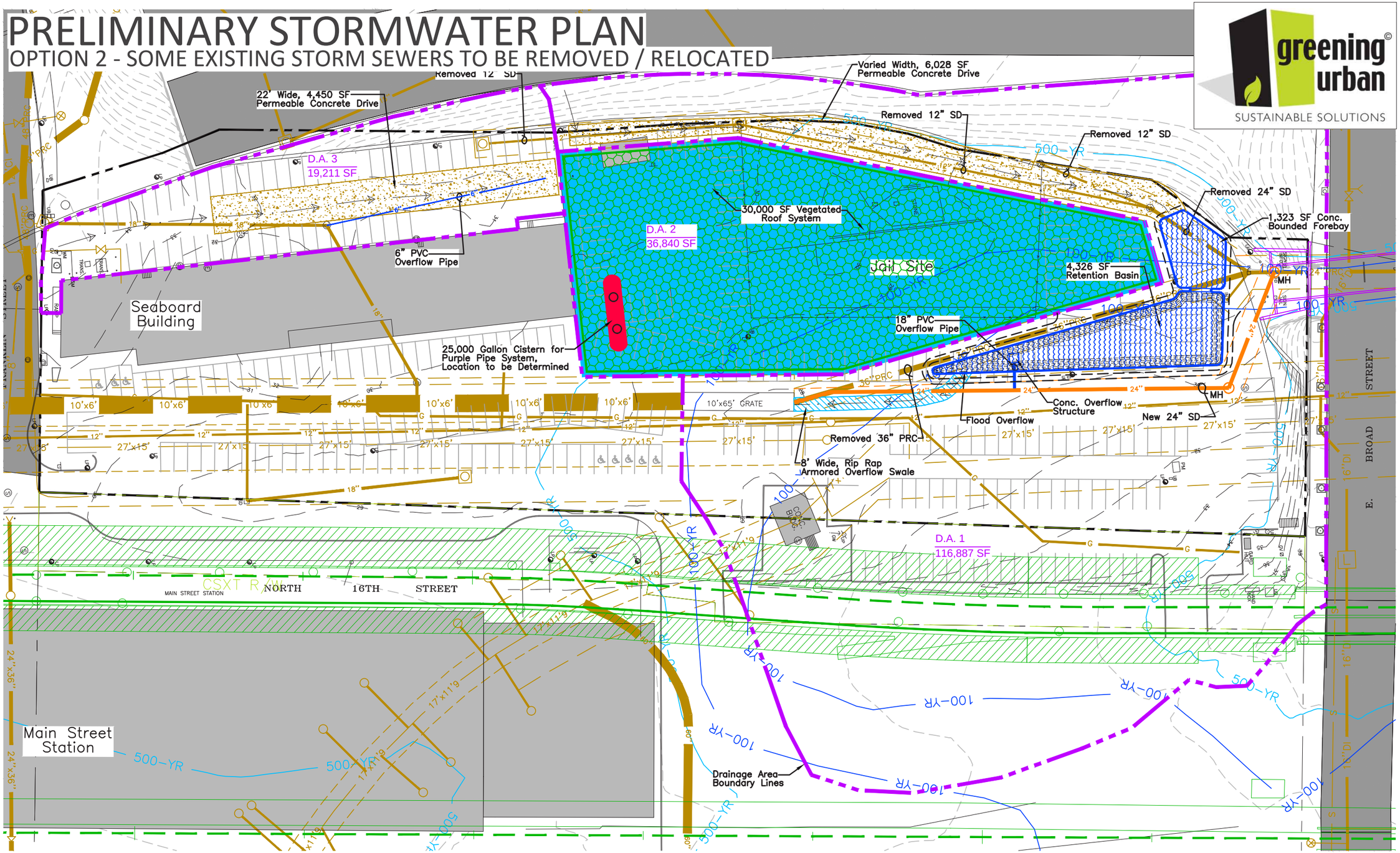
NORTH 16TH STREET

BROAD STREET

Main Street Station

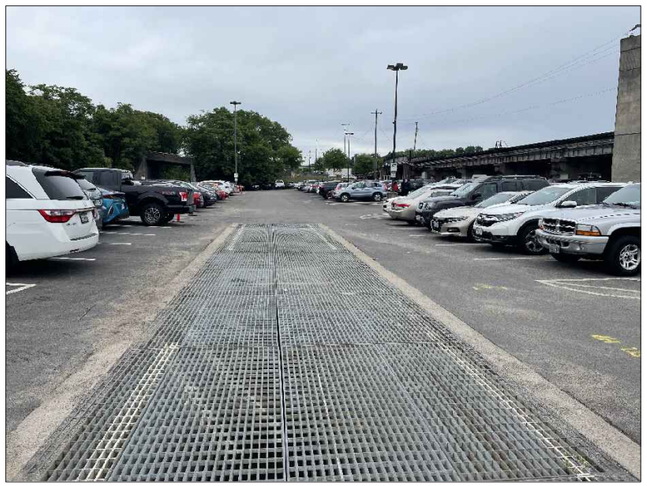
Drainage Area Boundary Lines

# CIVIL REPORT

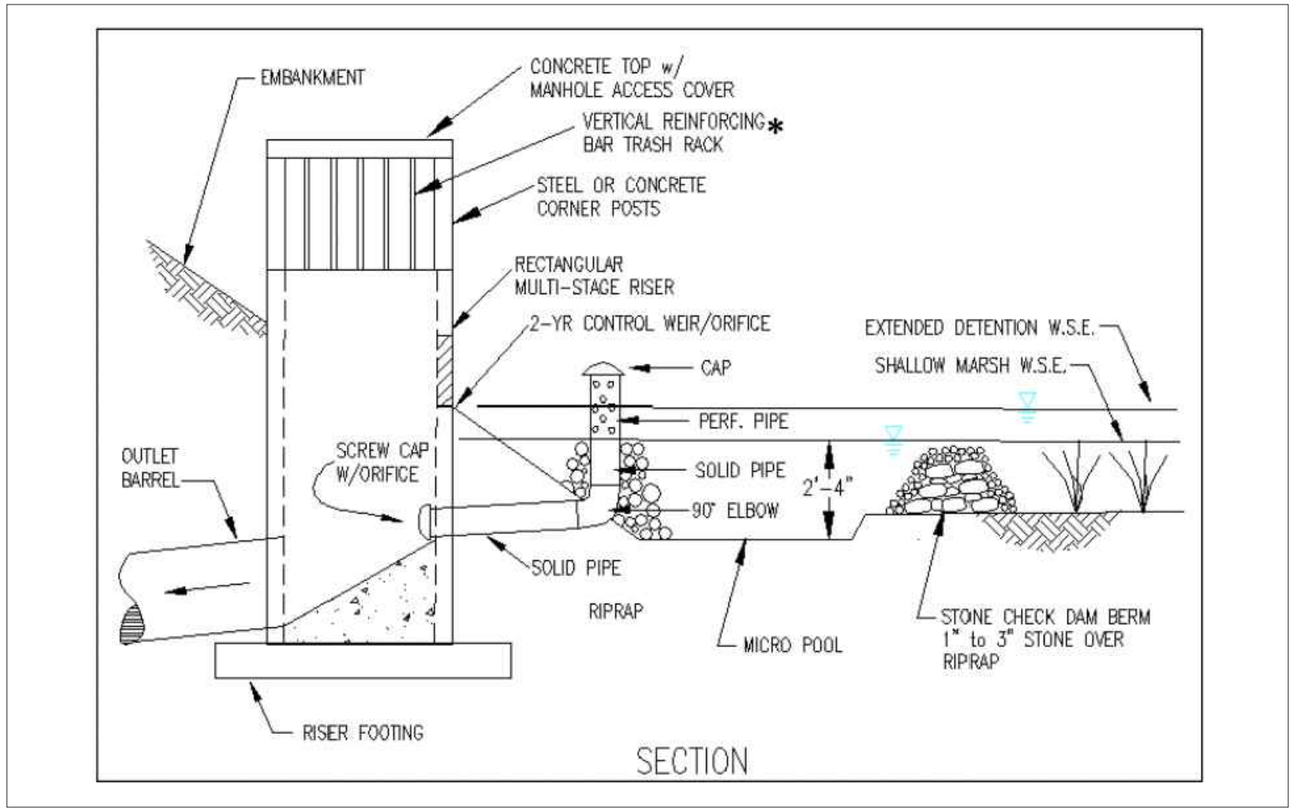


# CIVIL REPORT

## STORMWATER DETAILS



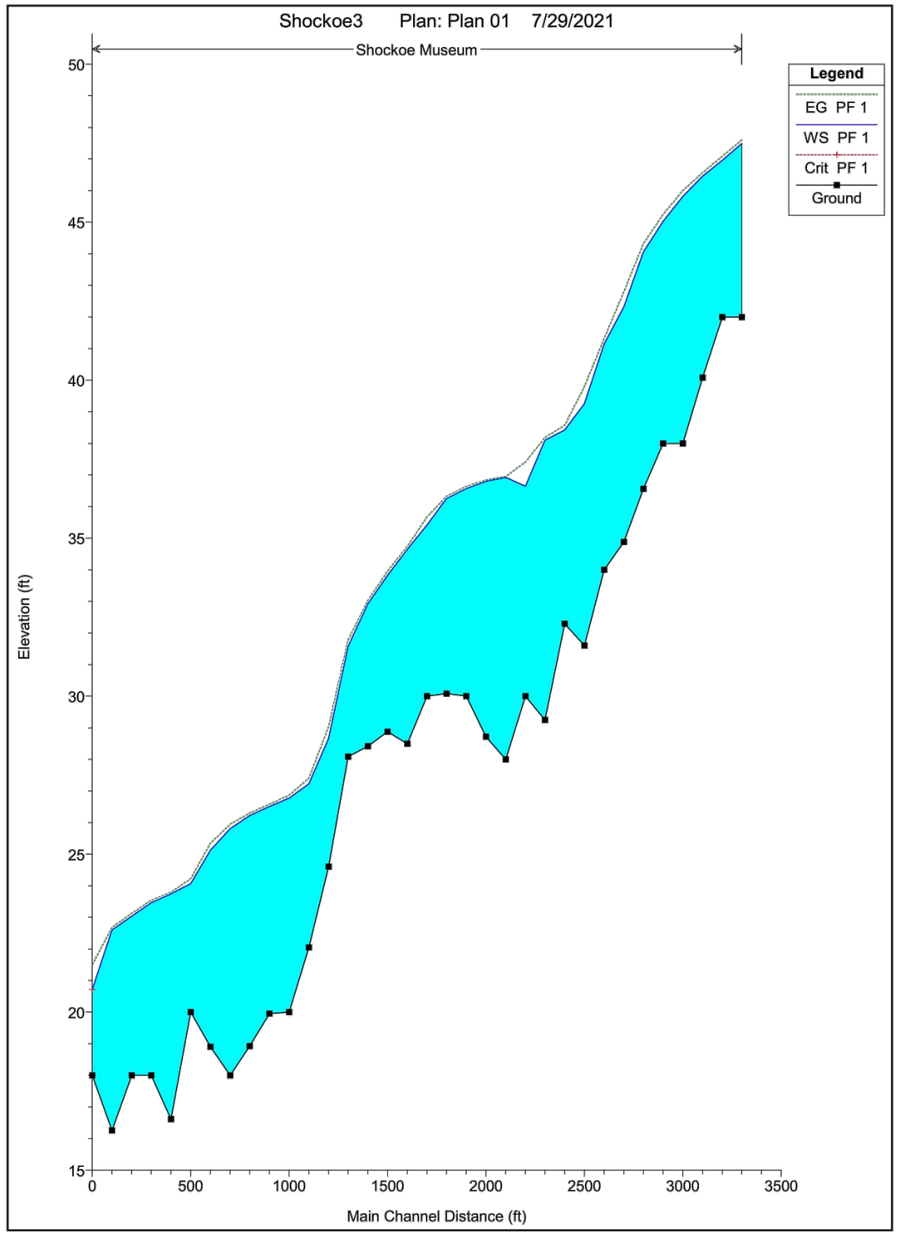
EXISTING 10' X 65' GRATE




VDOT BMP DRAINAGE DETAIL

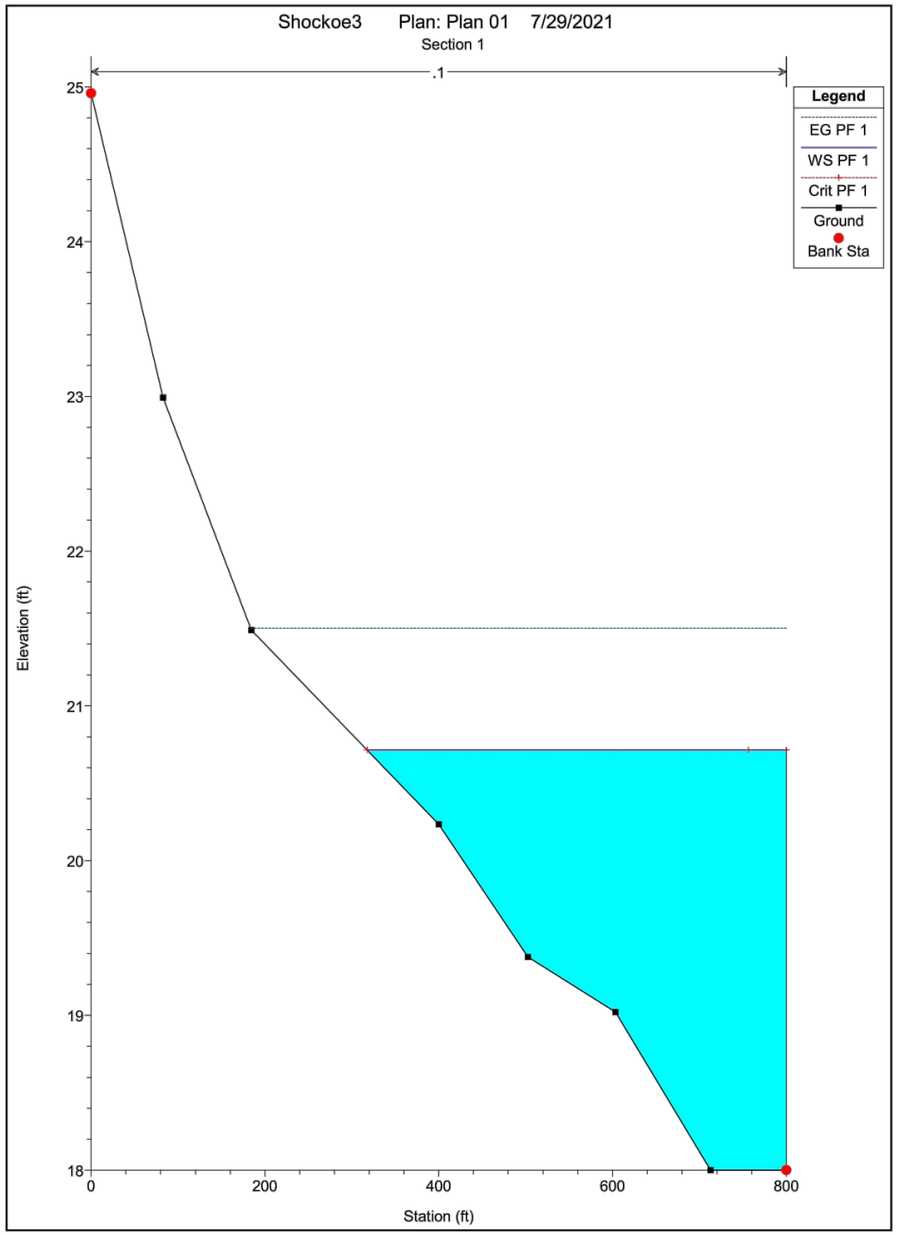
# CIVIL REPORT

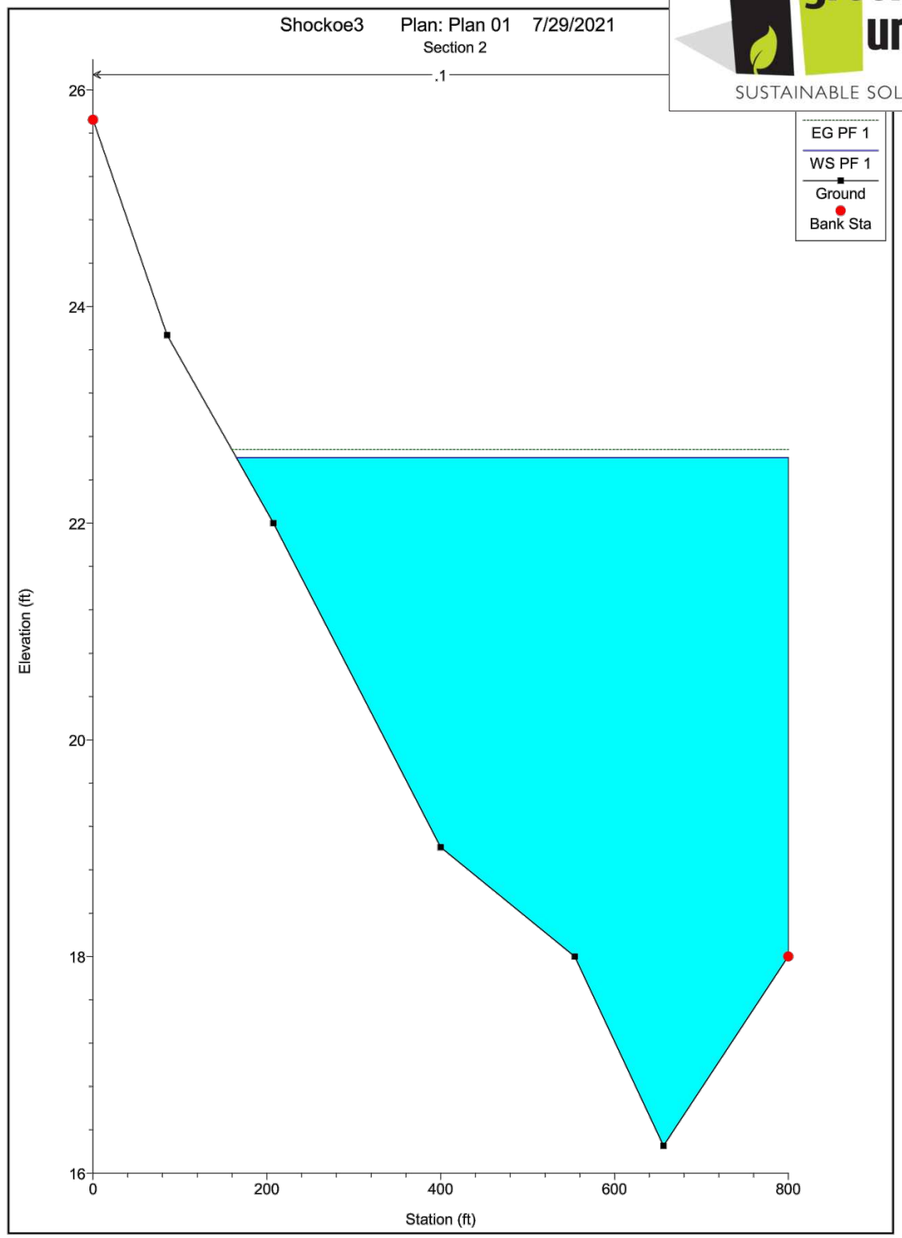
## FLOOD STUDY SECTIONS



# CIVIL REPORT

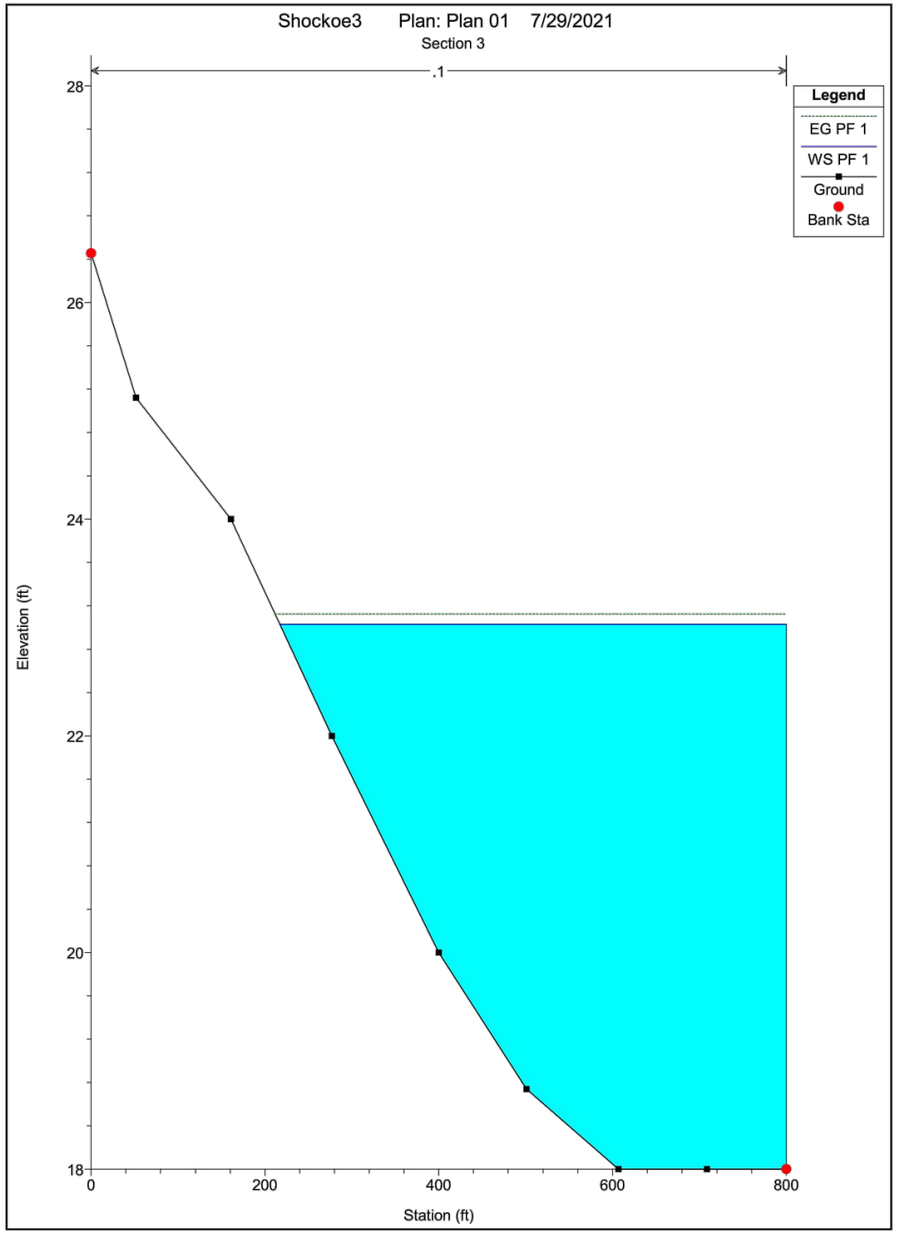
## FLOOD STUDY SECTIONS

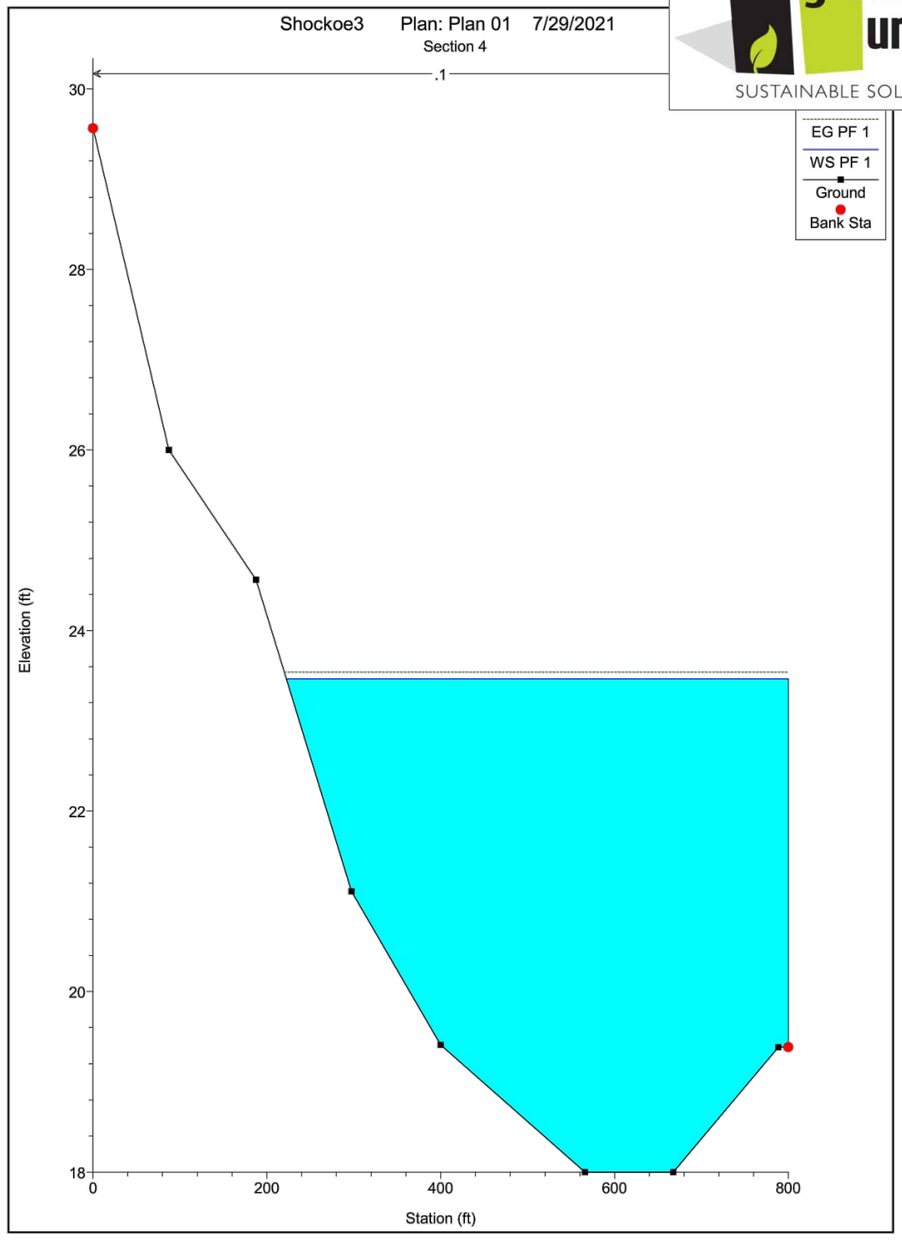


# CIVIL REPORT

## FLOOD STUDY SECTIONS



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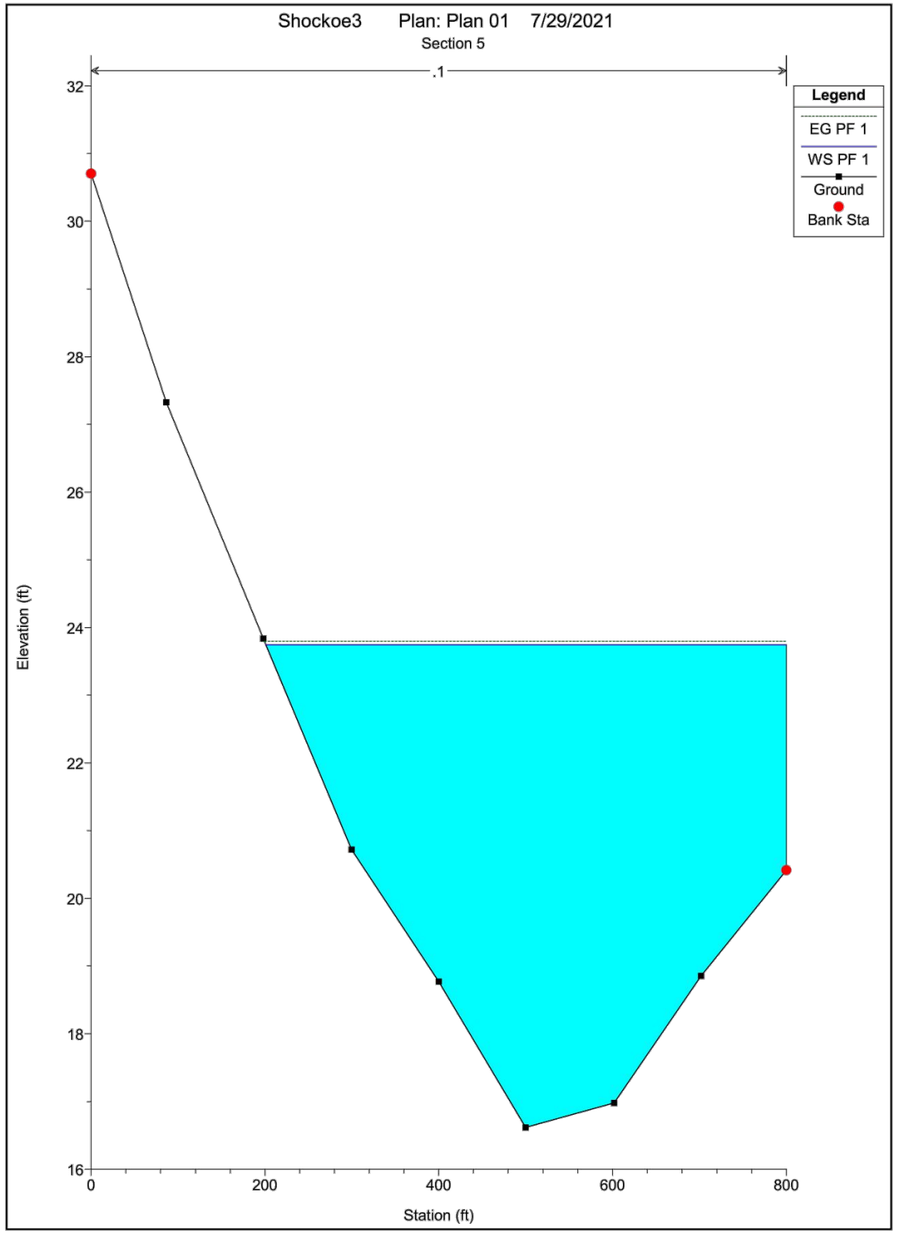


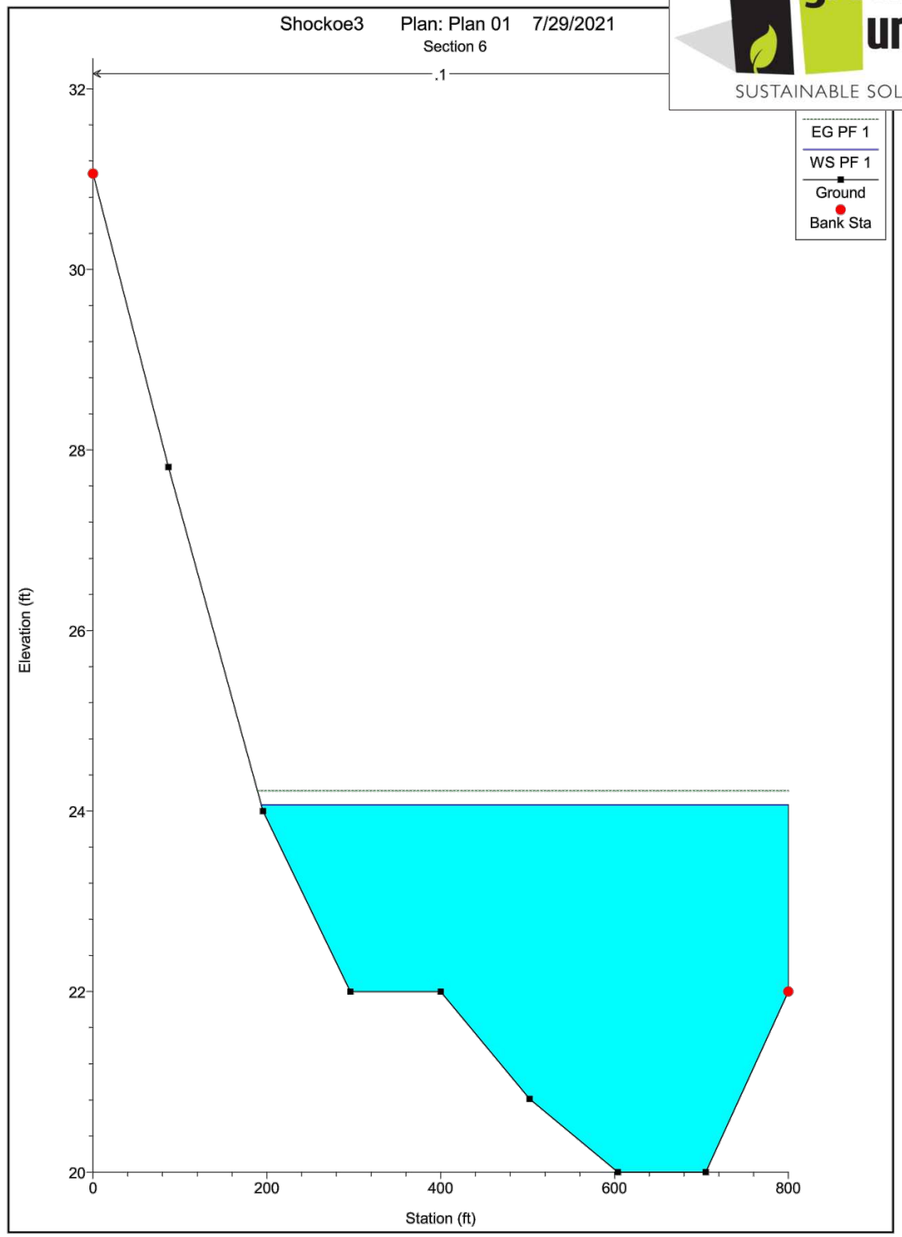

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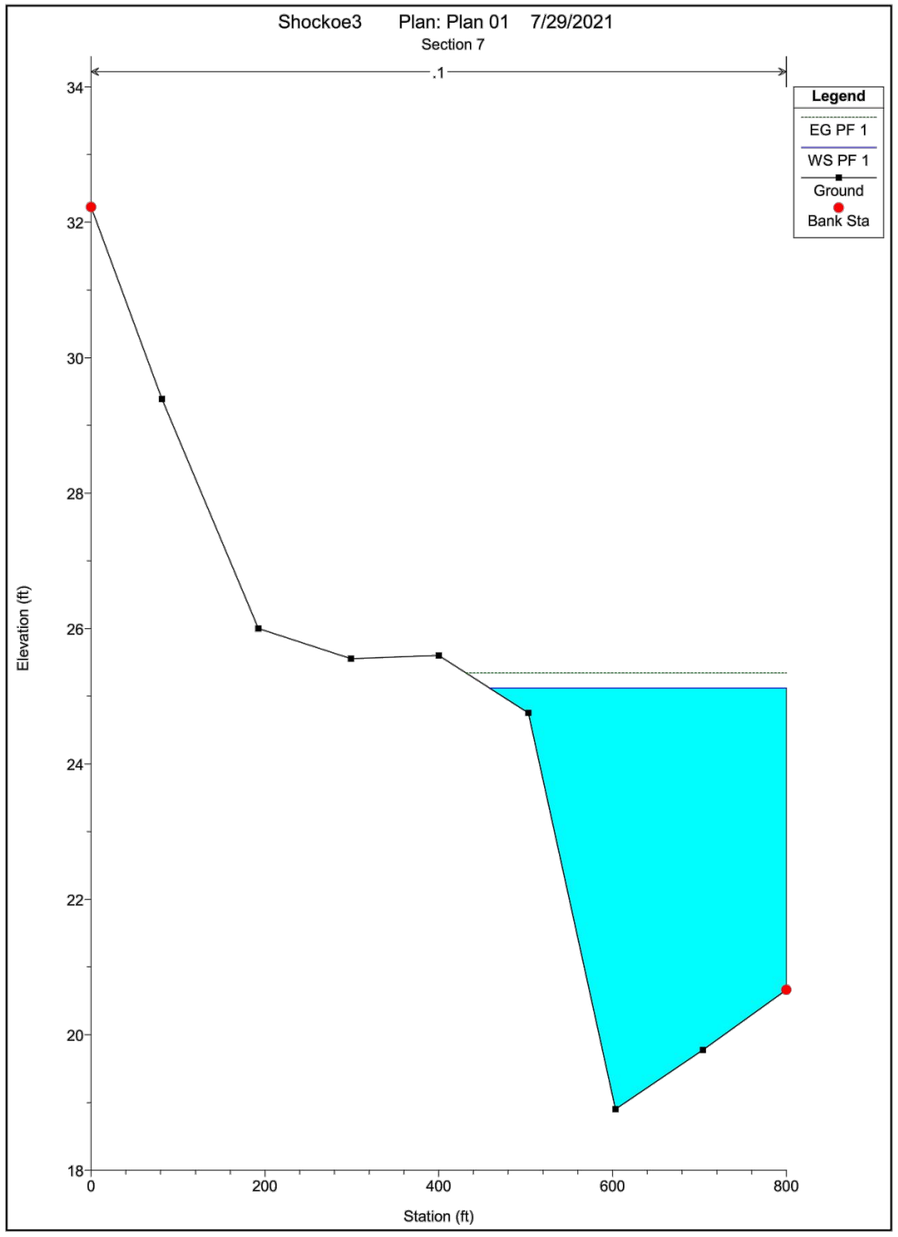


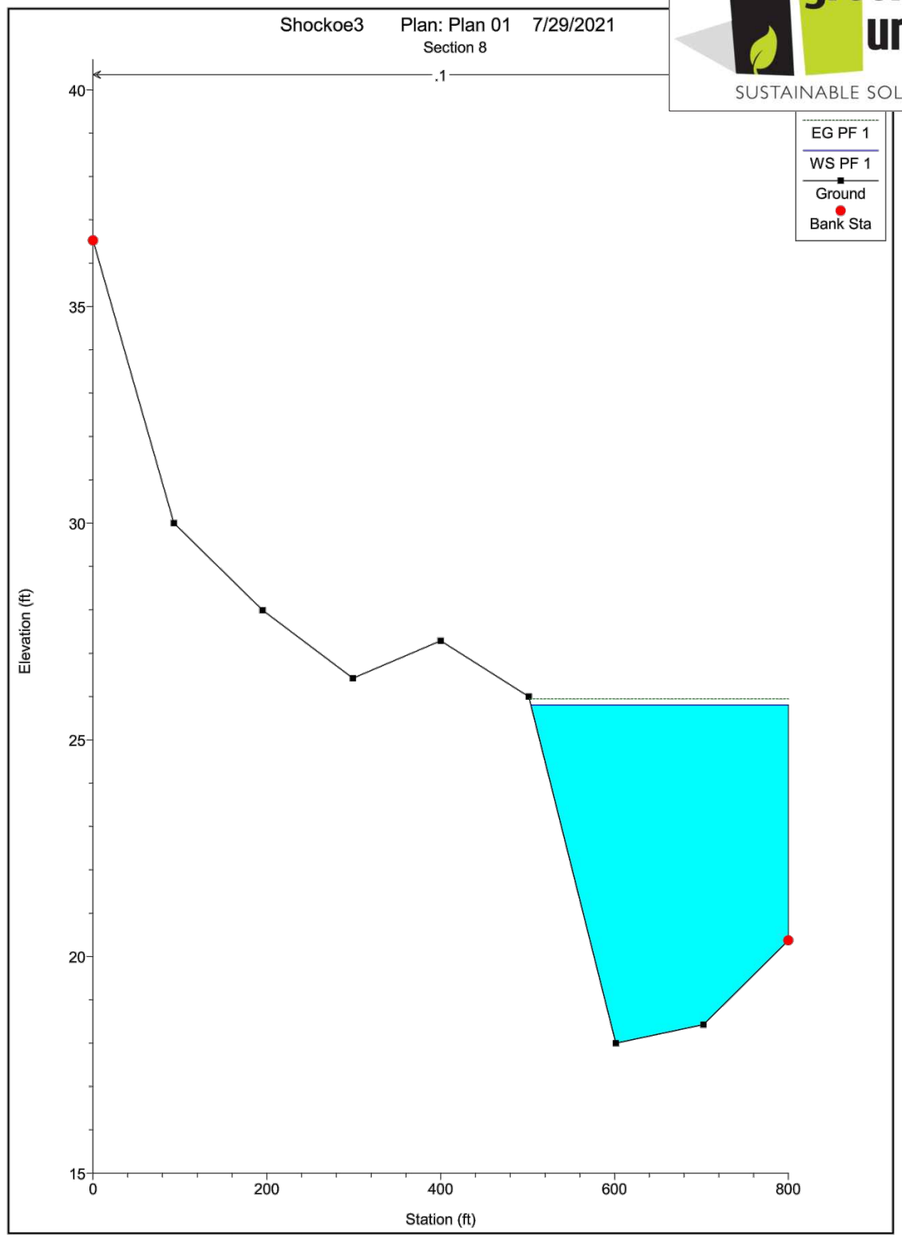

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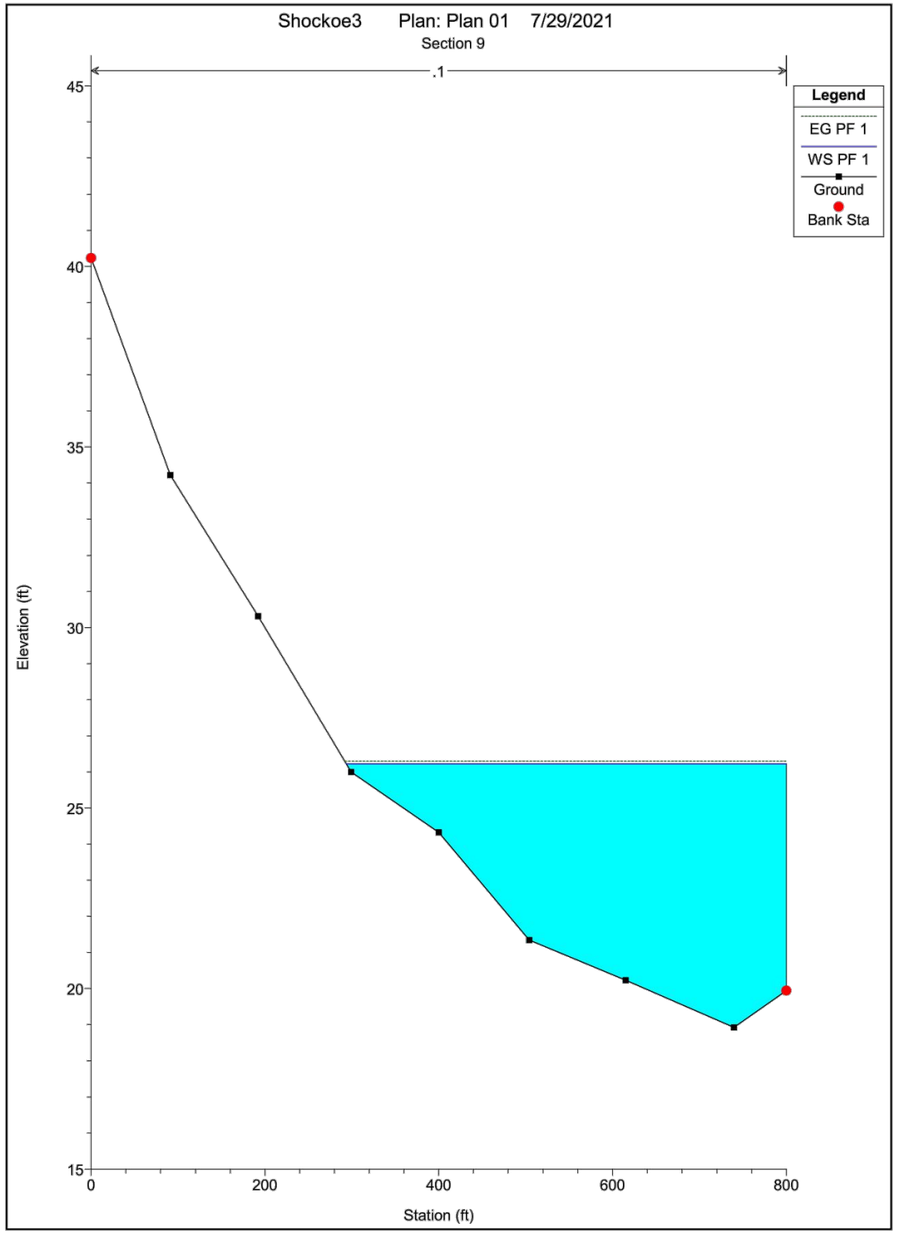


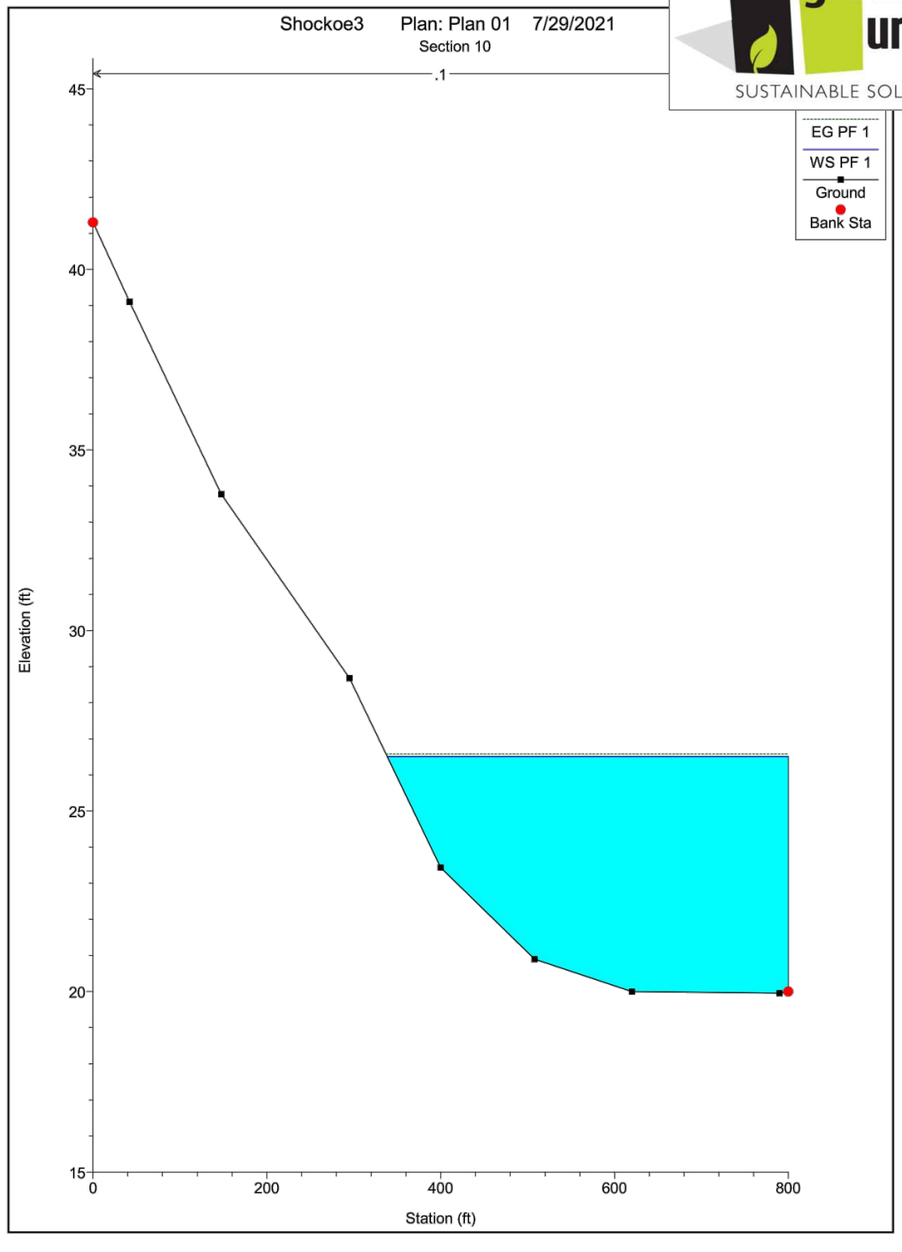

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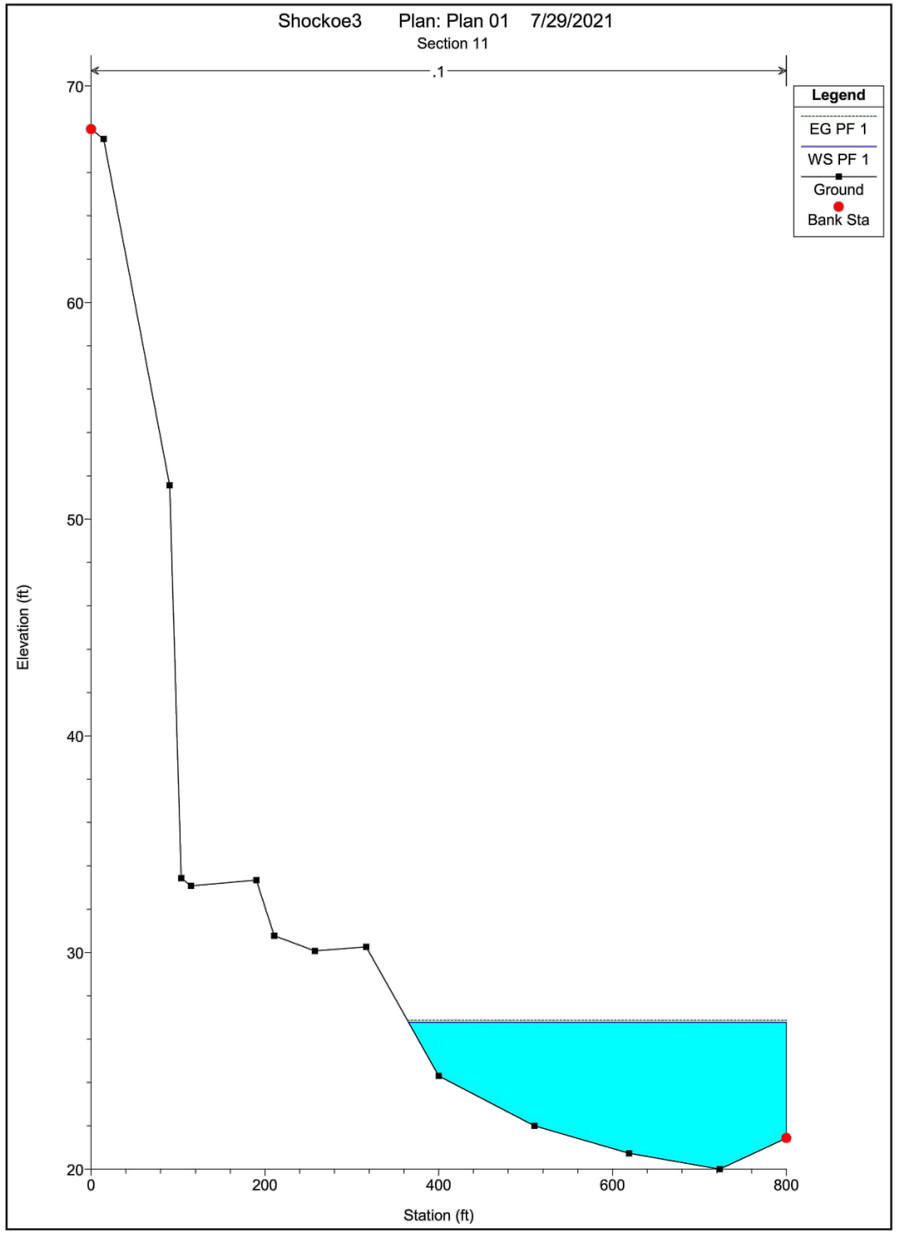


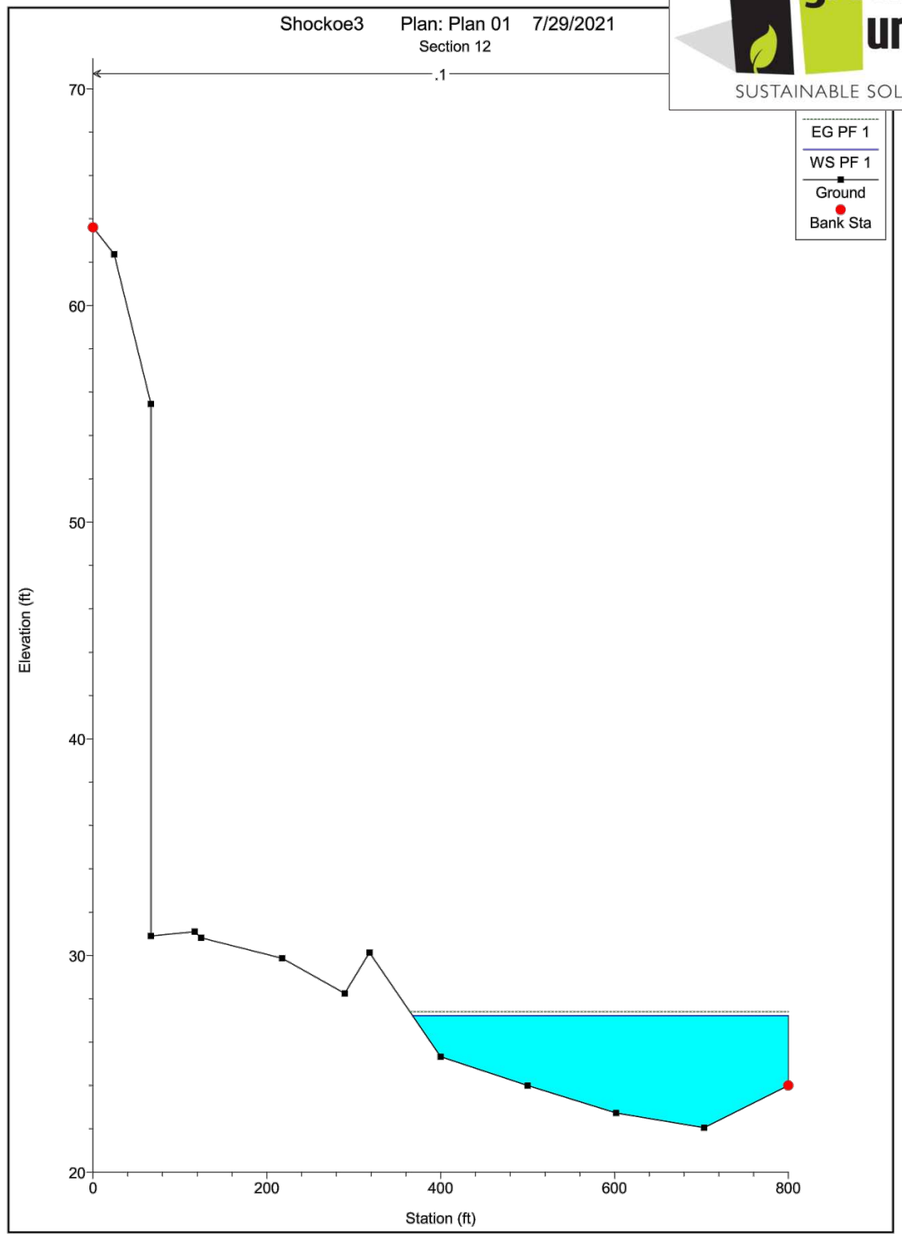

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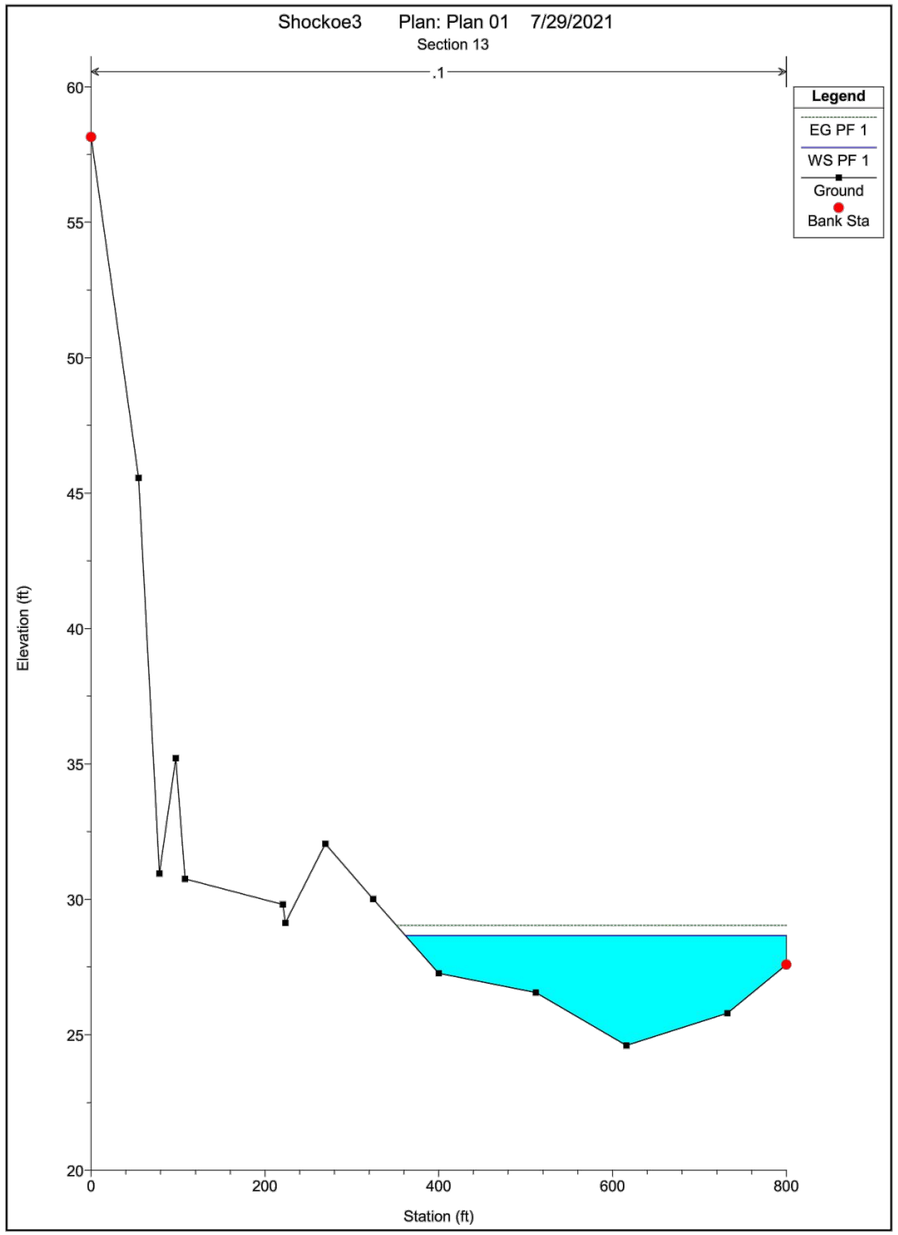


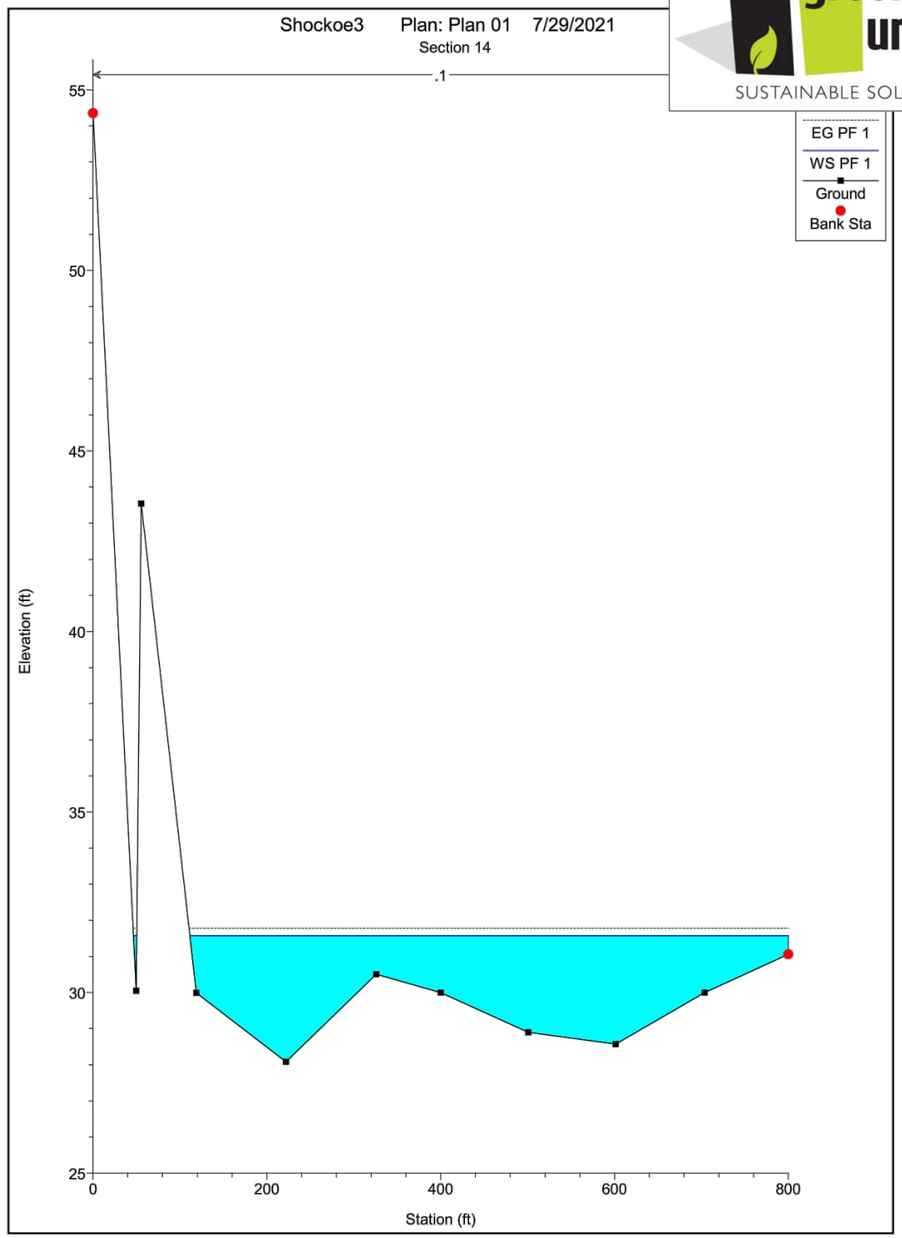

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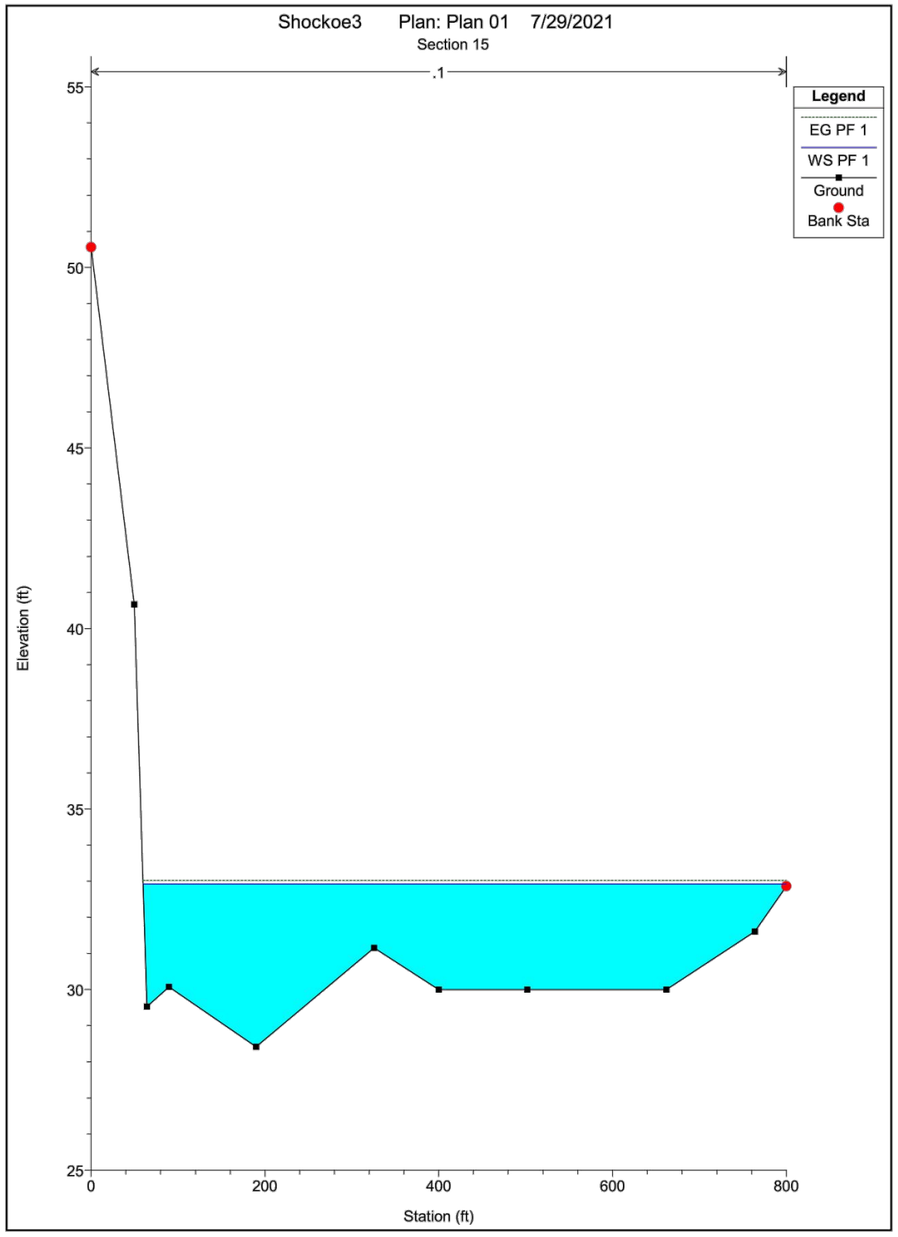


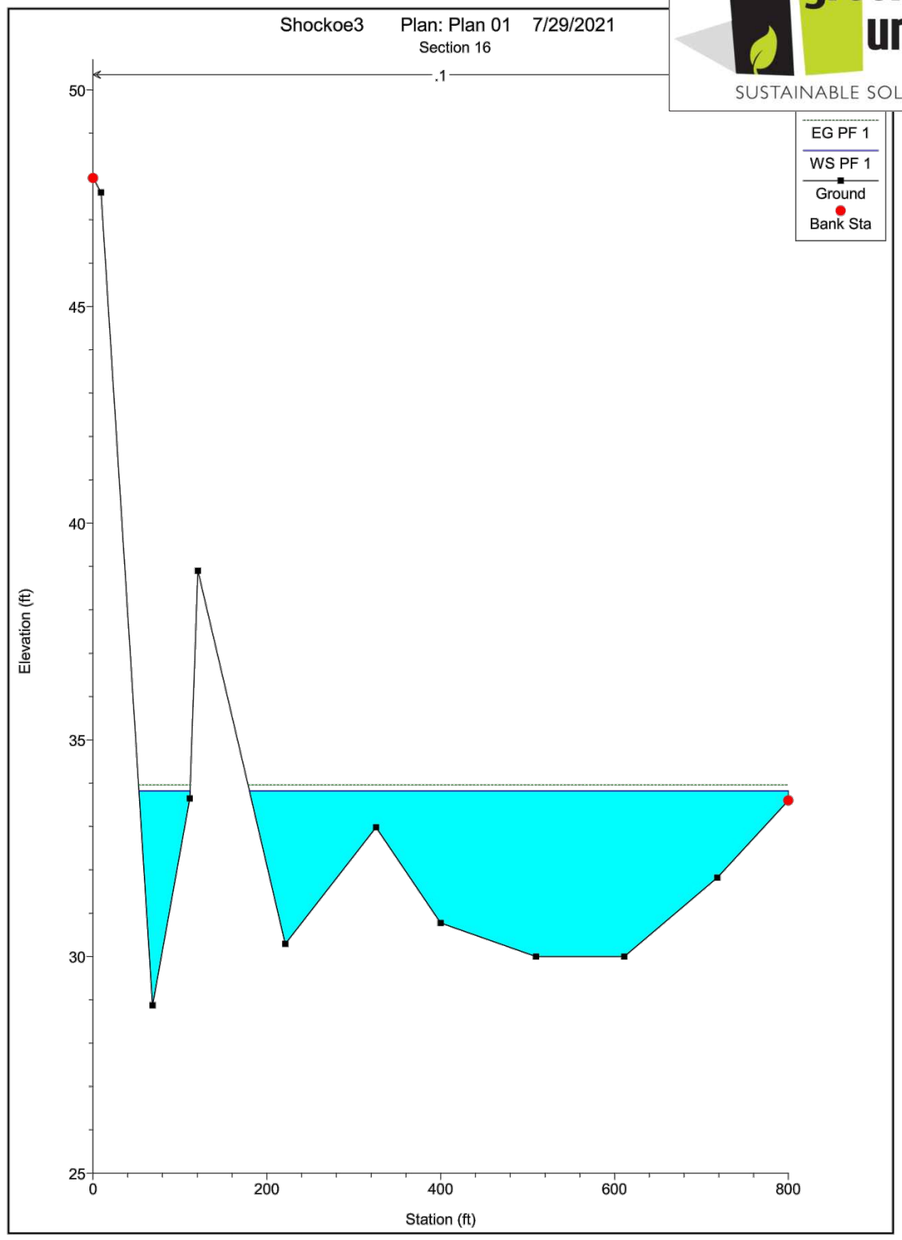

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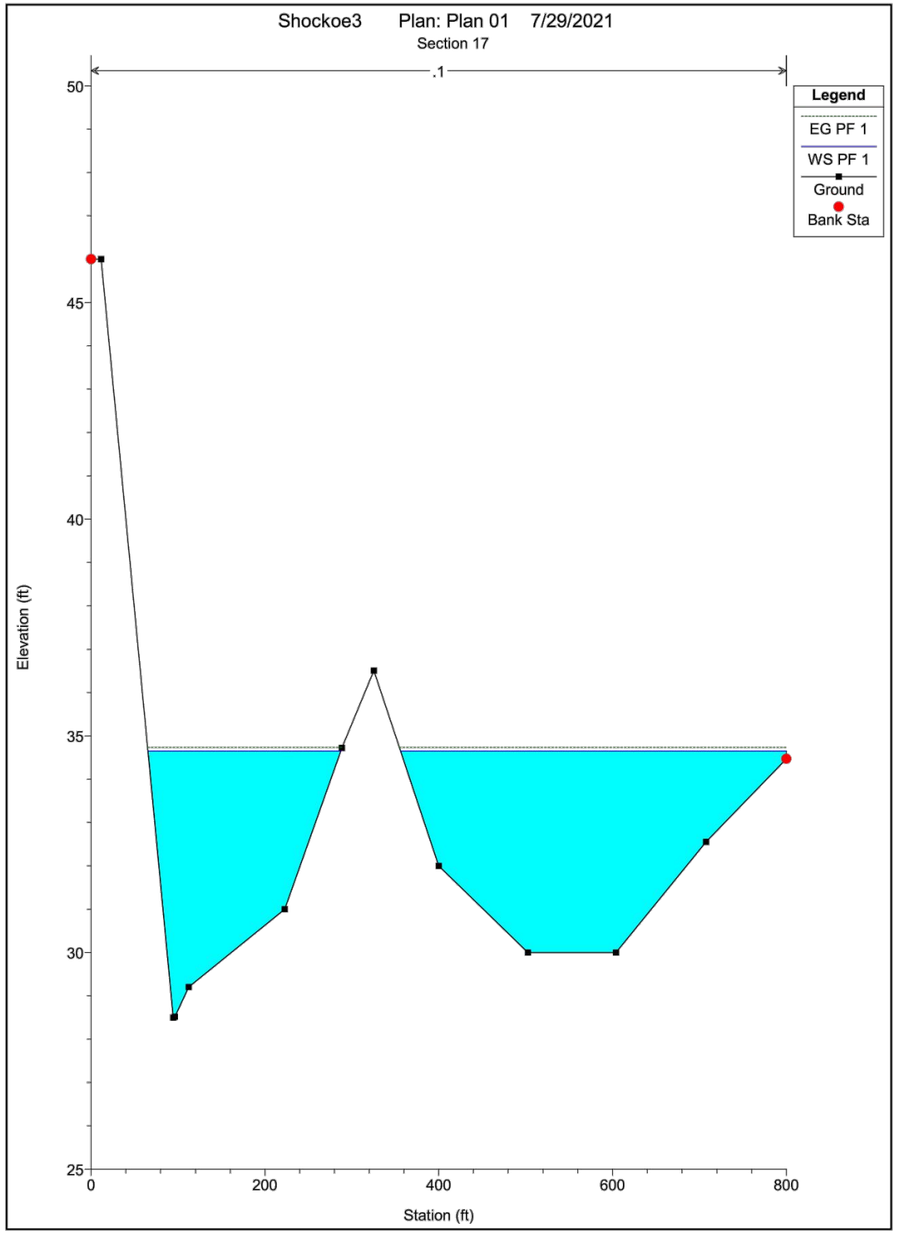


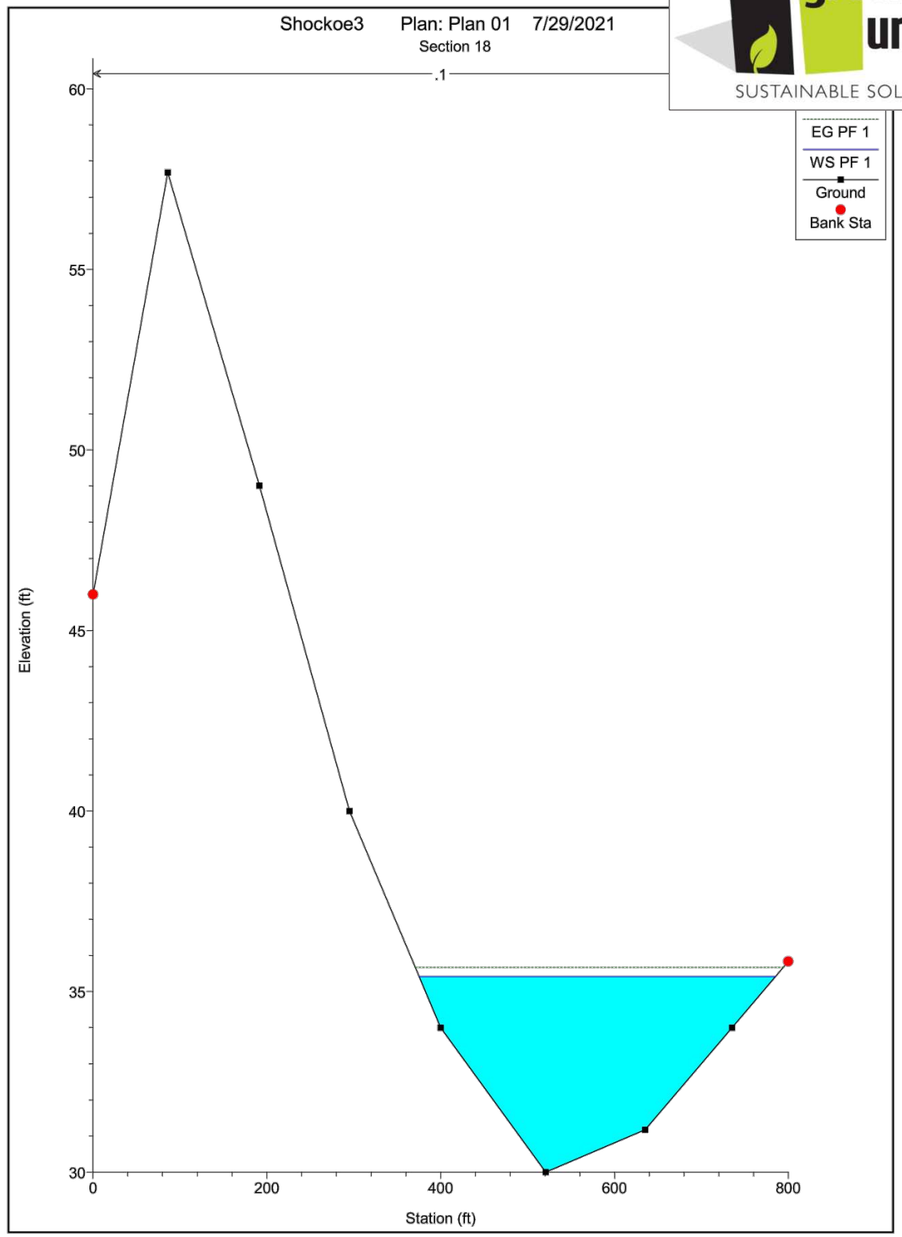

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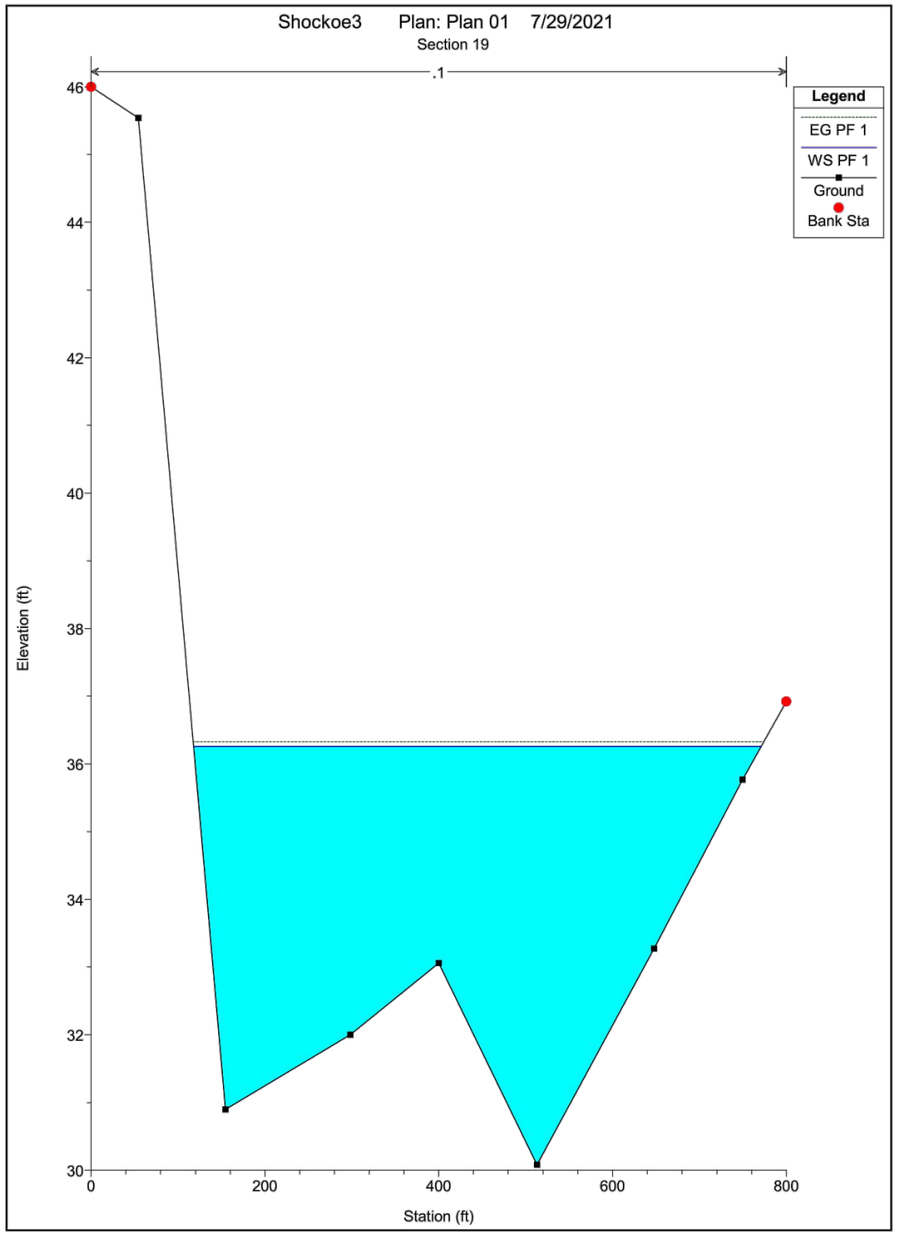


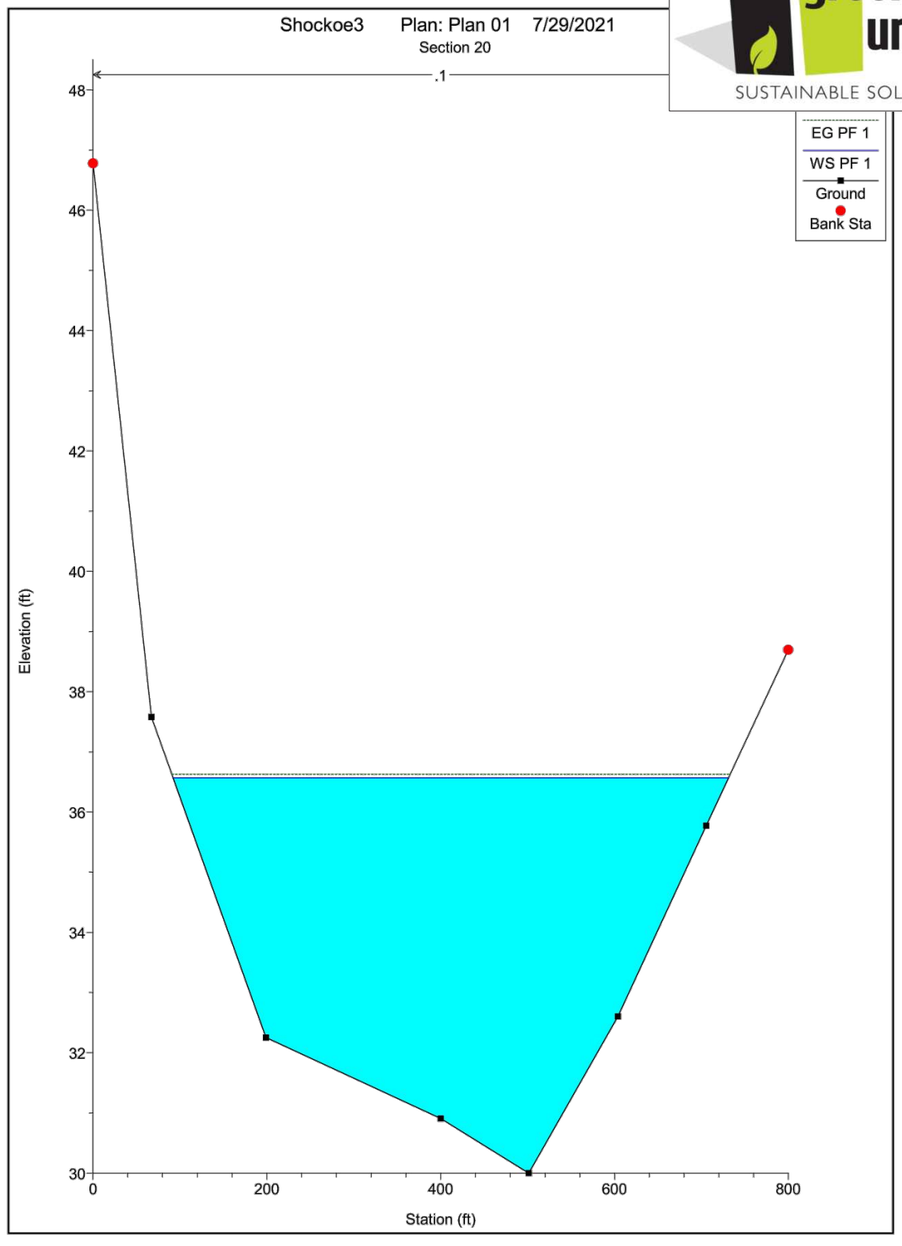

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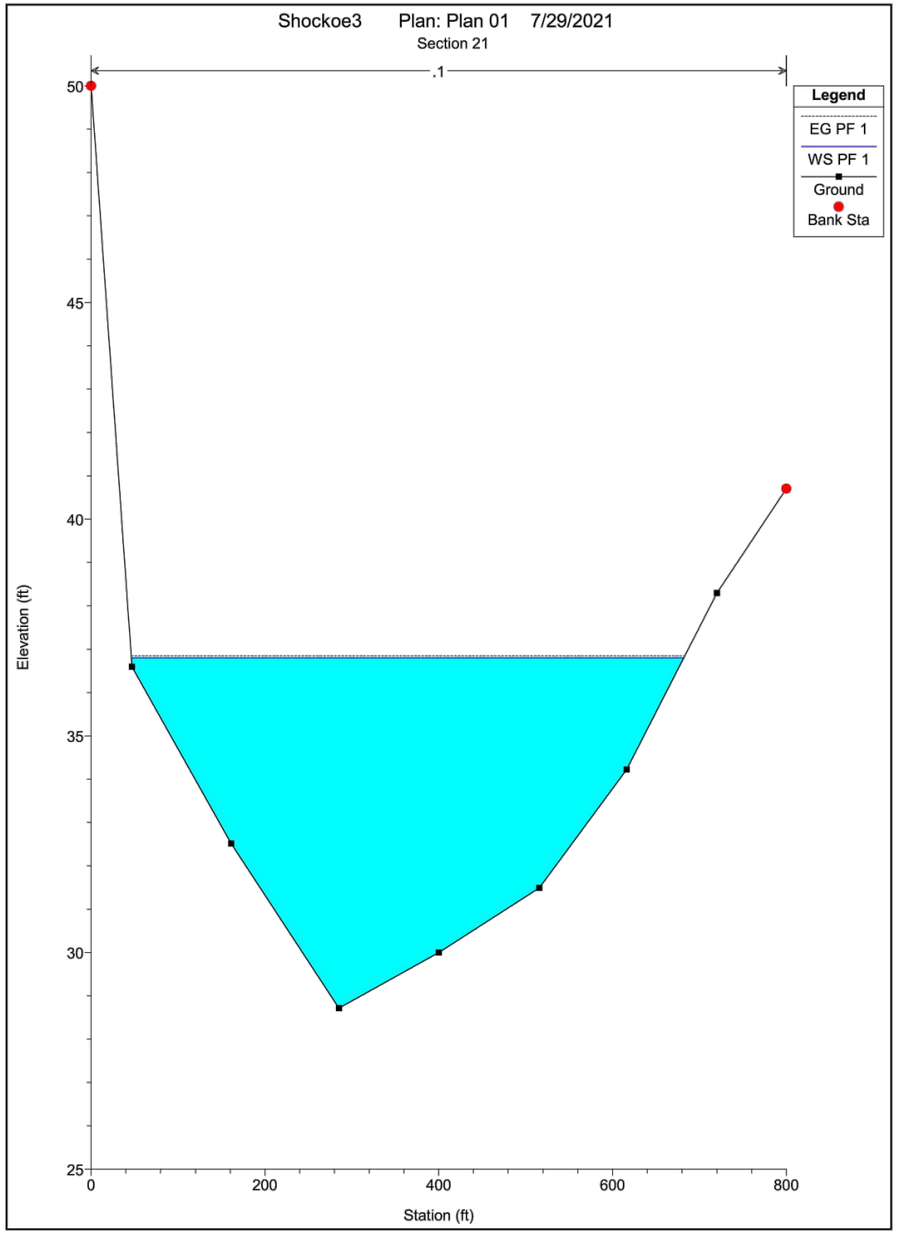


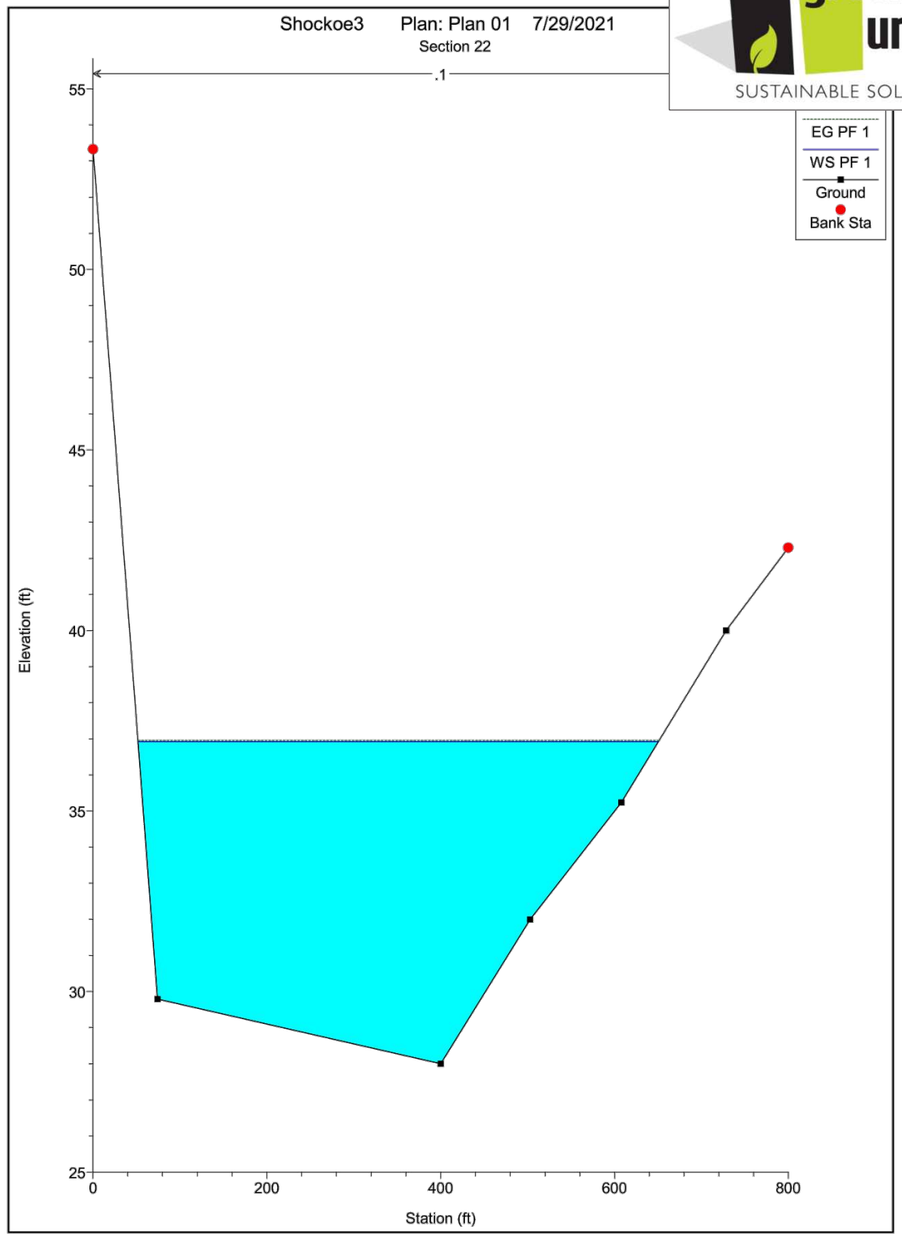

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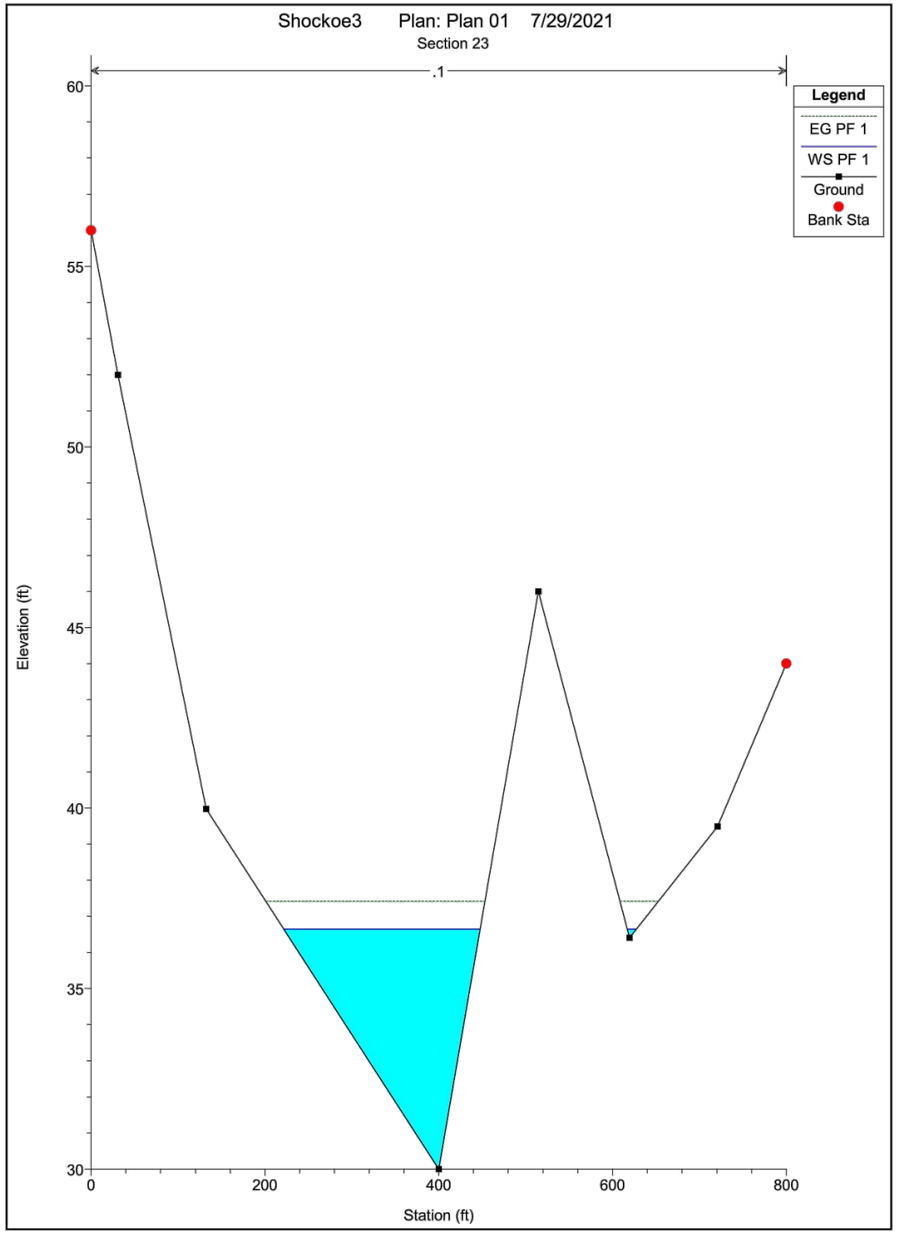


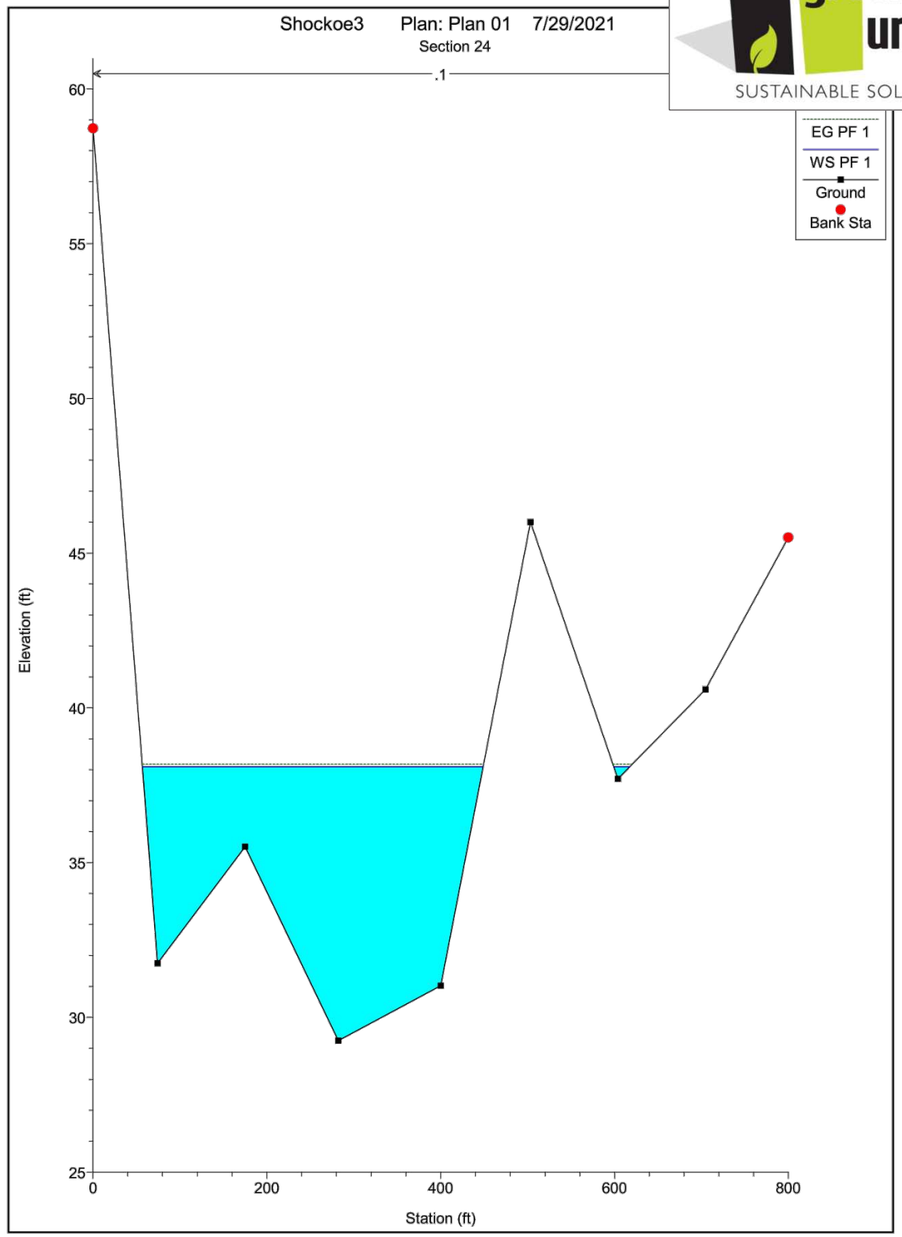

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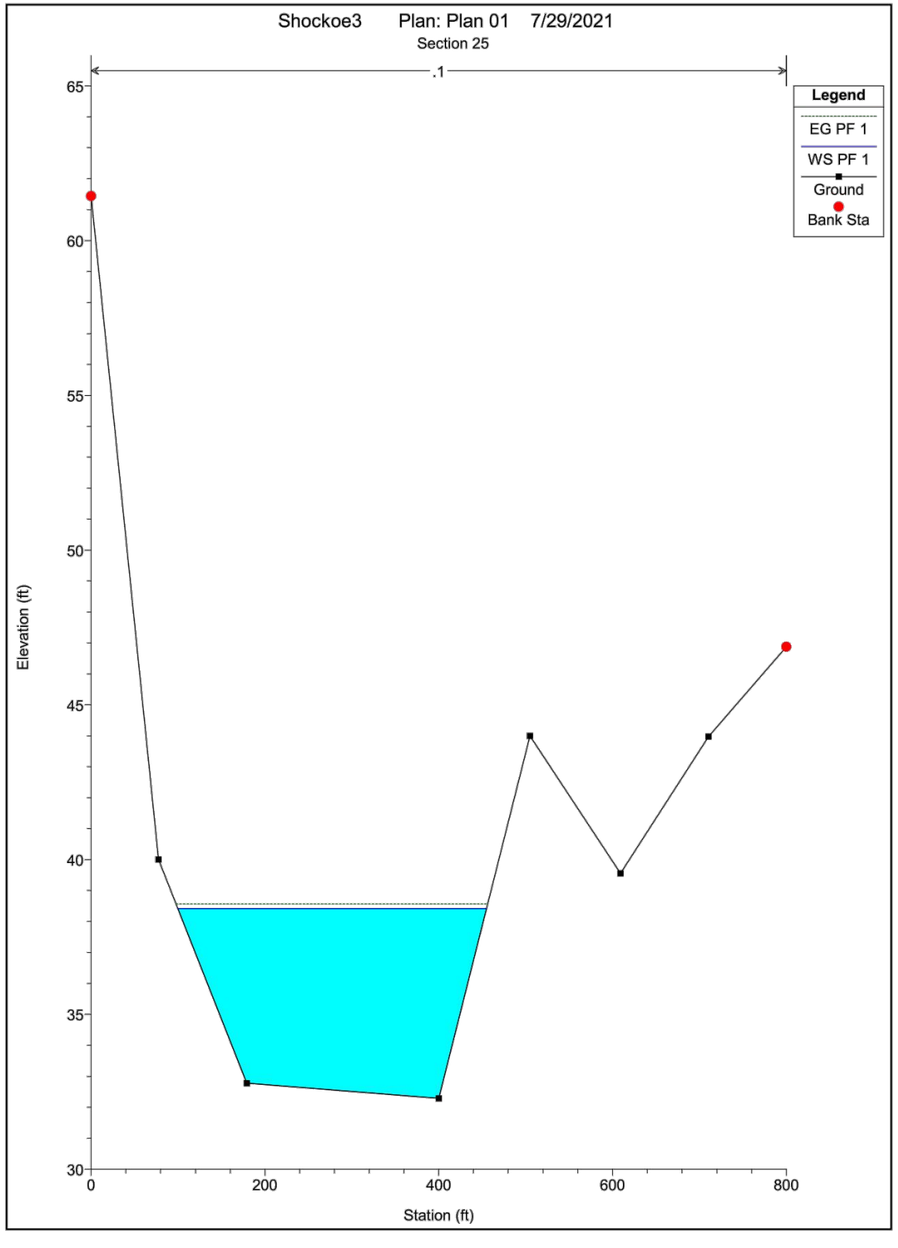


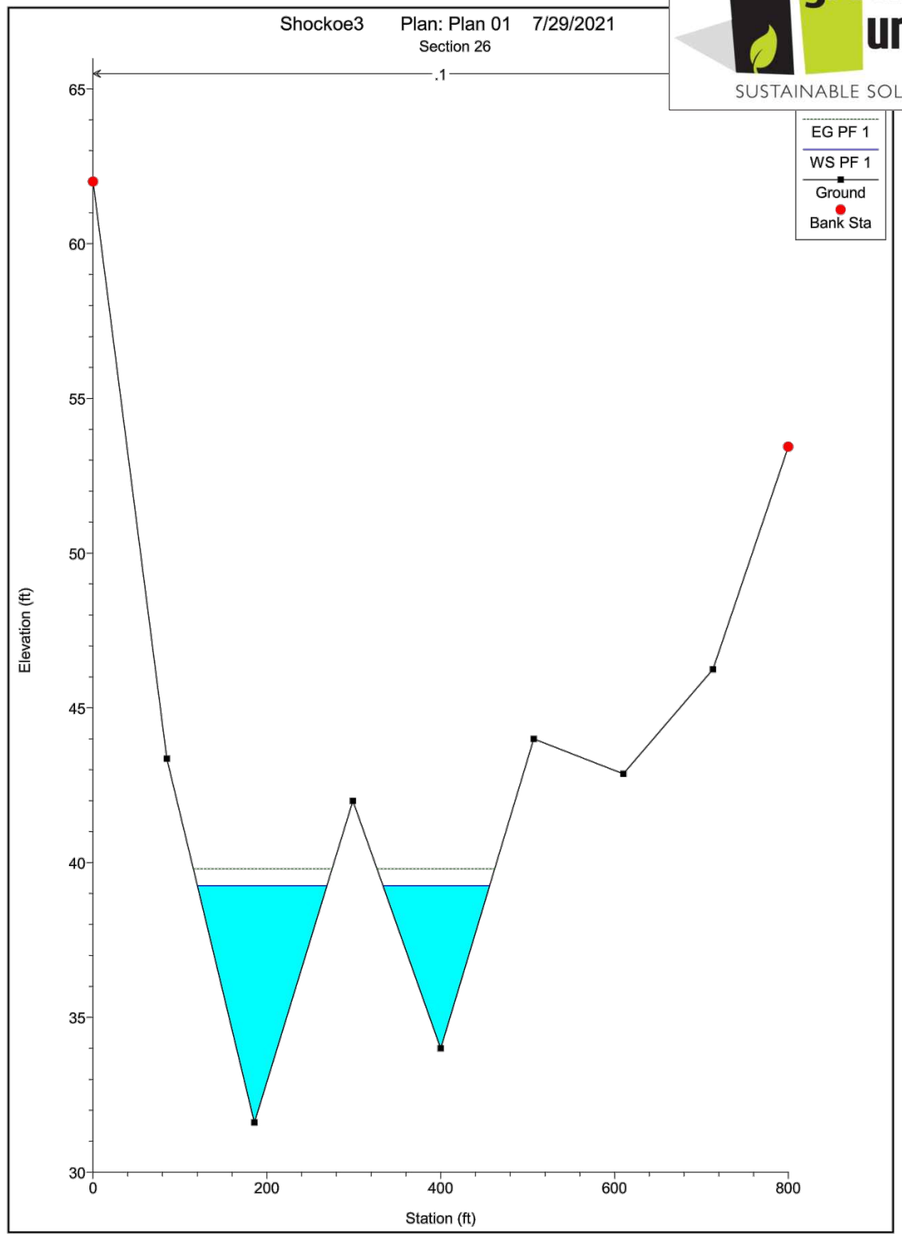

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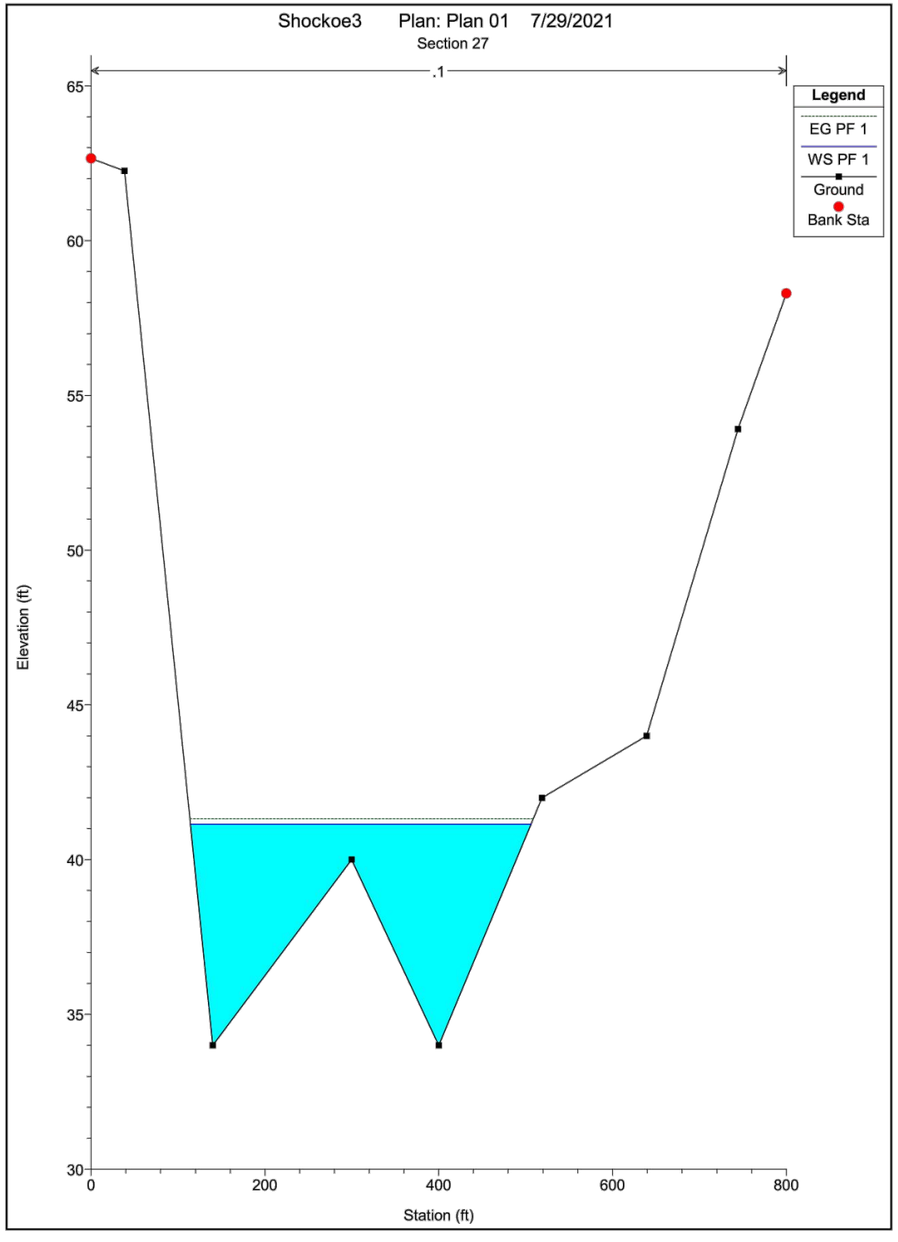


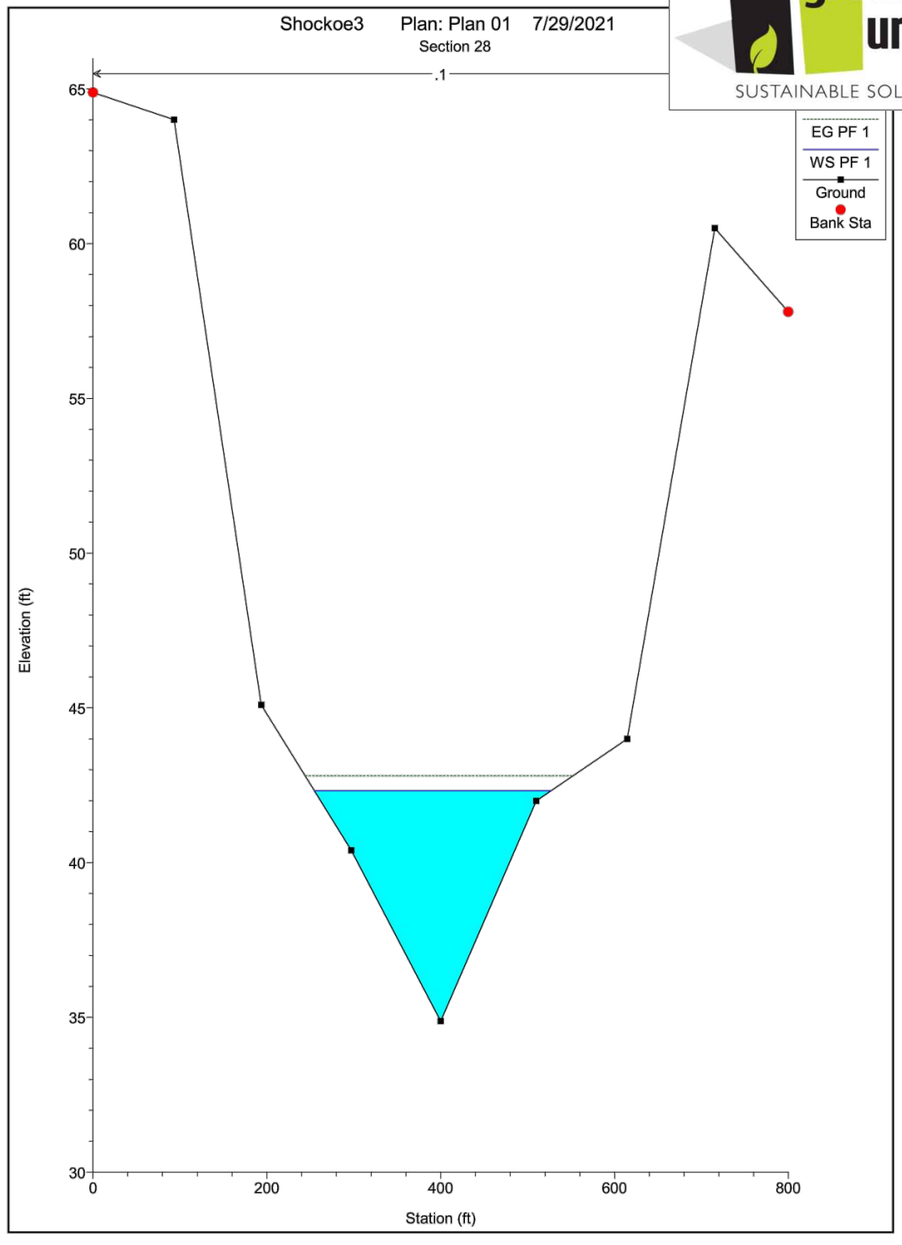

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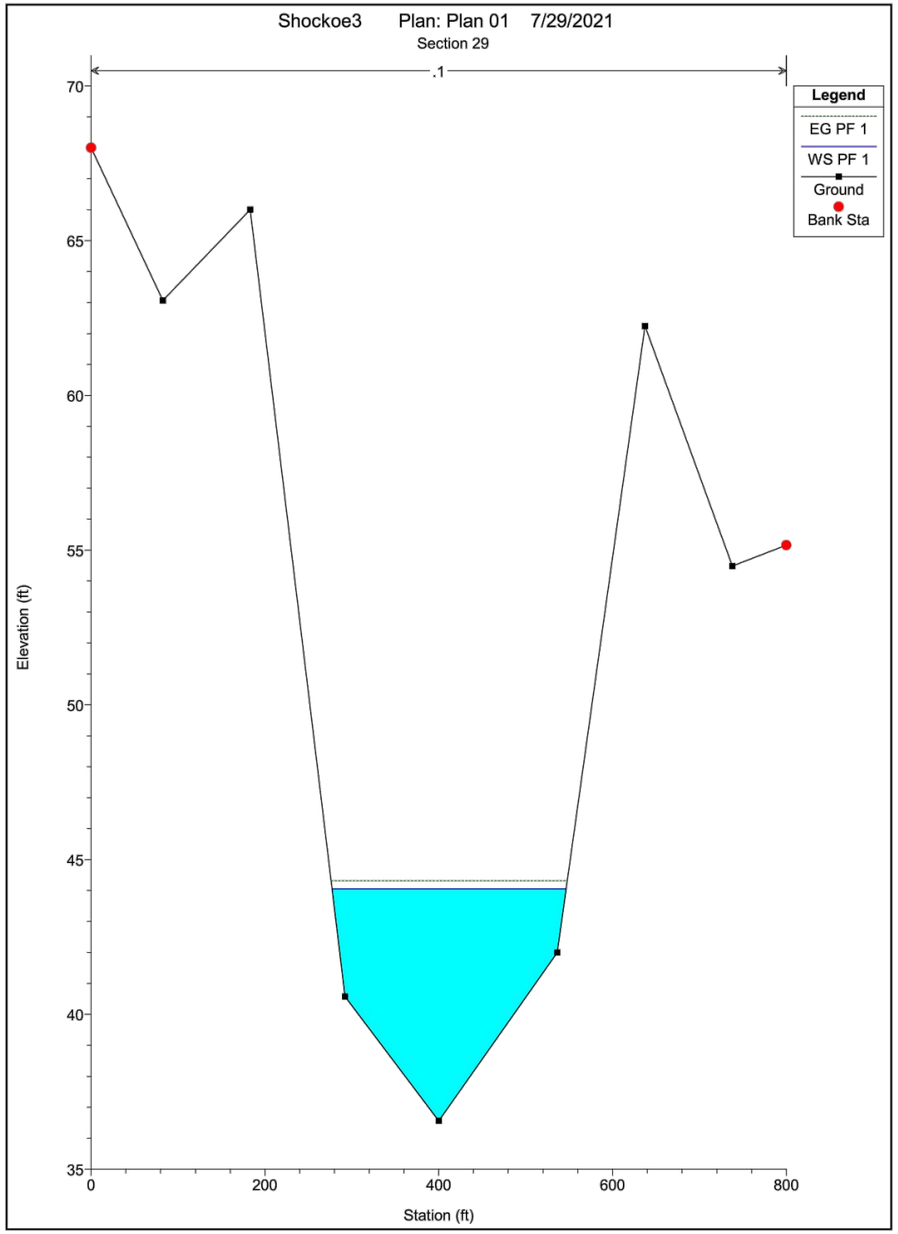


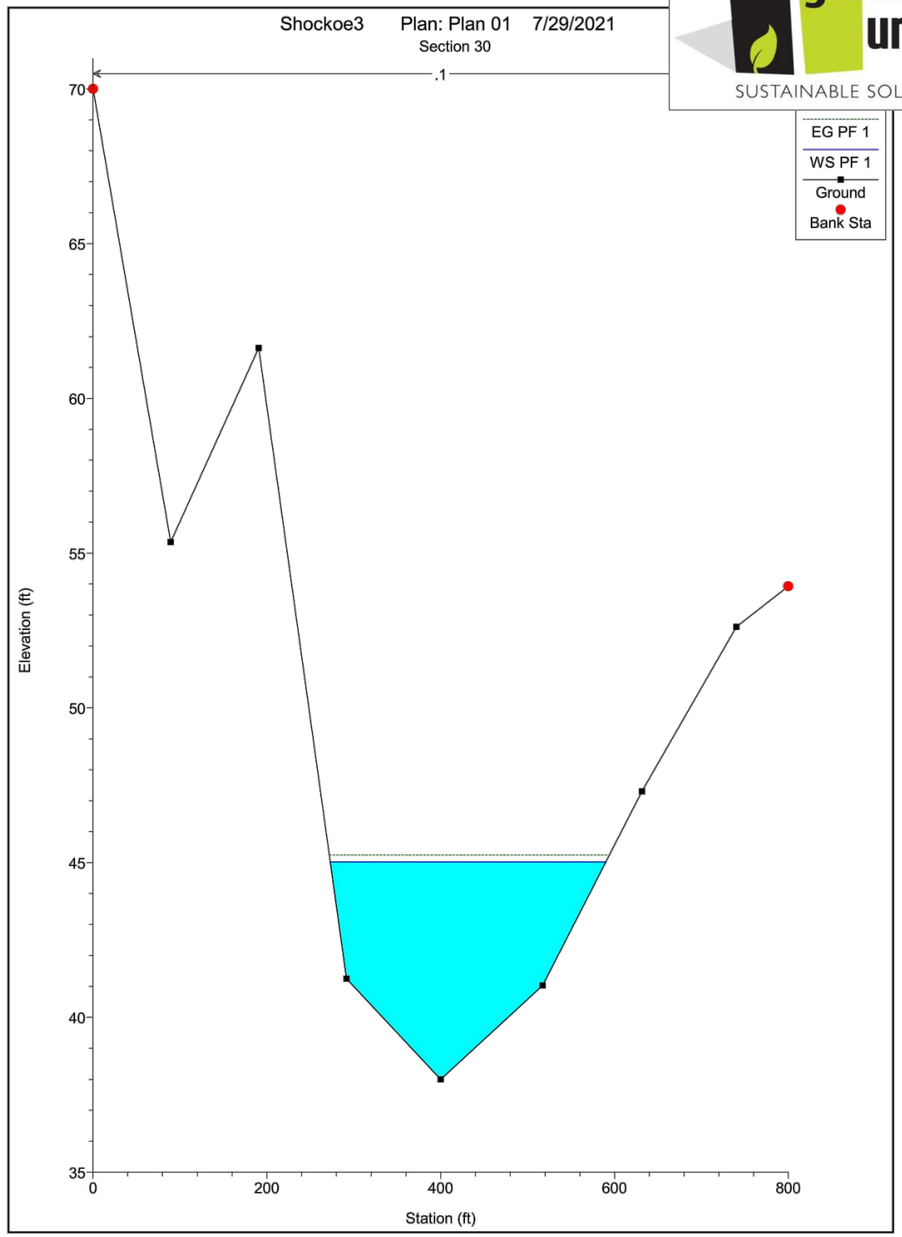

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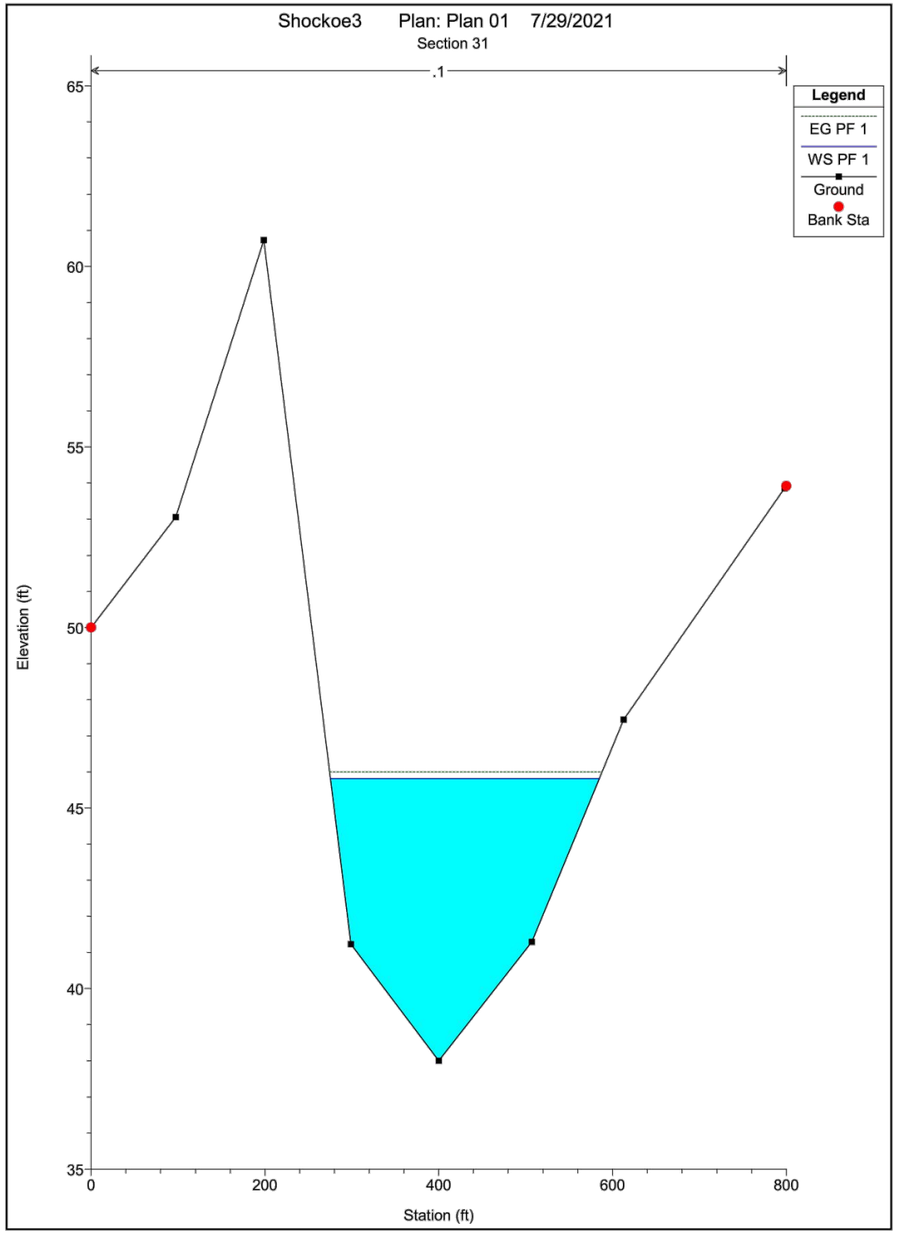


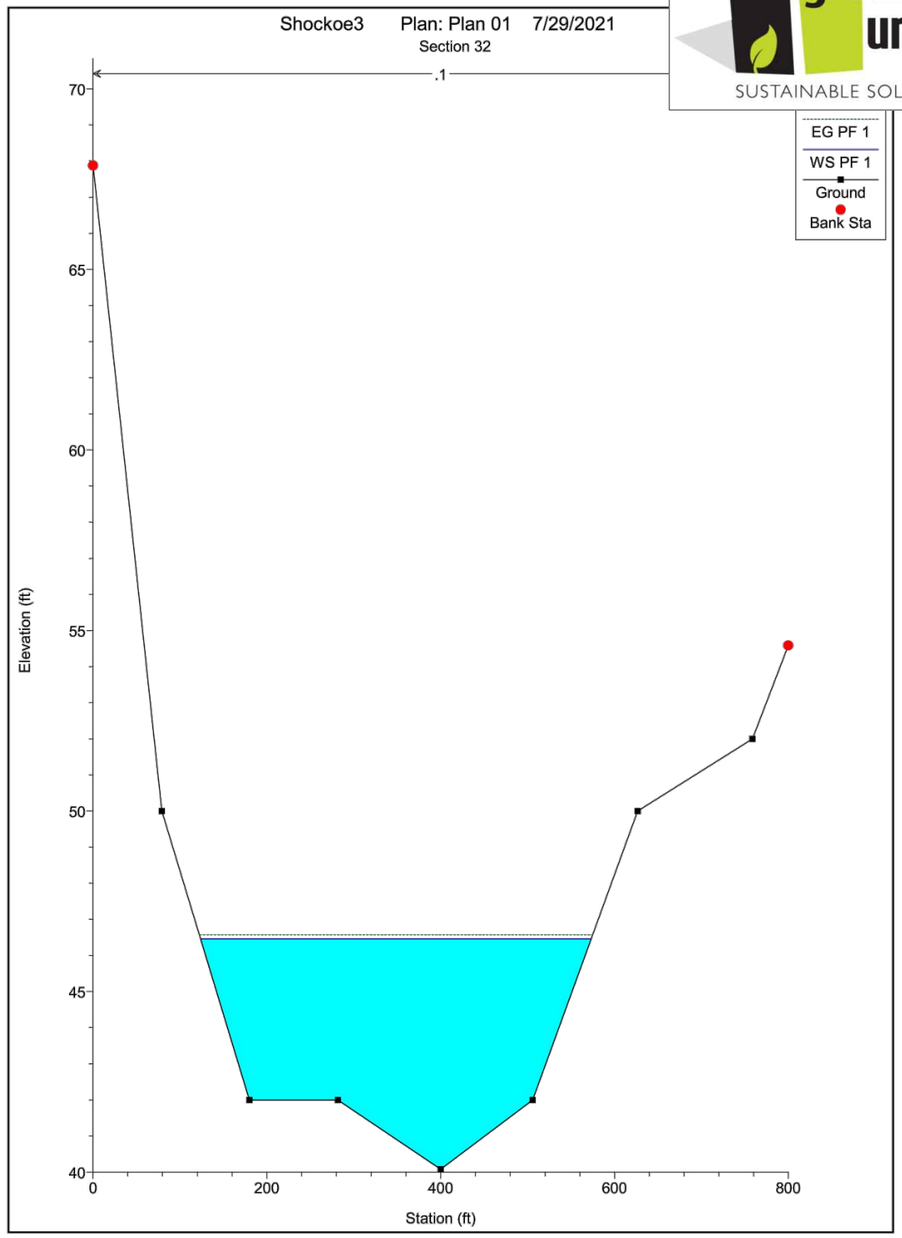

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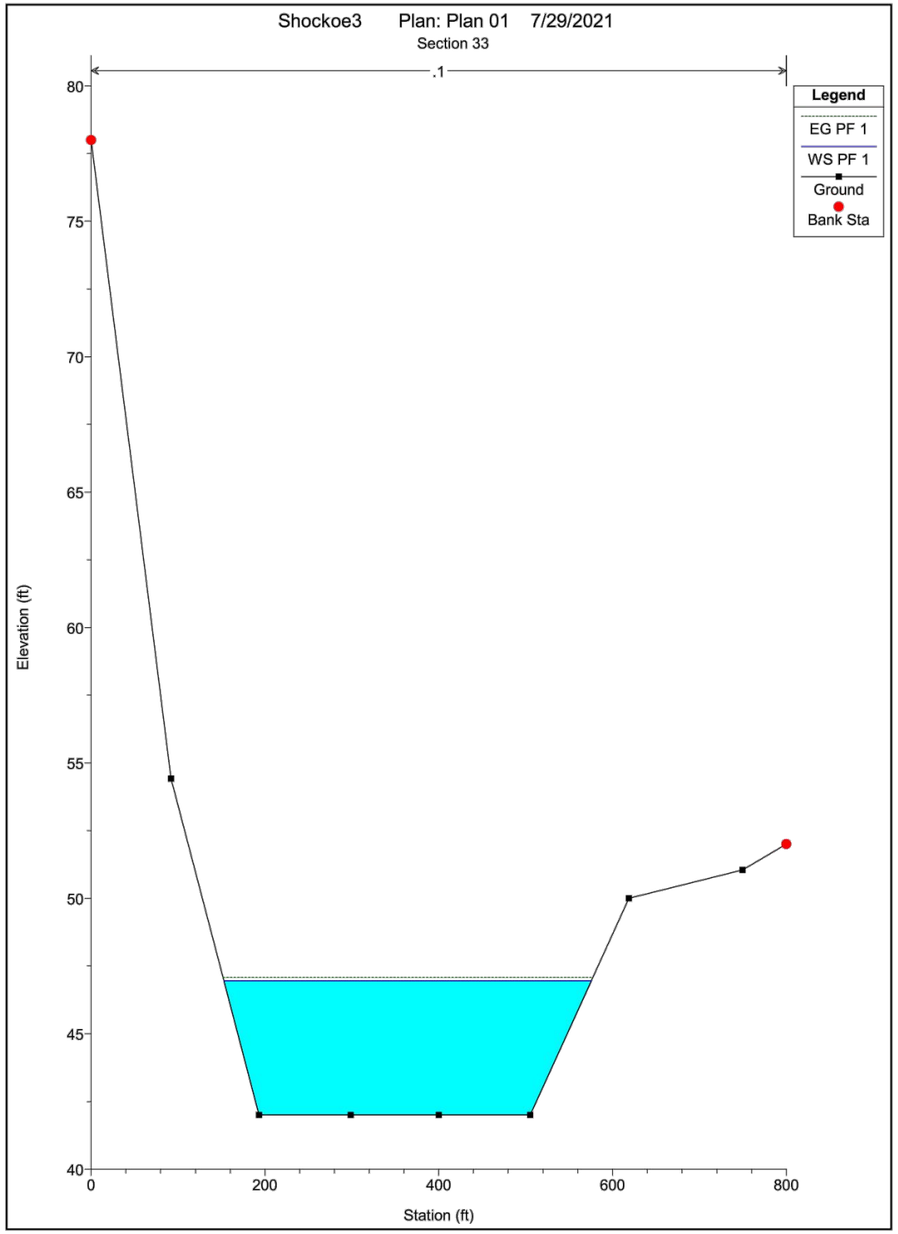


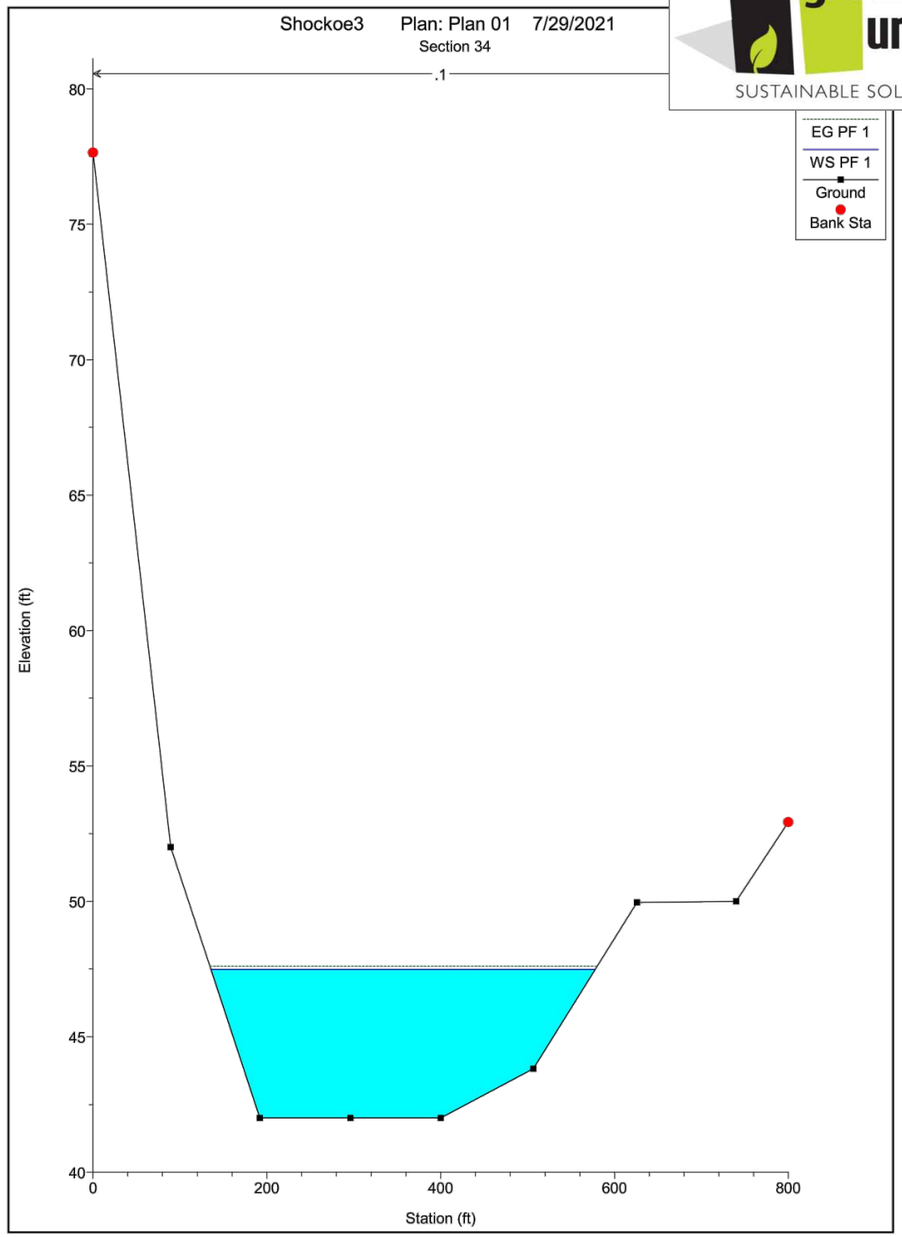

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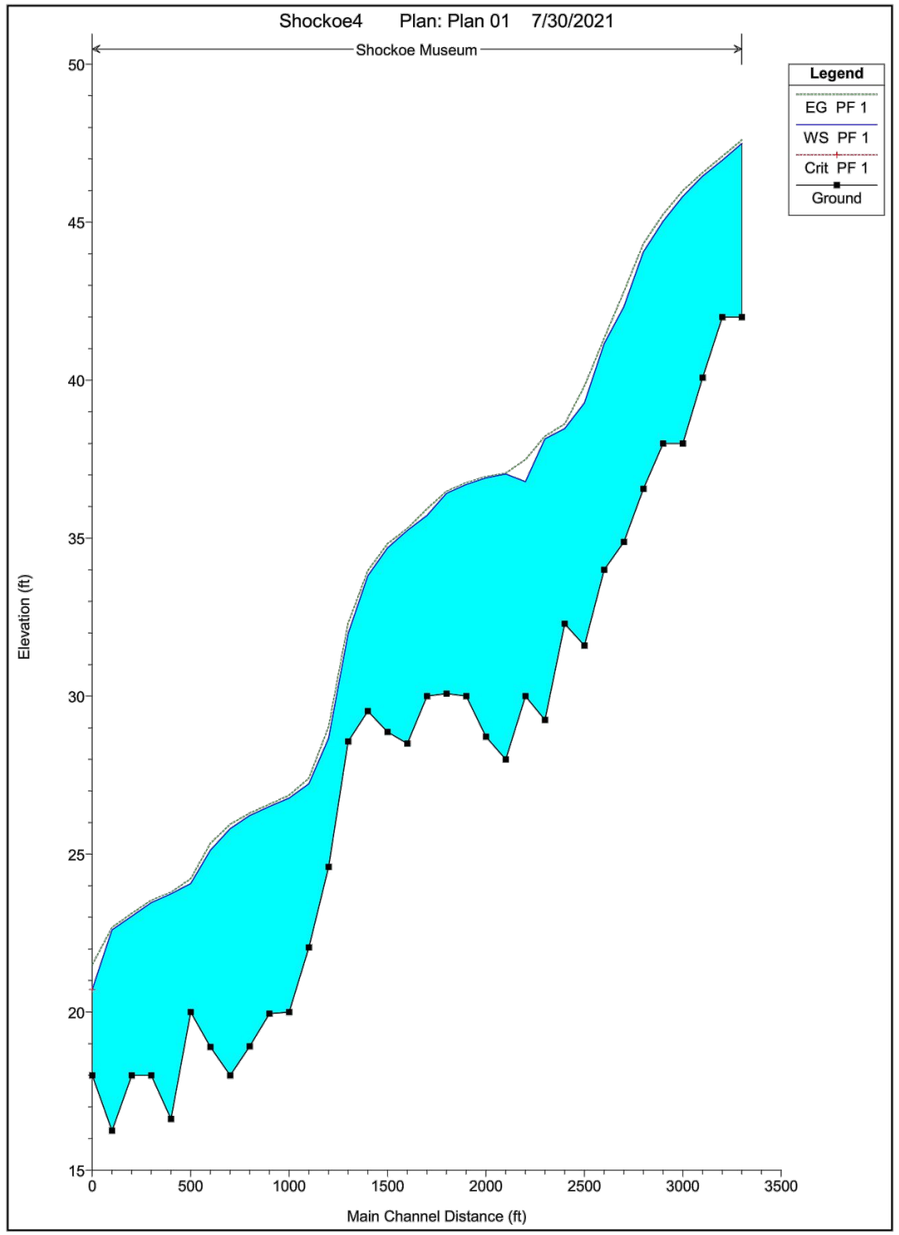

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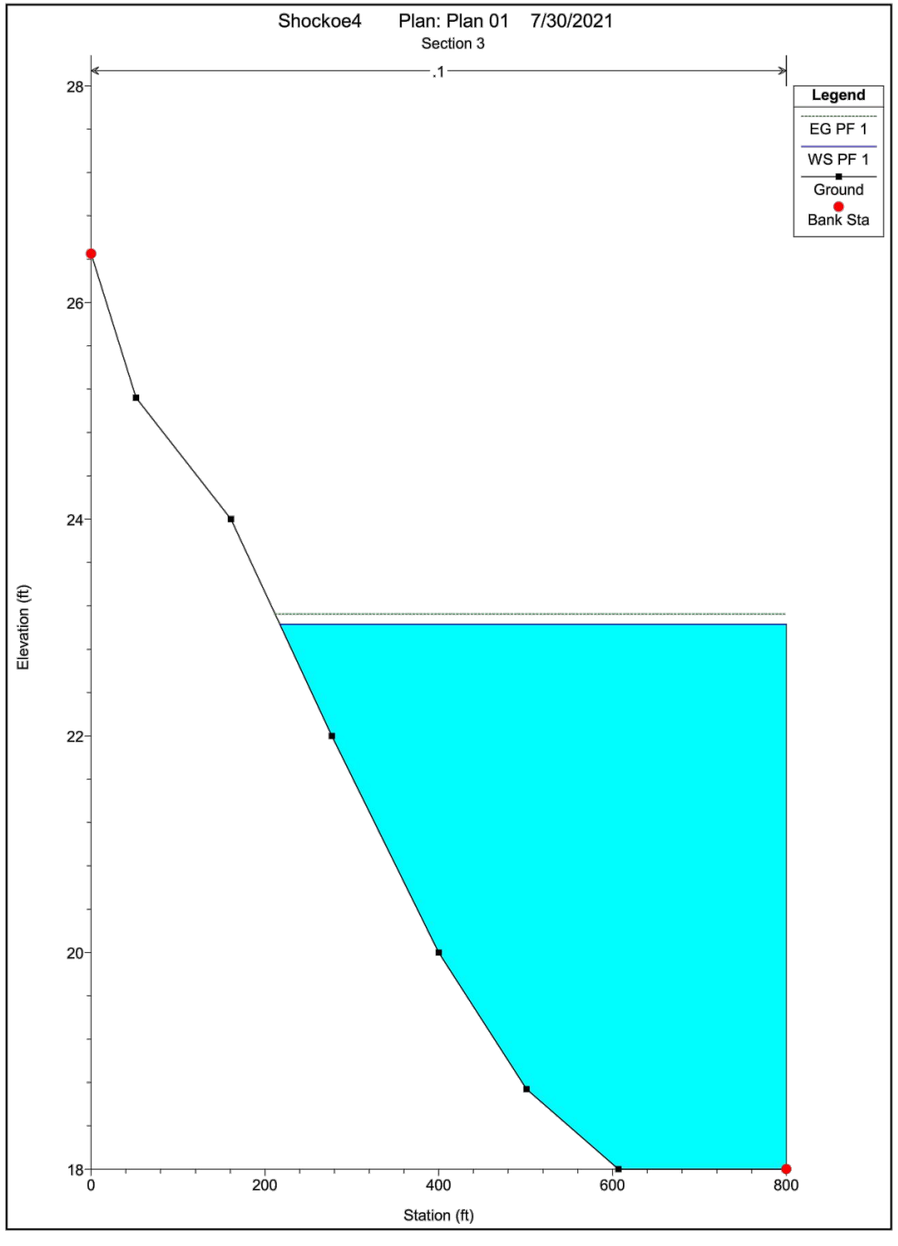


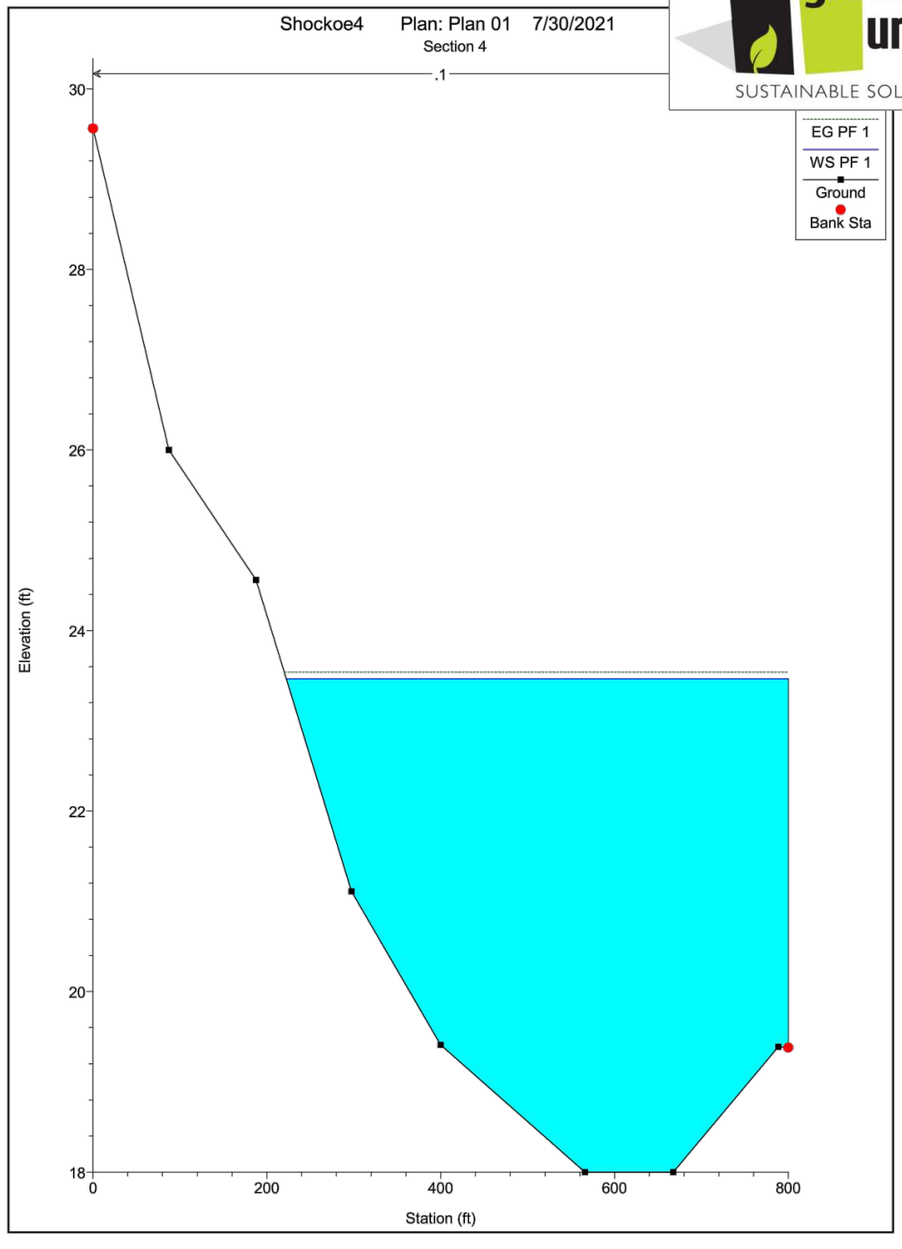

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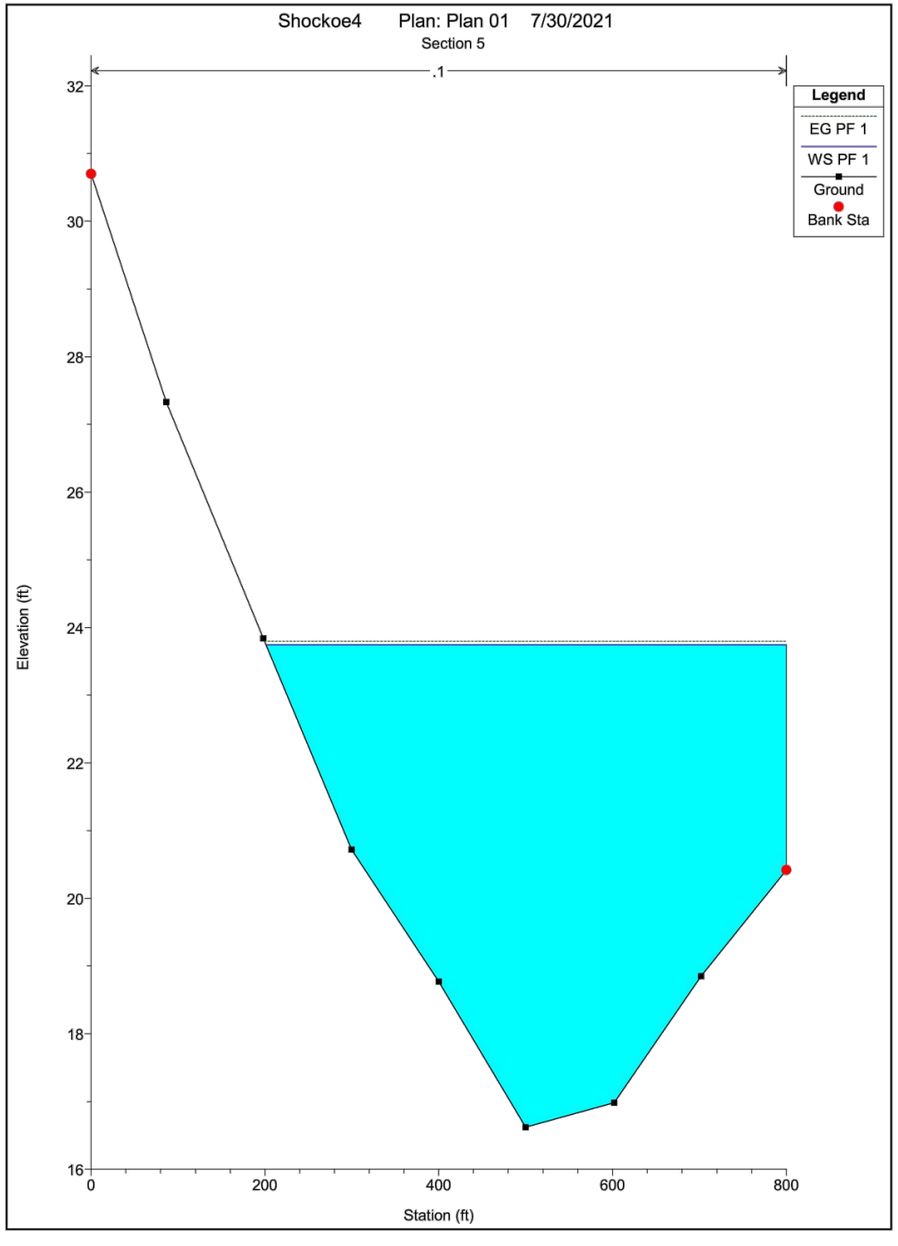


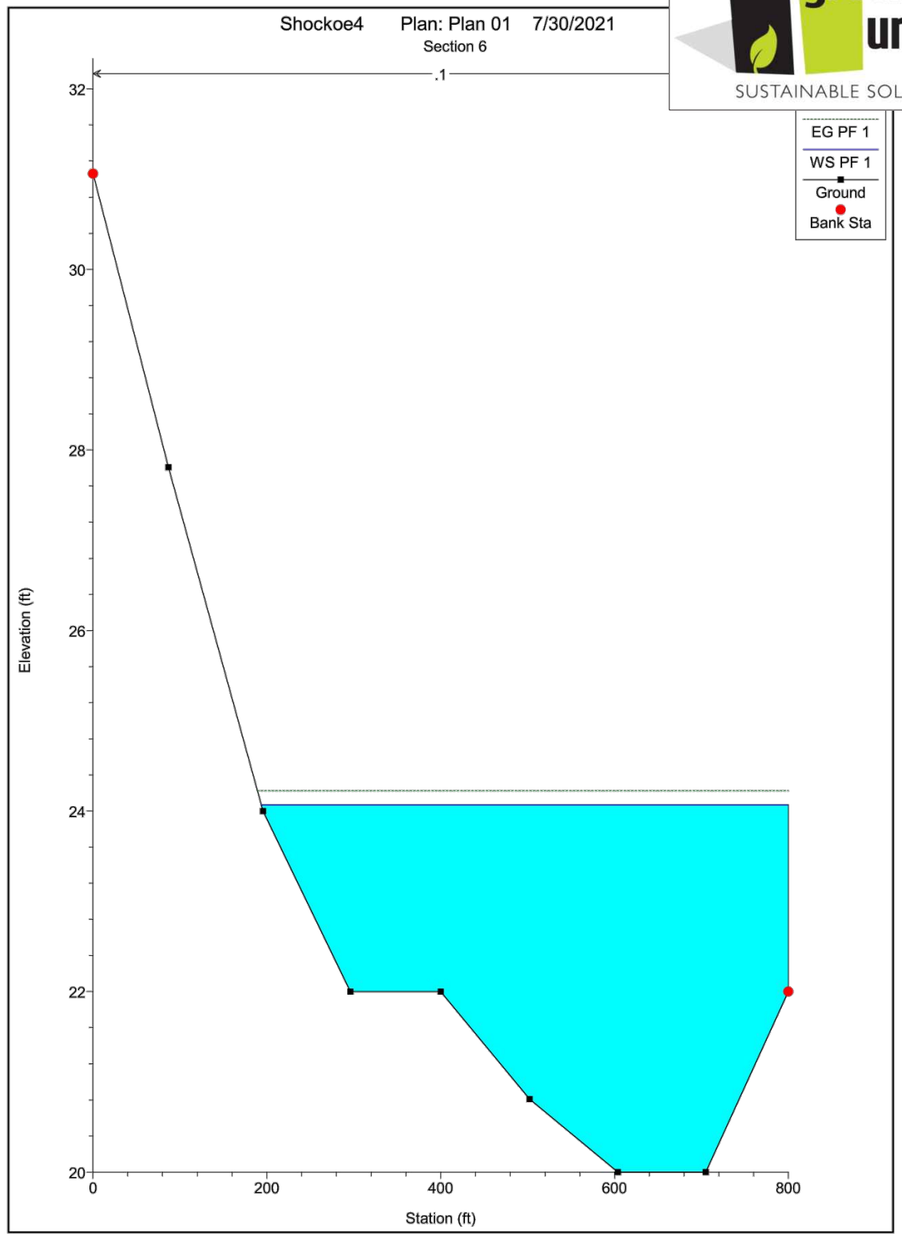

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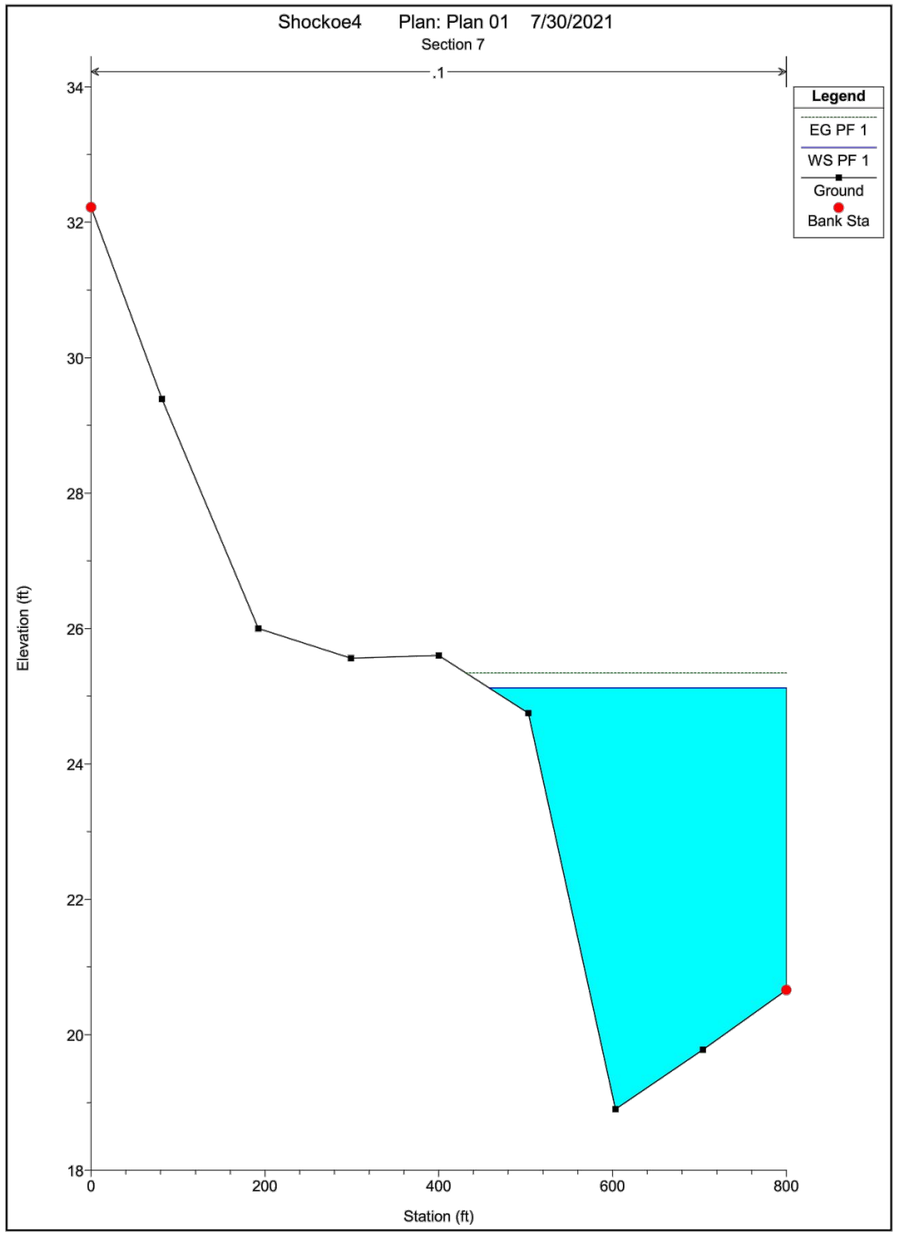


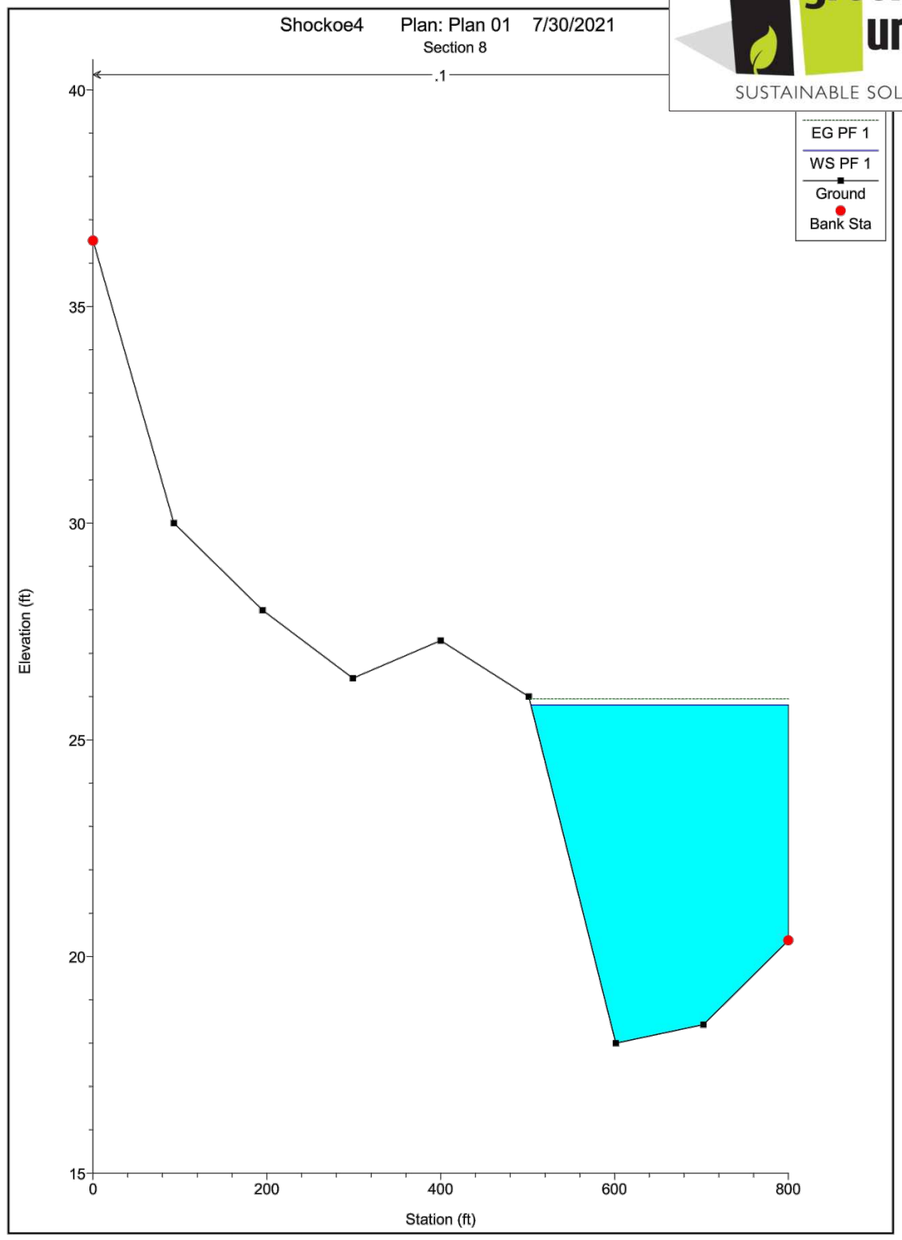

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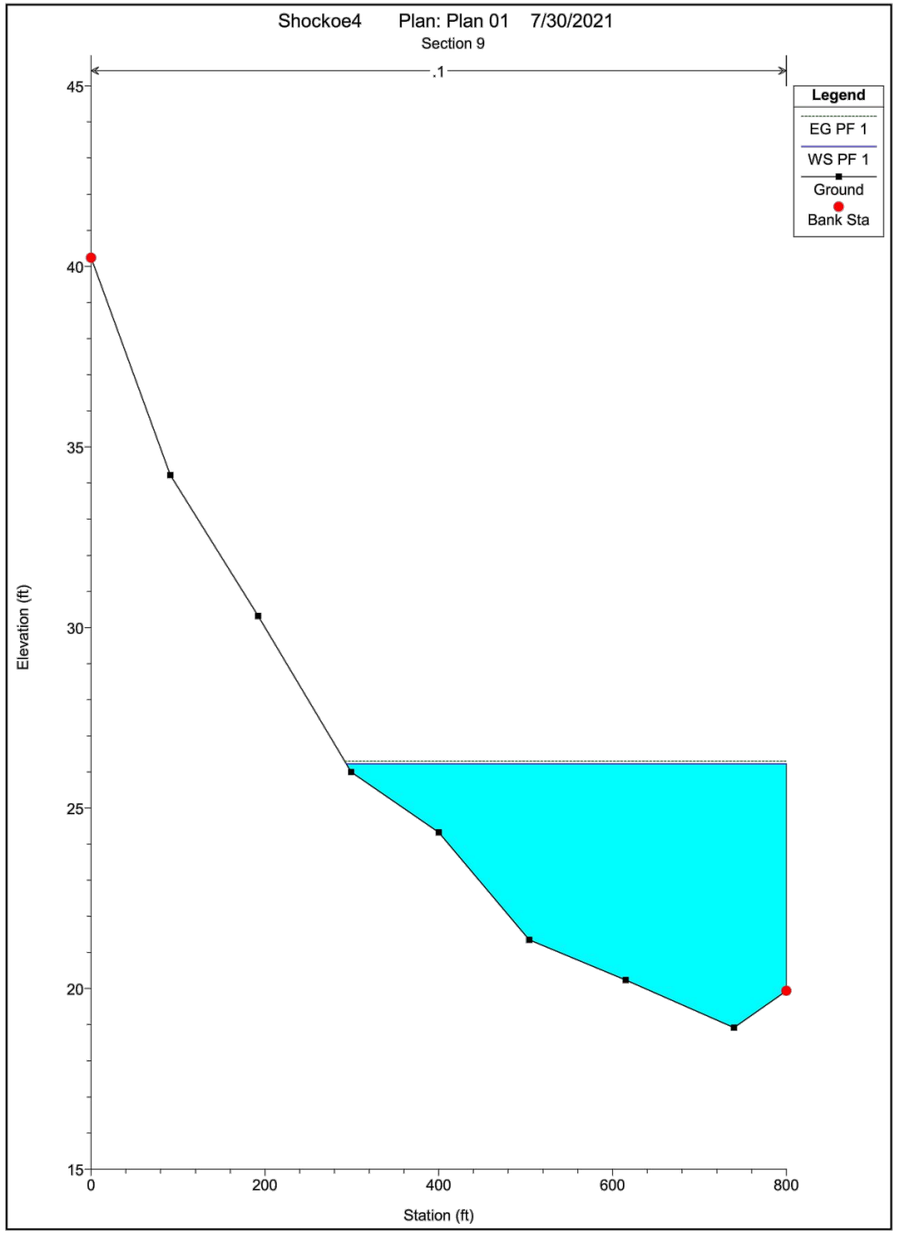


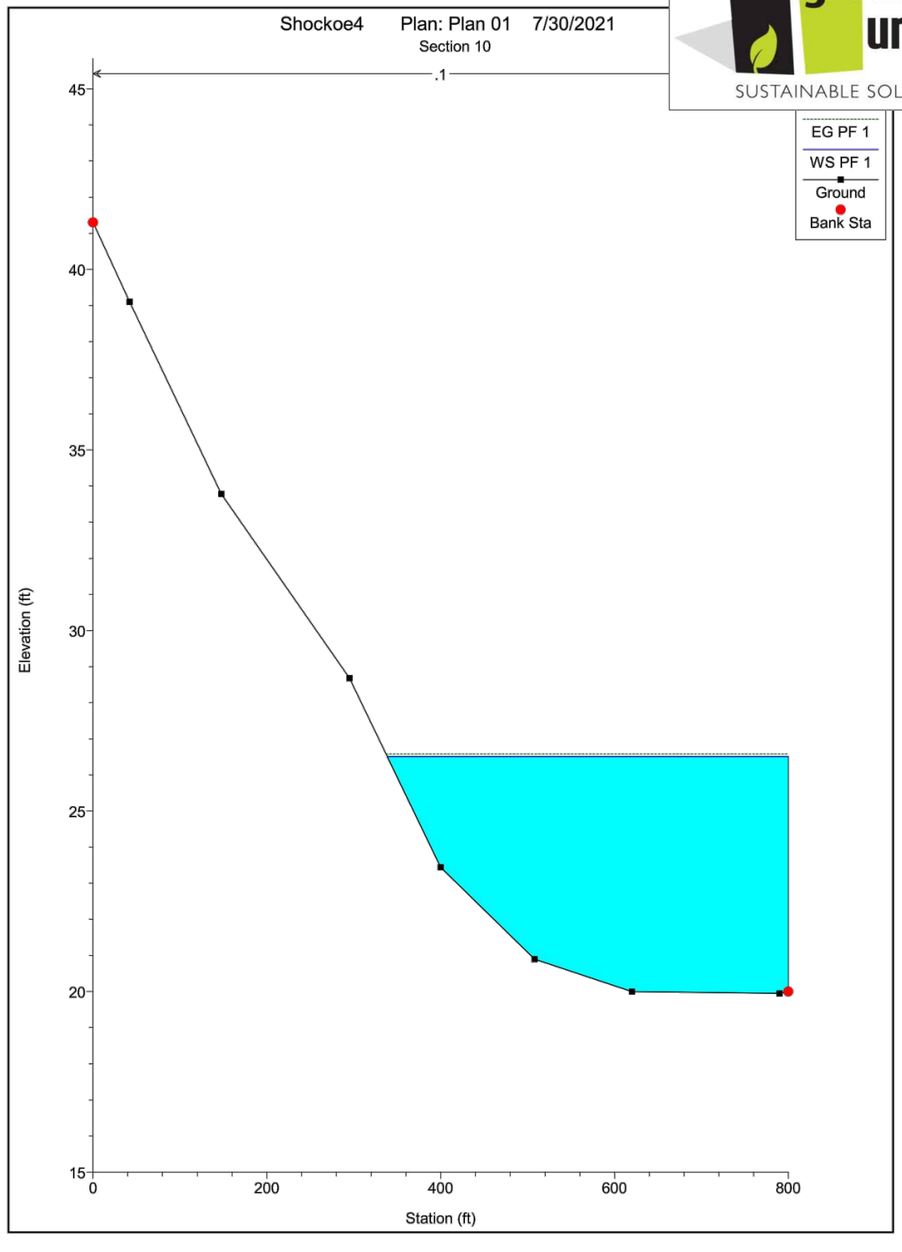

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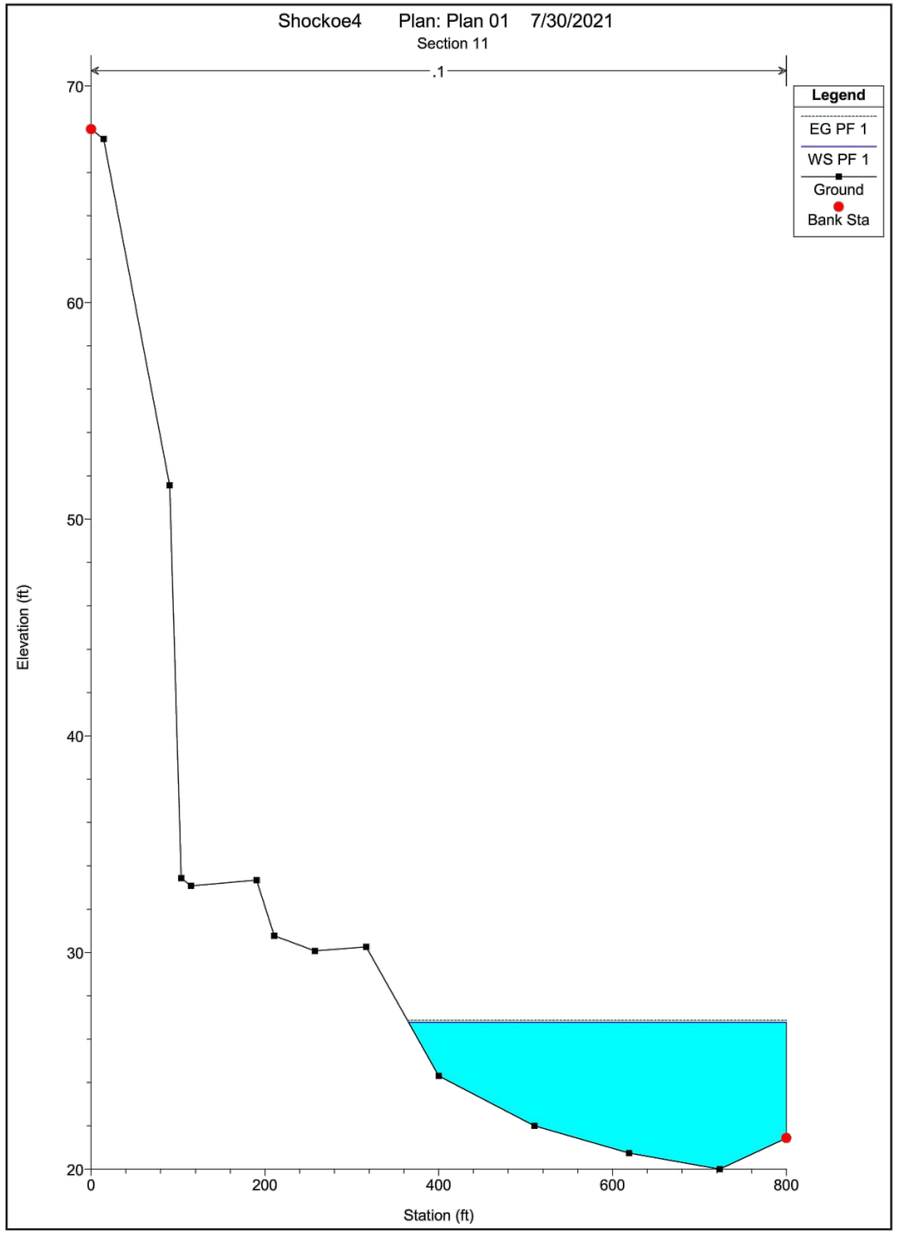


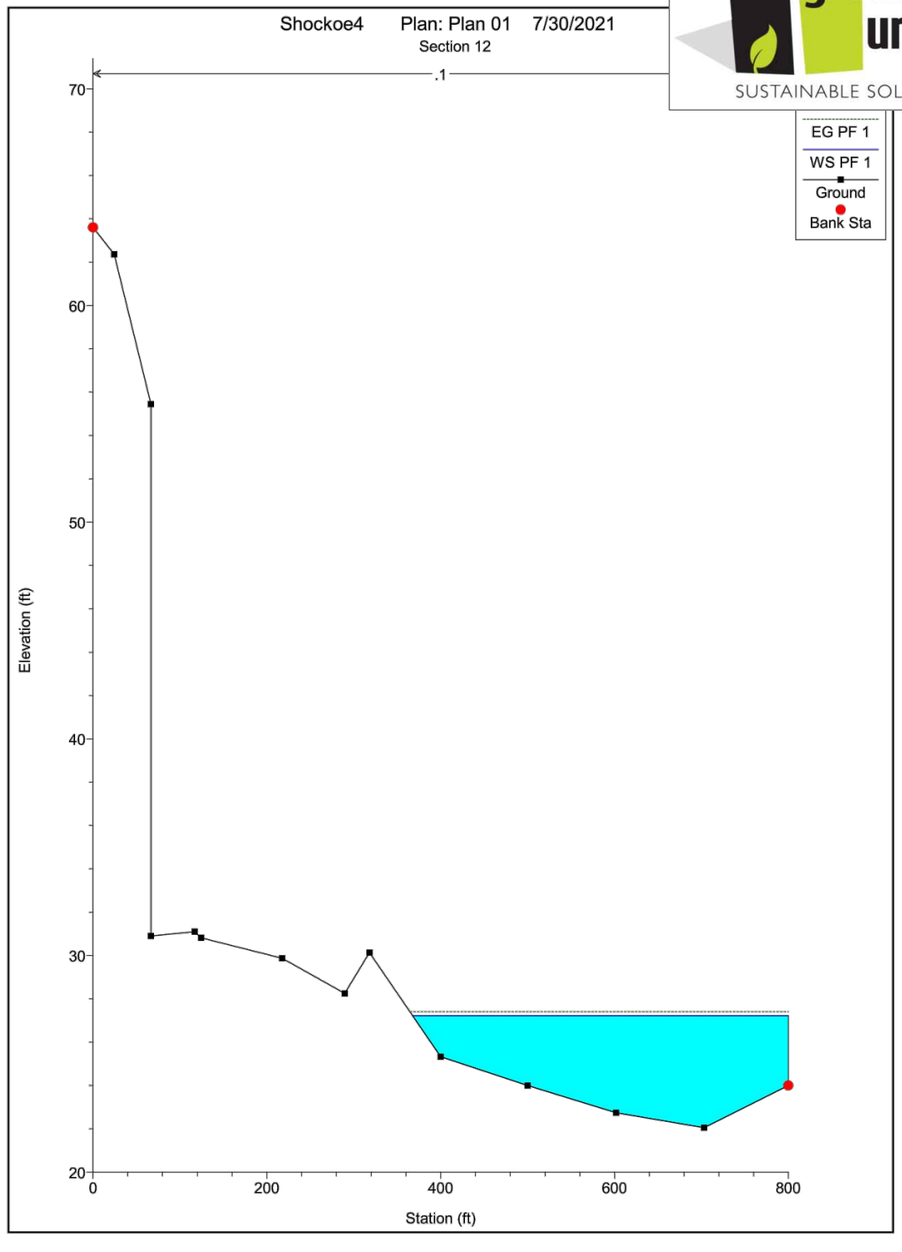

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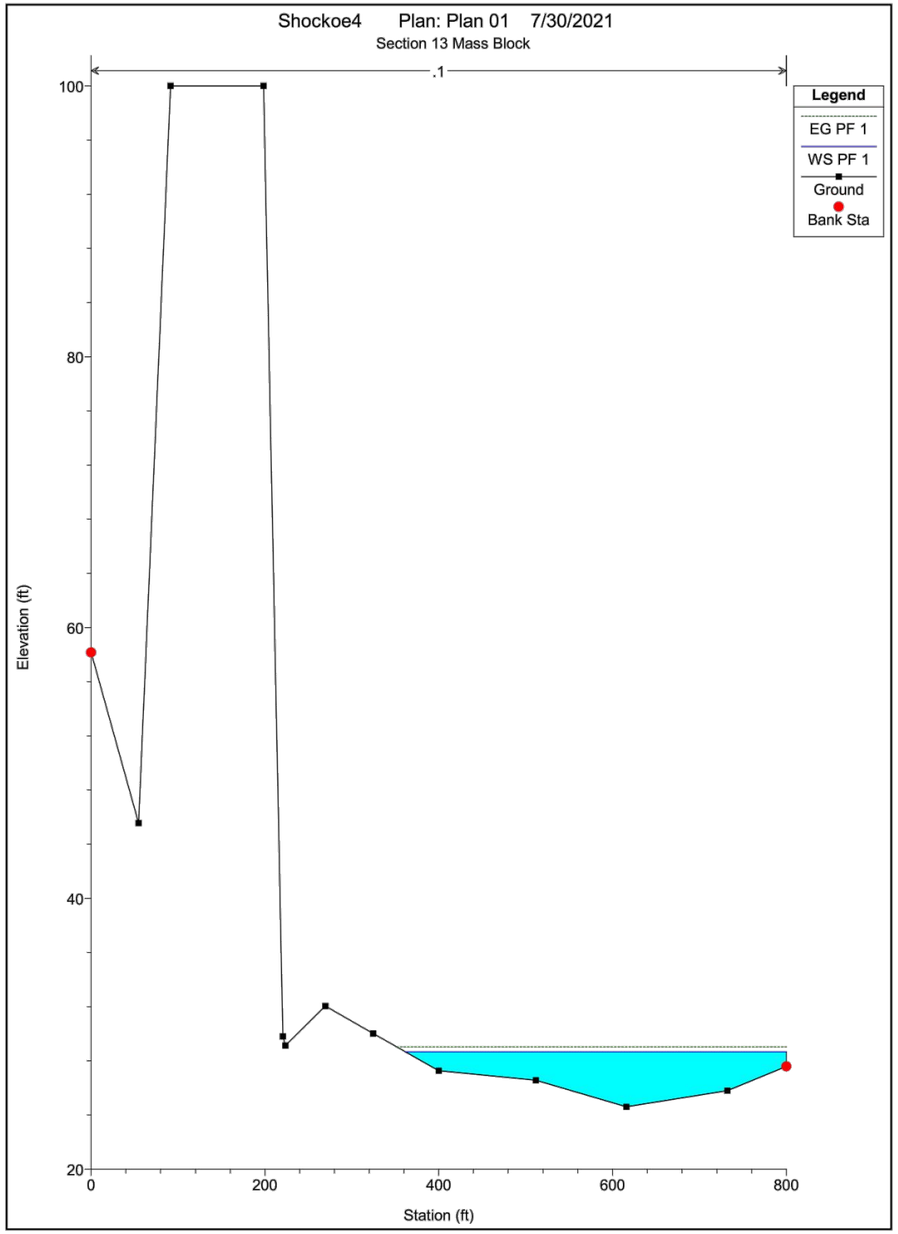


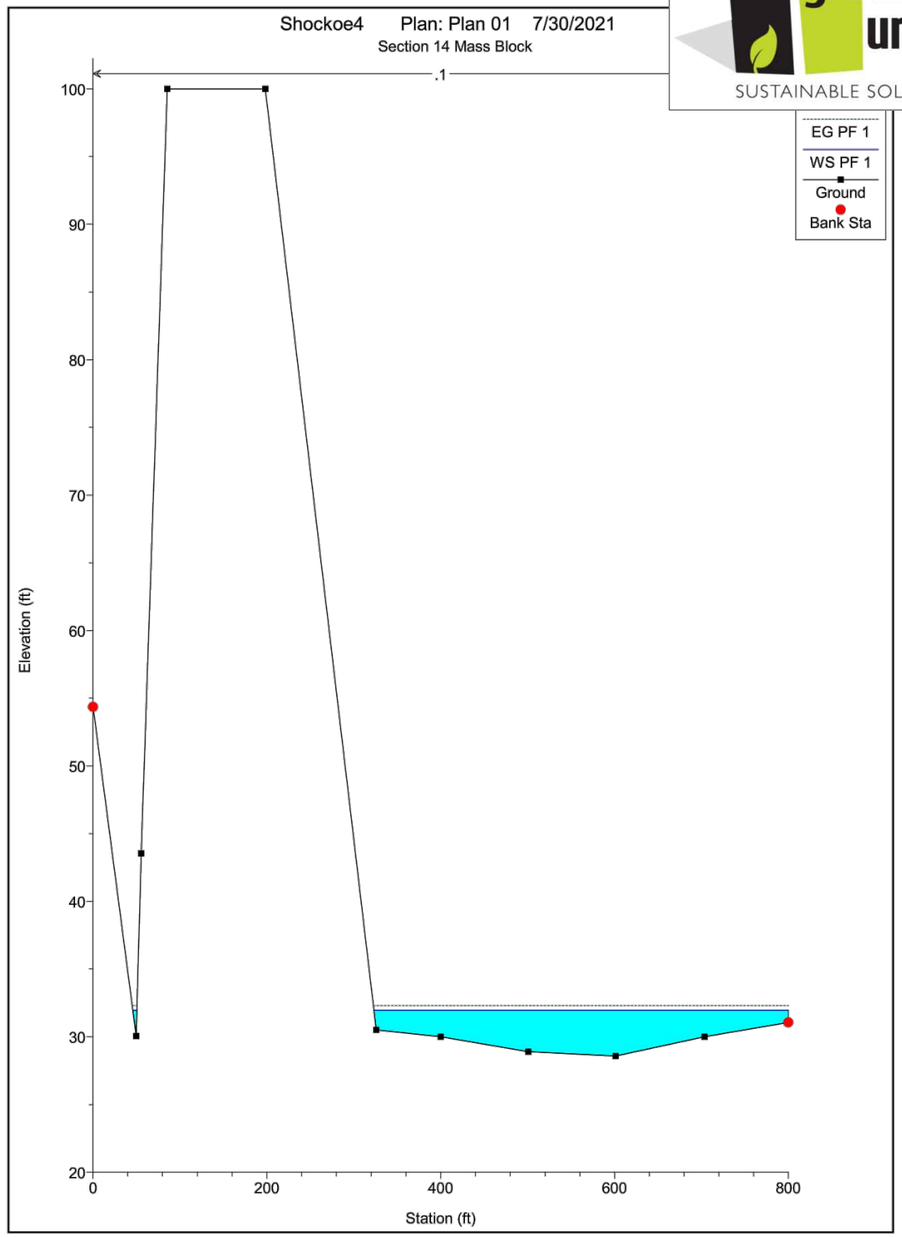

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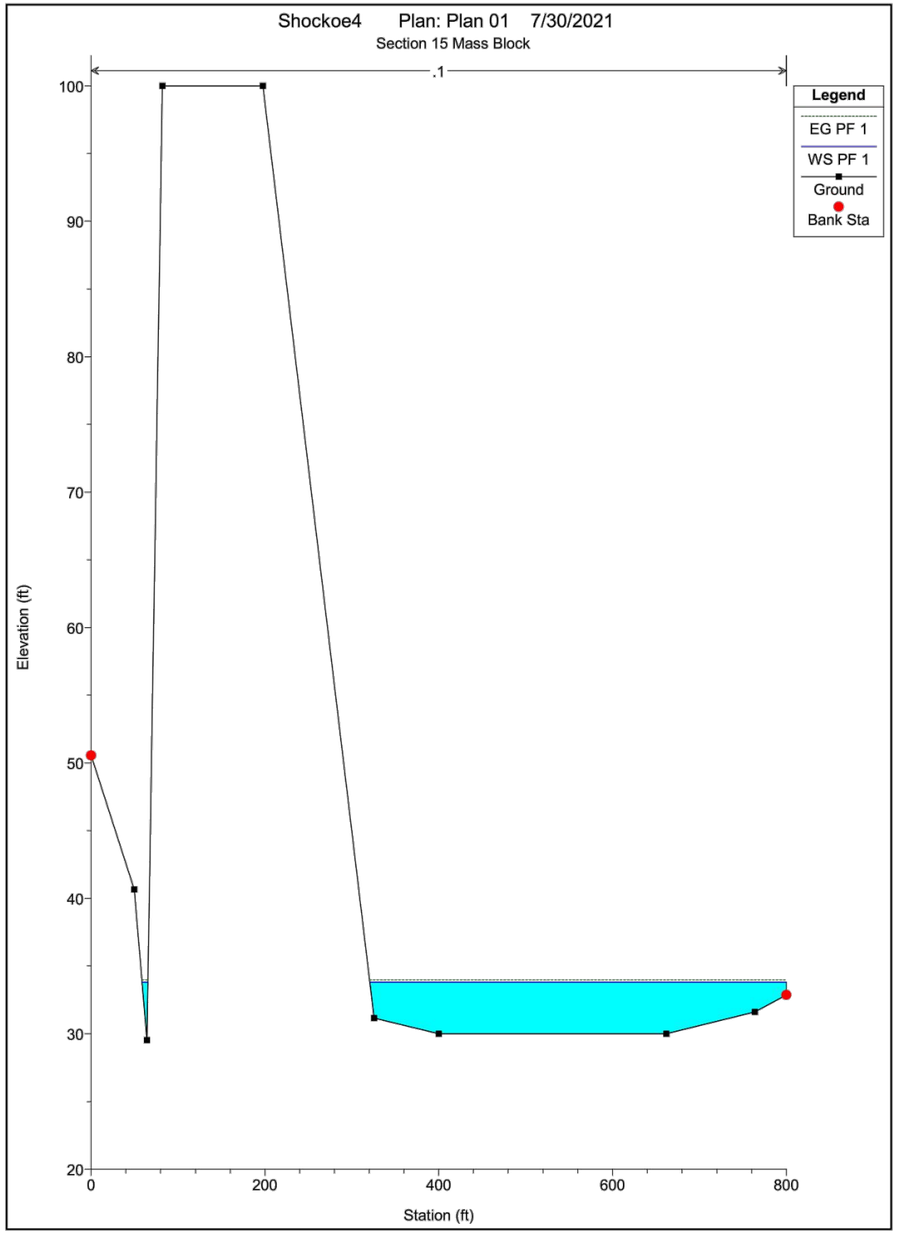


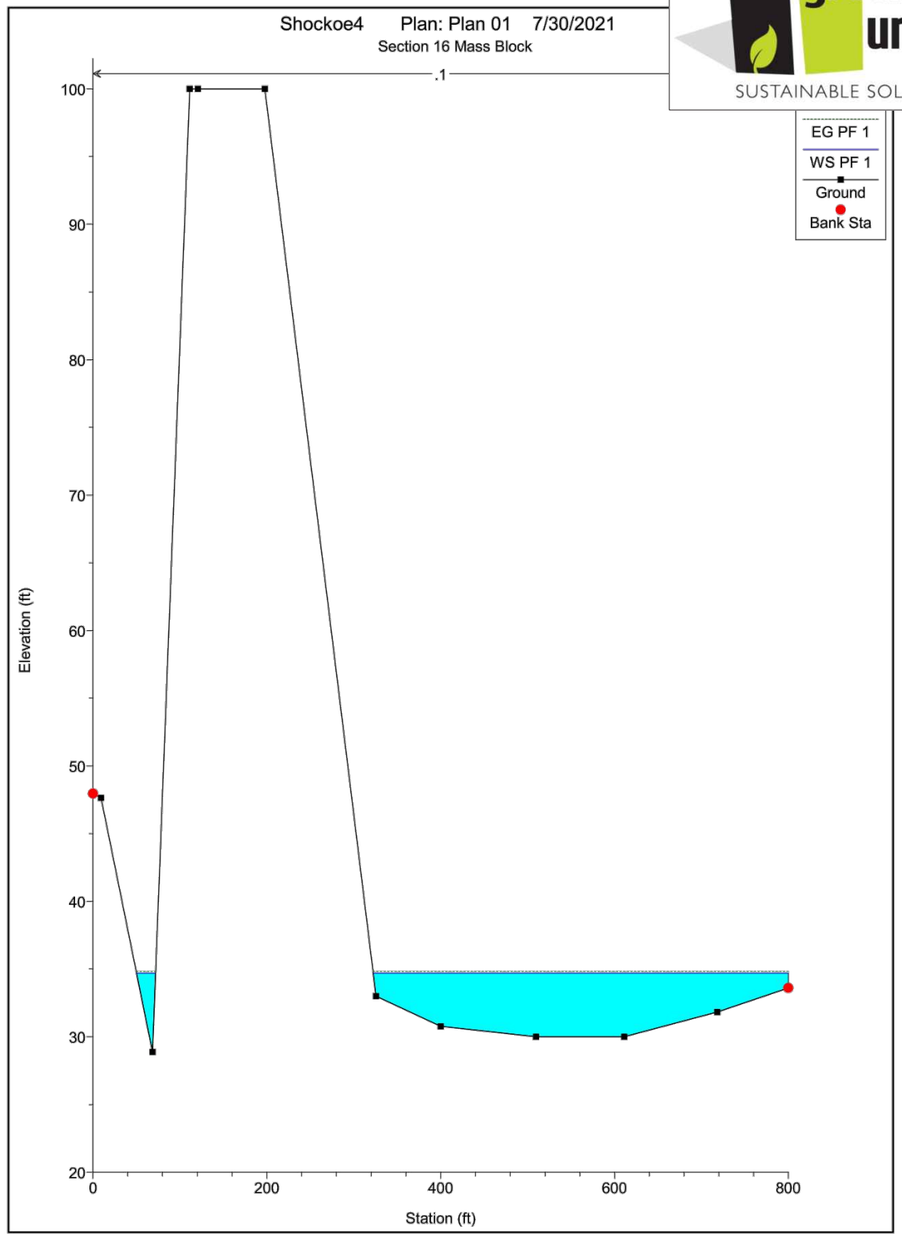

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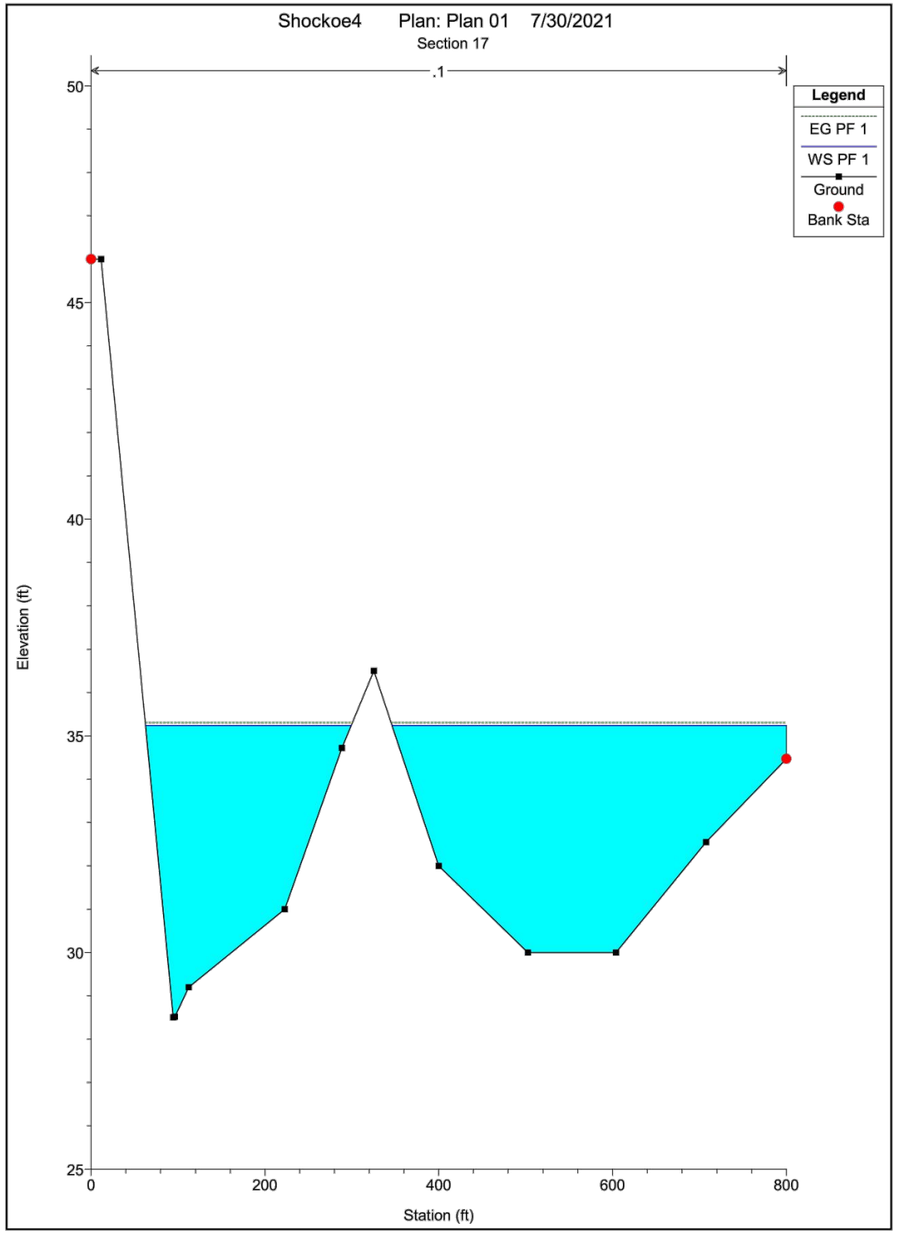


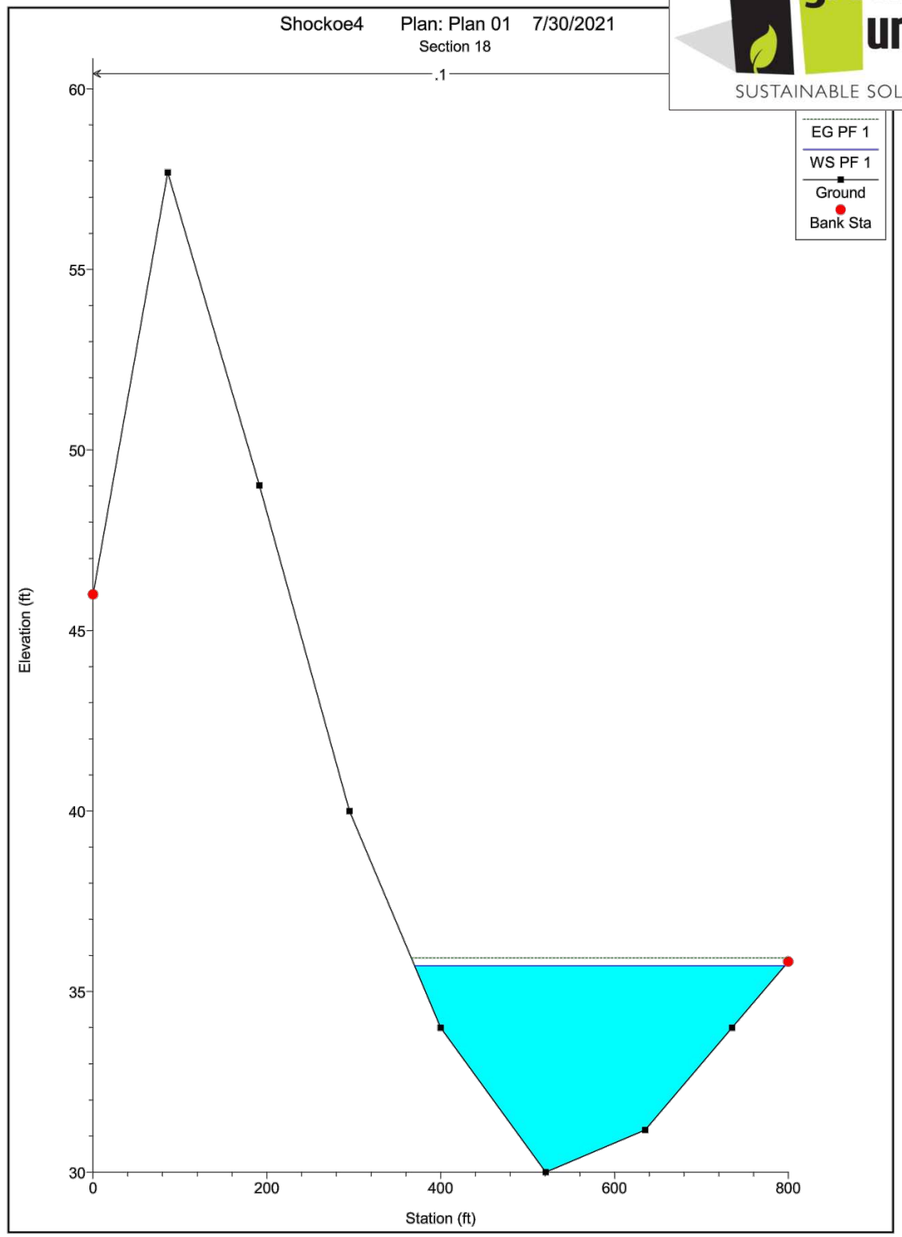

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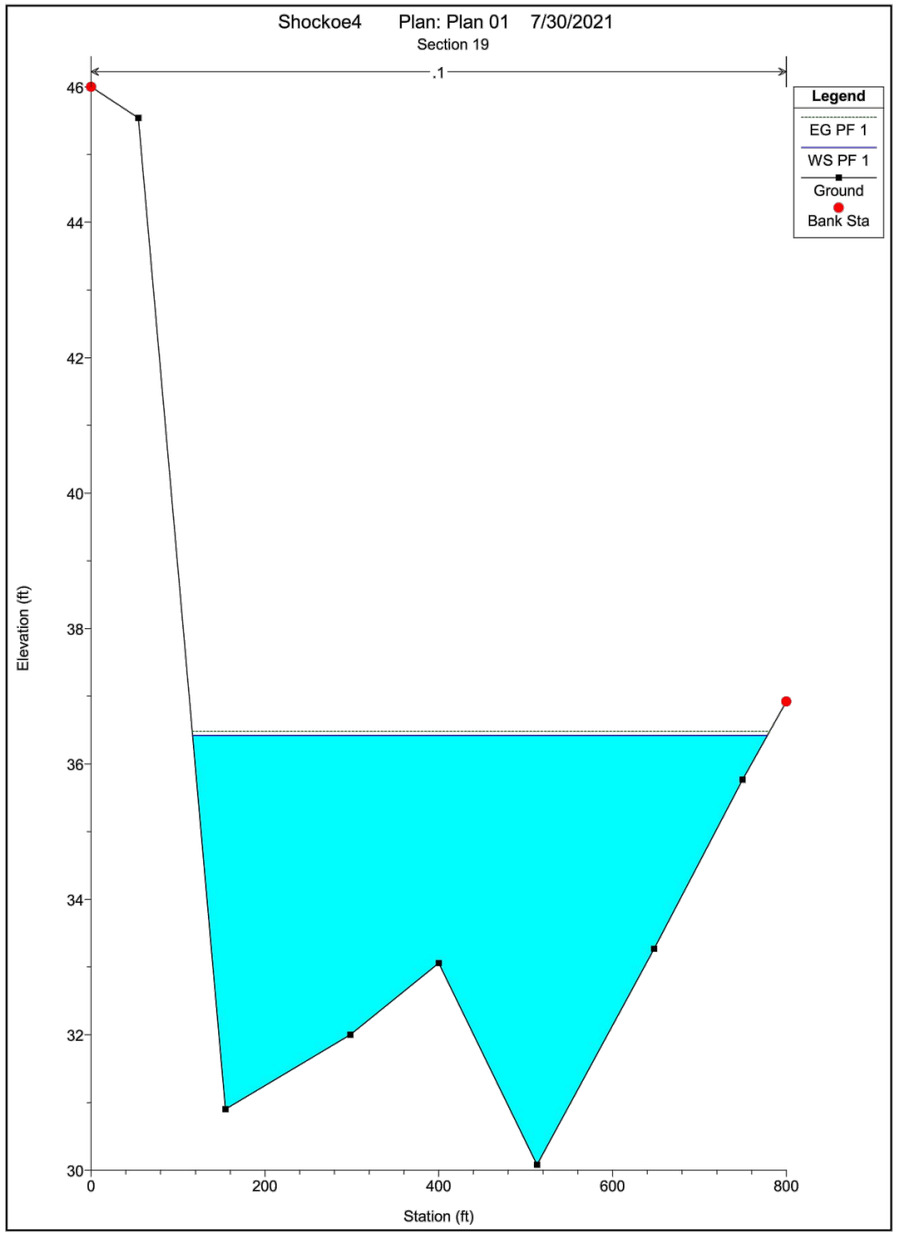


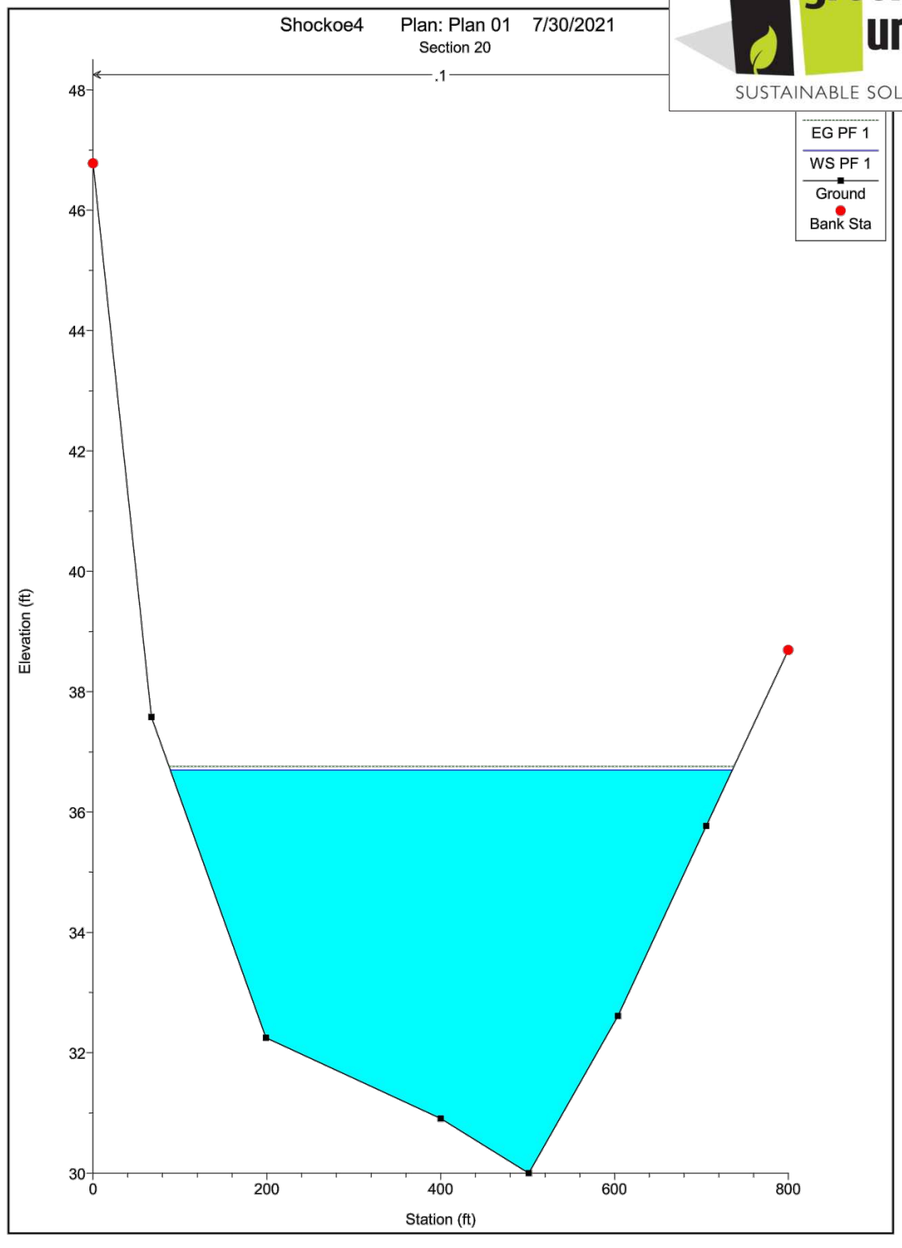

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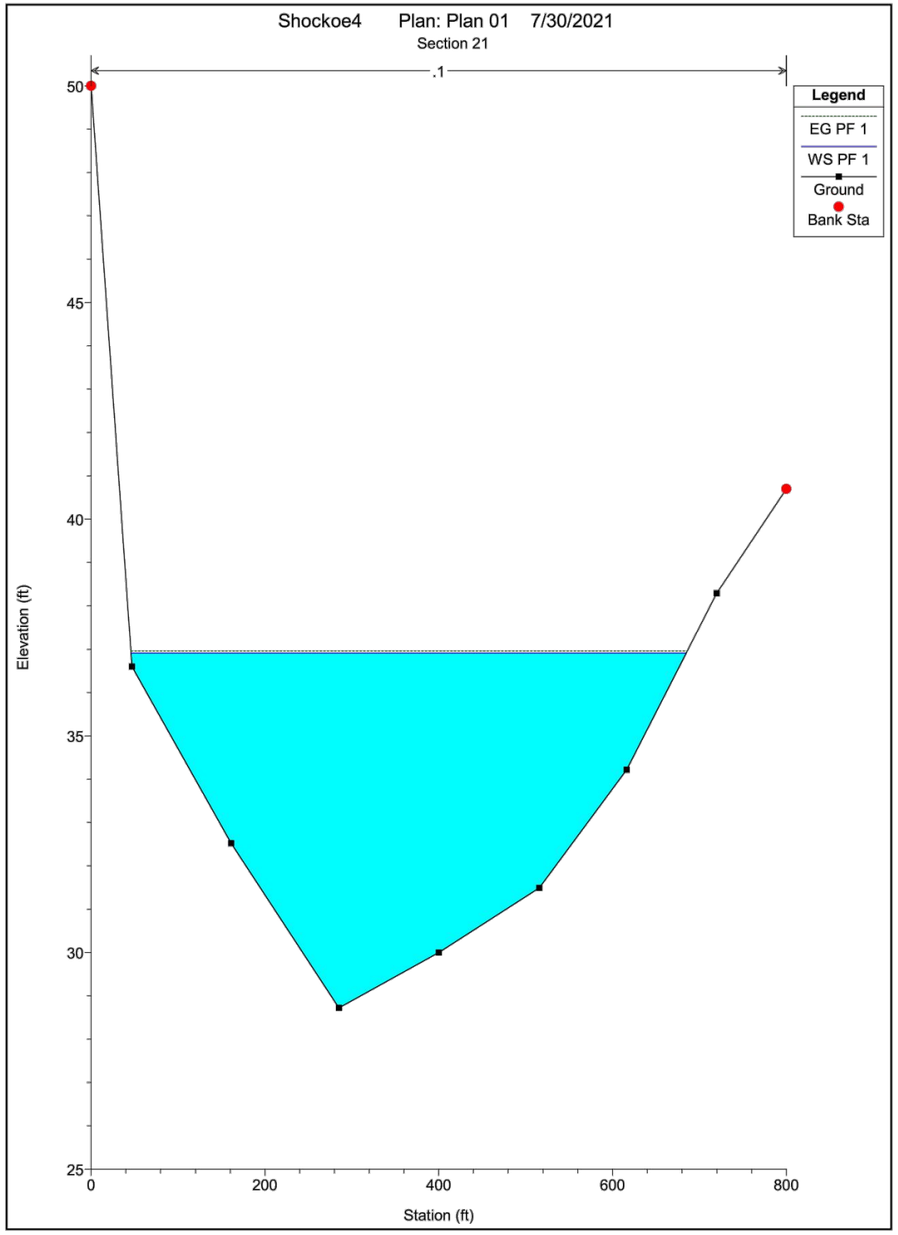
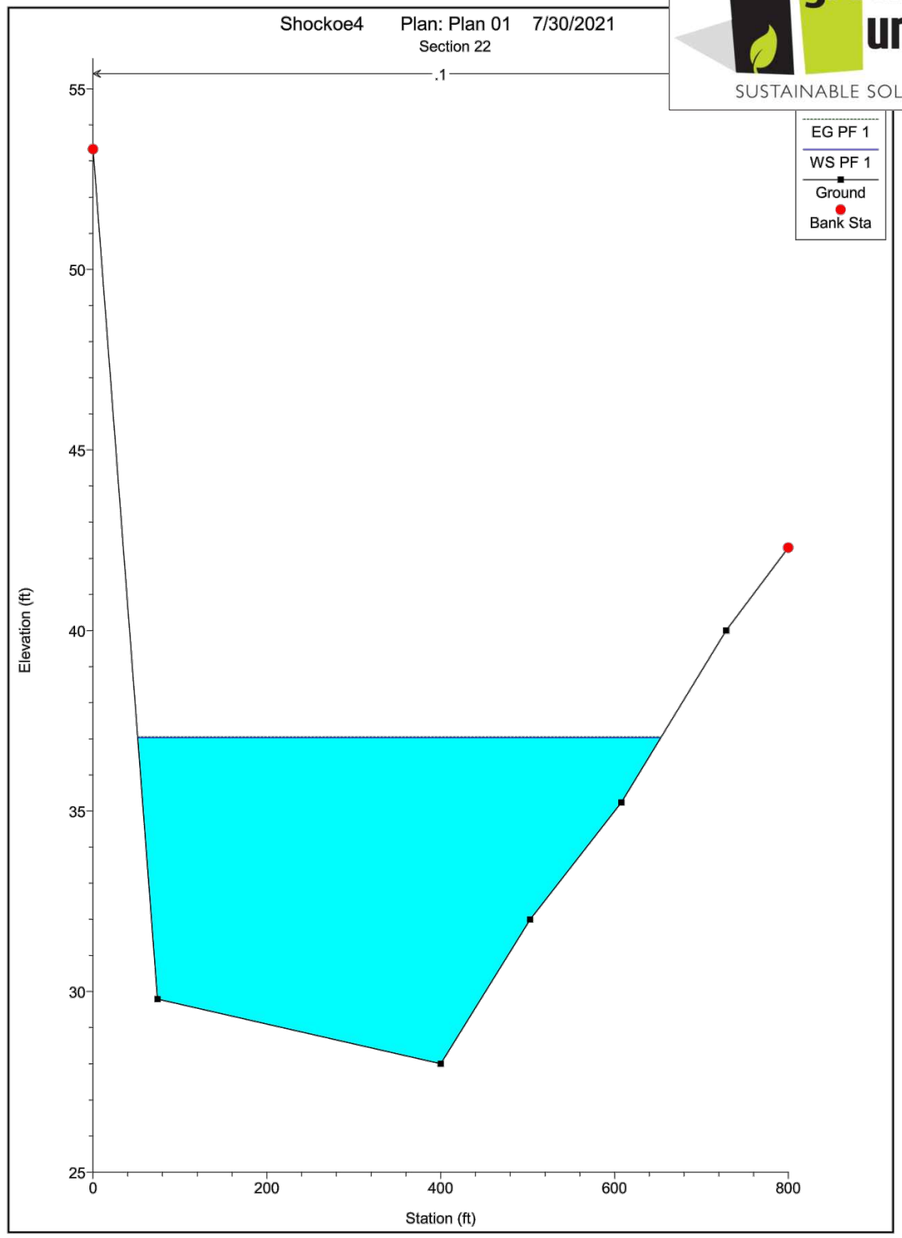
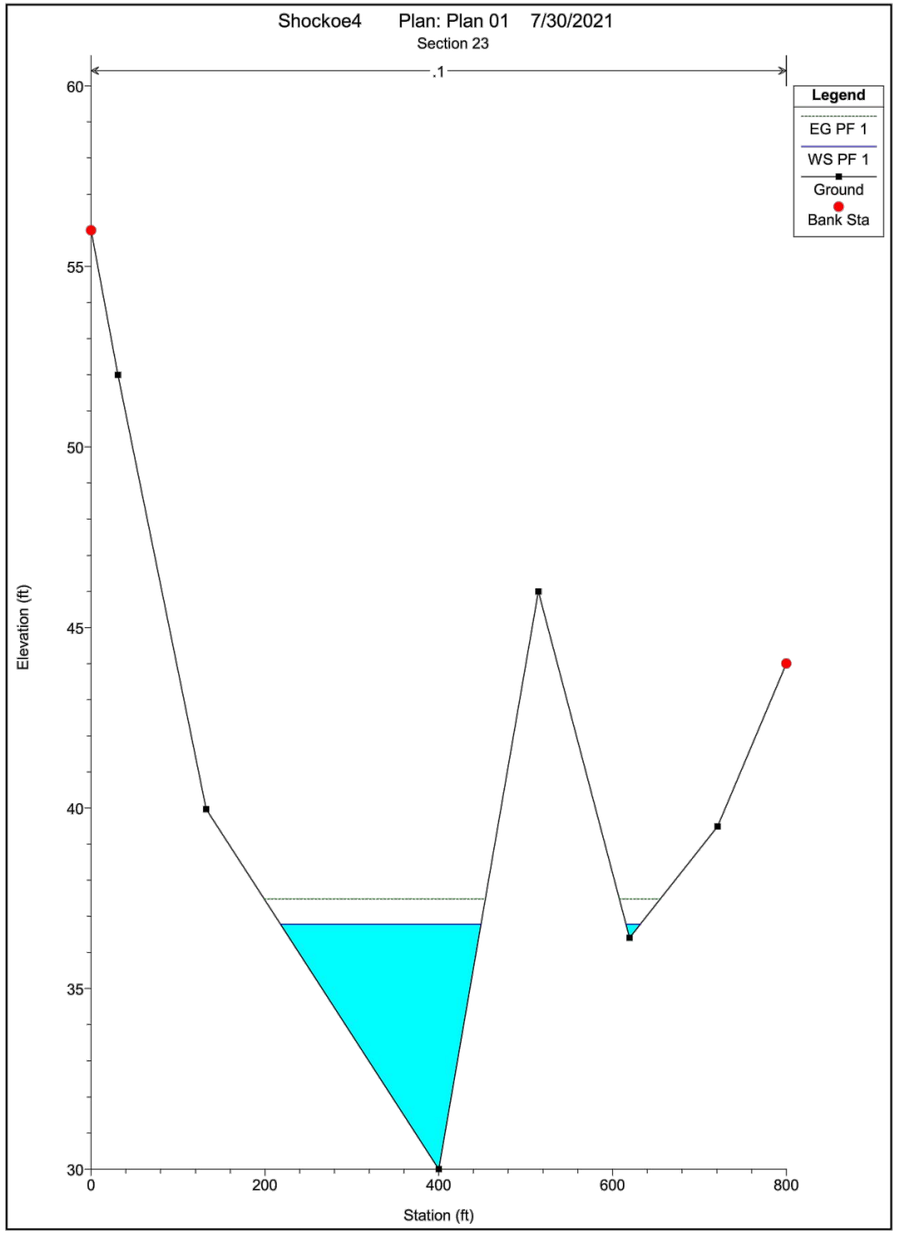
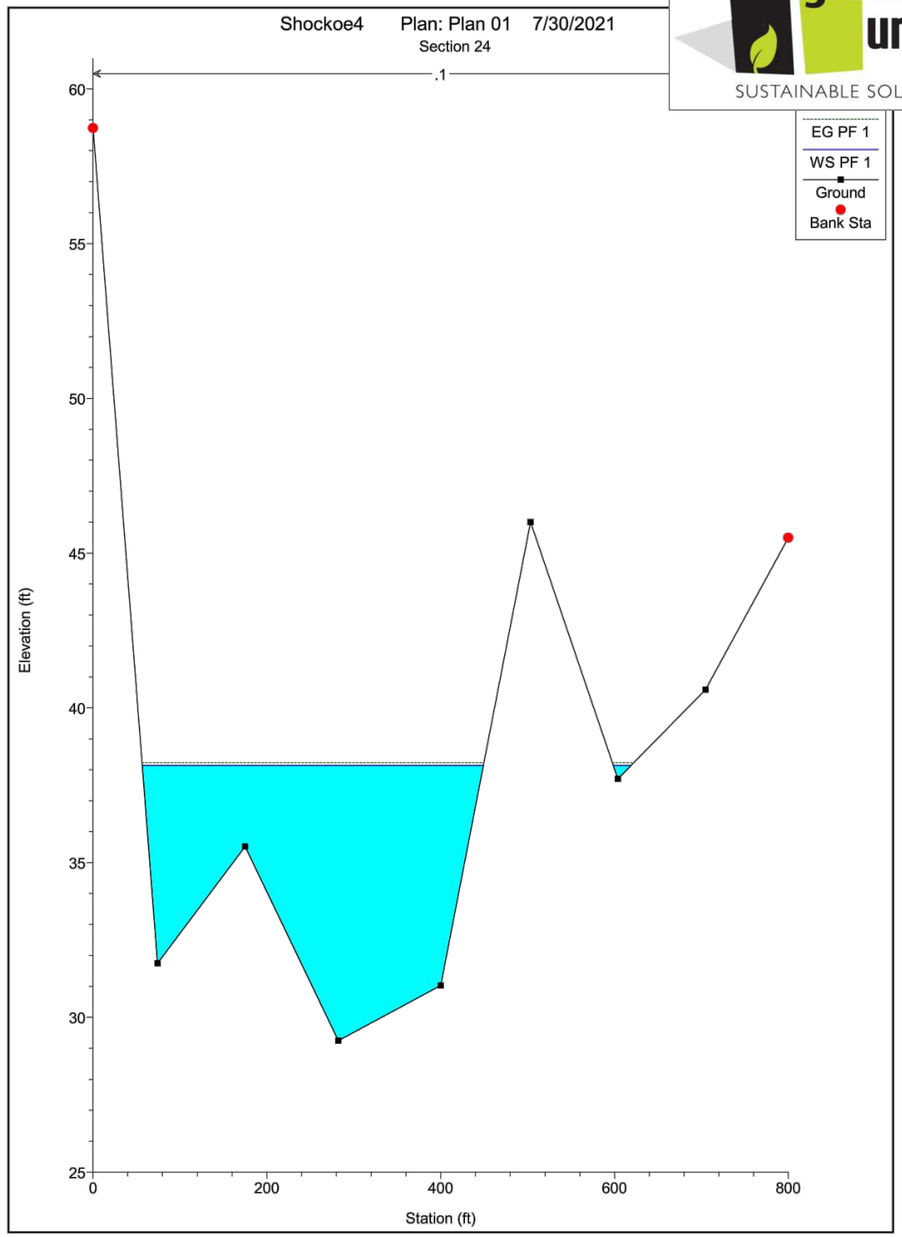


# CIVIL REPORT

## FLOOD STUDY SECTIONS



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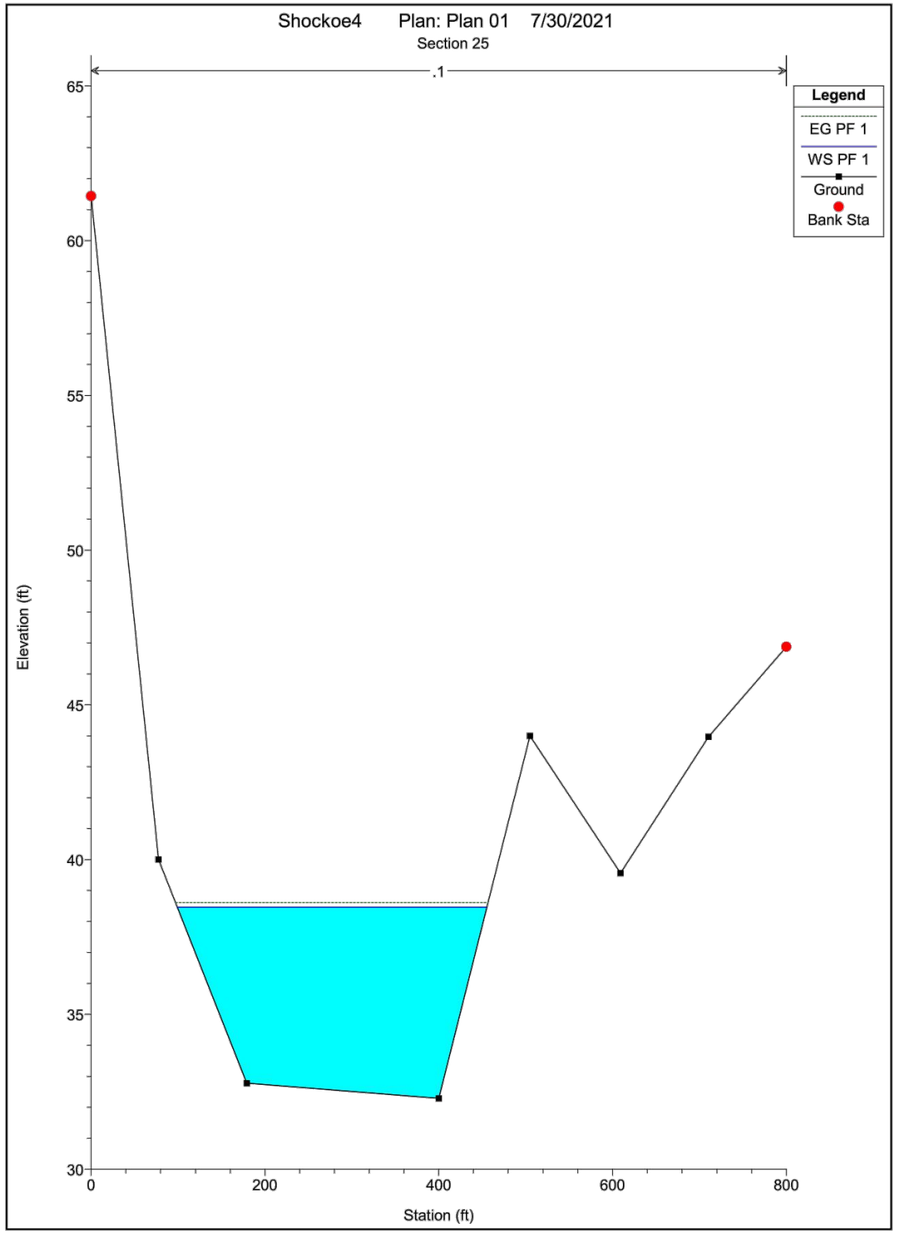


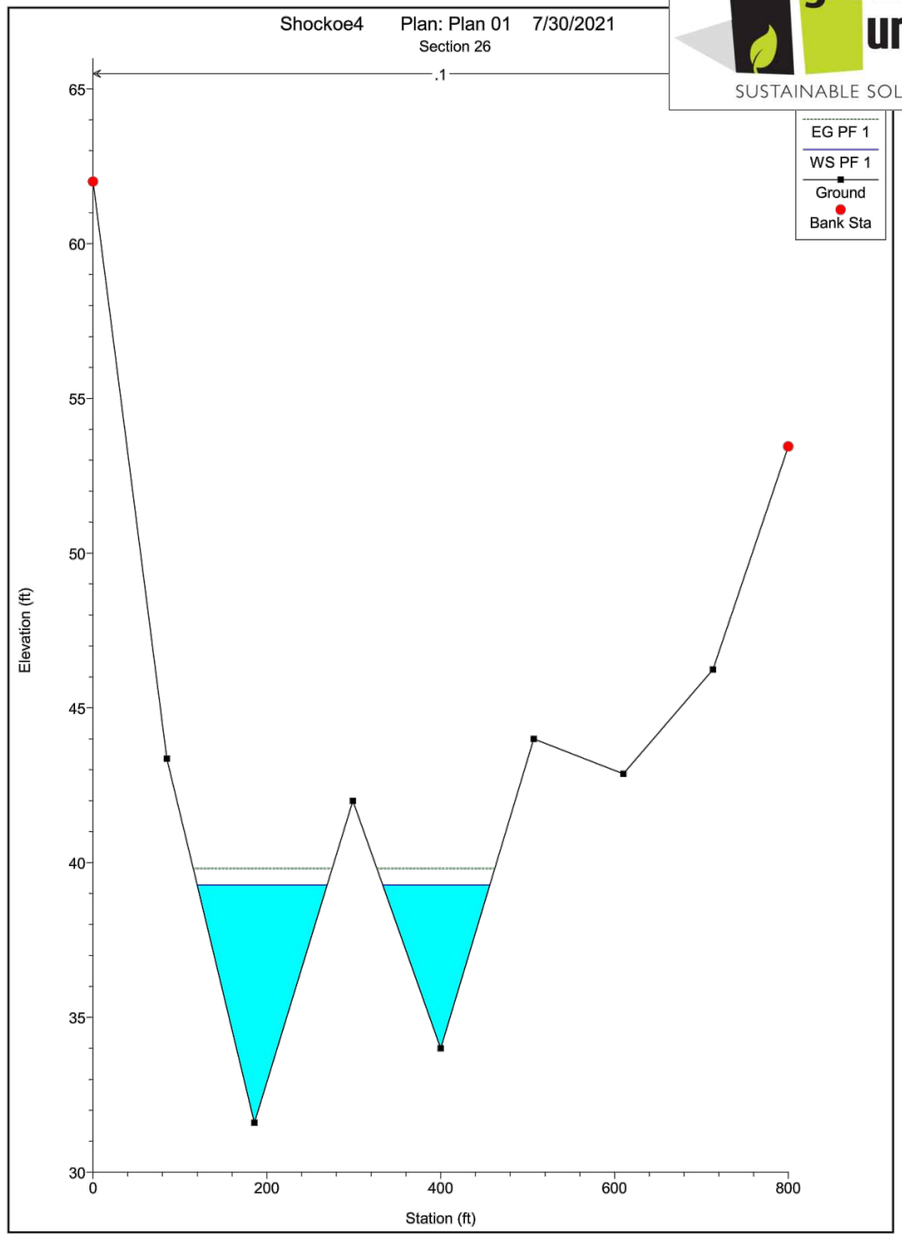

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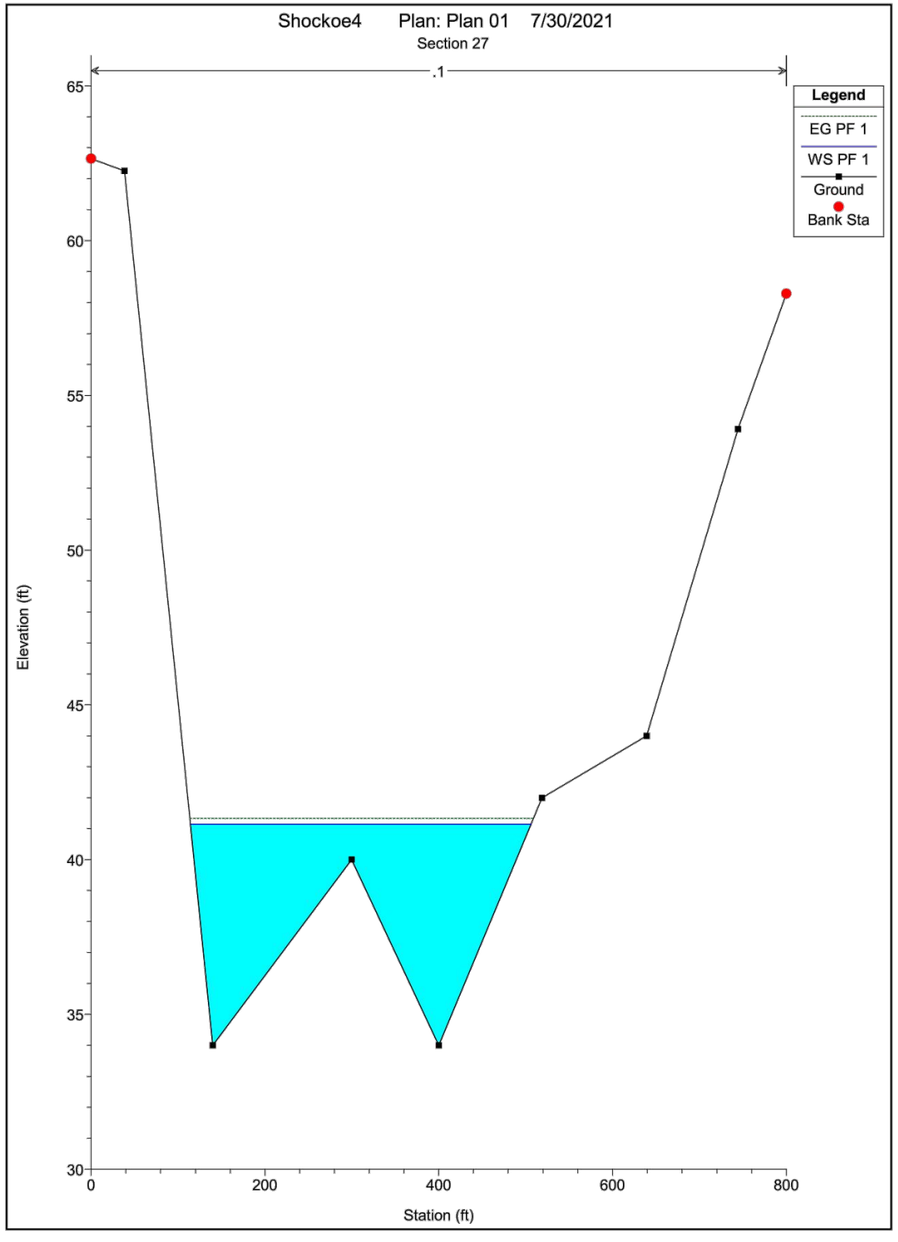


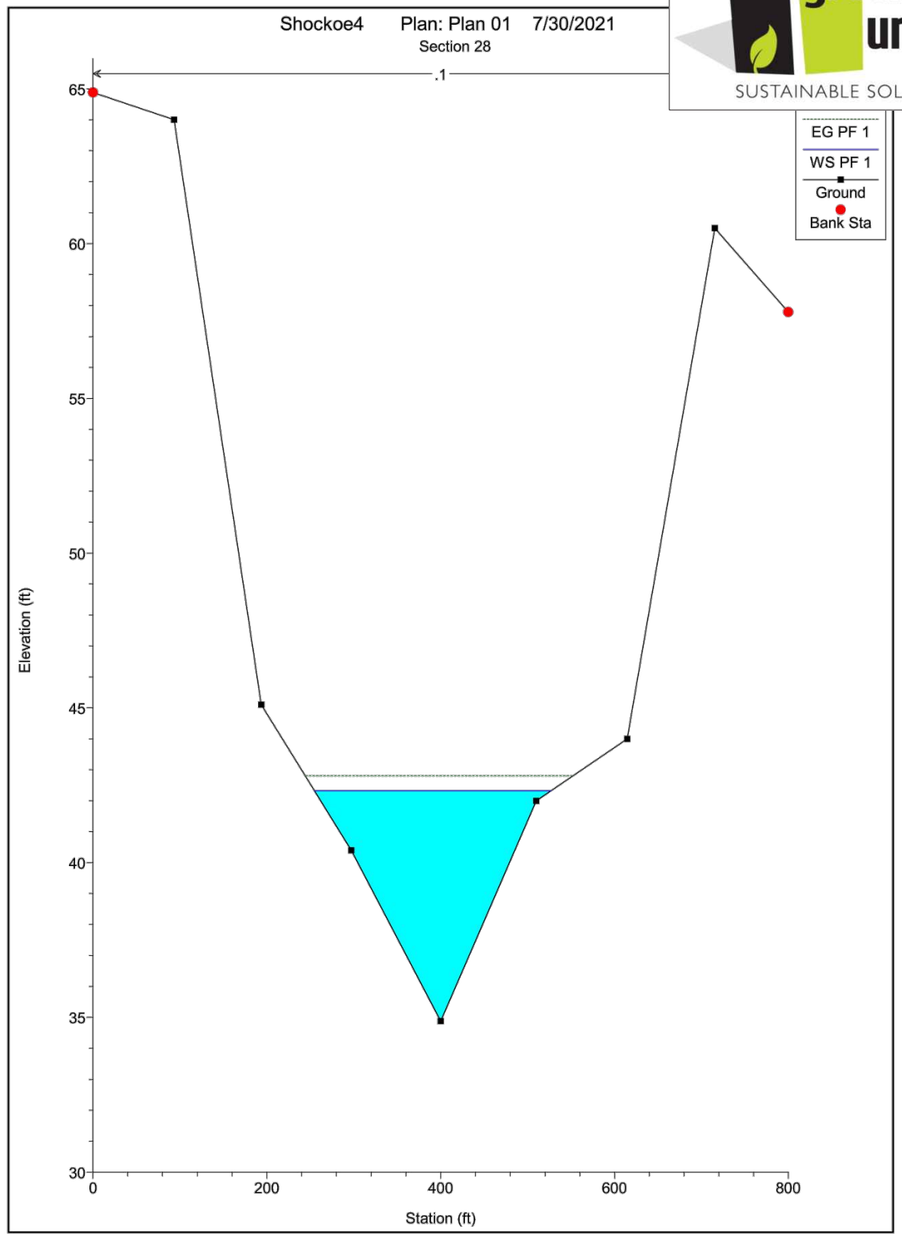

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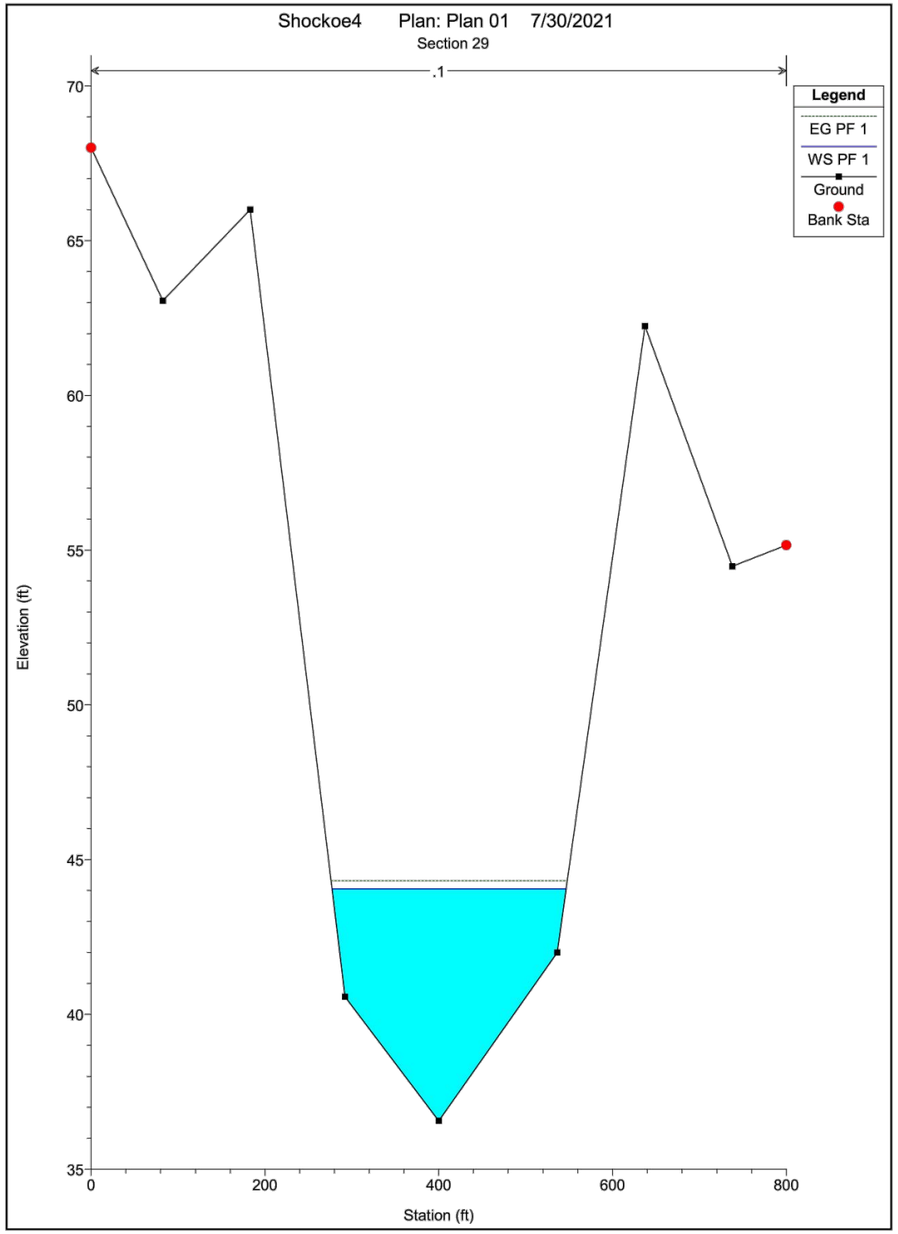


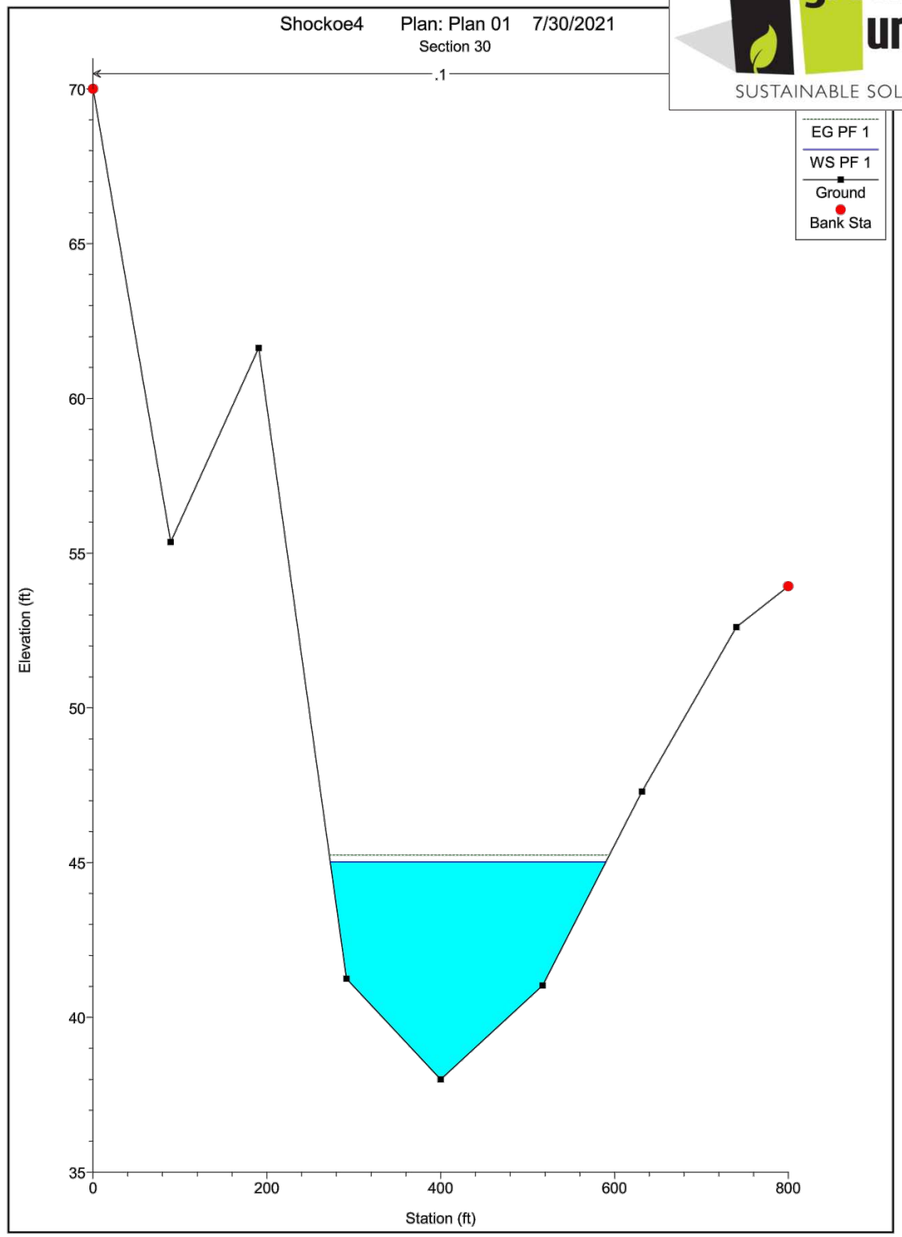

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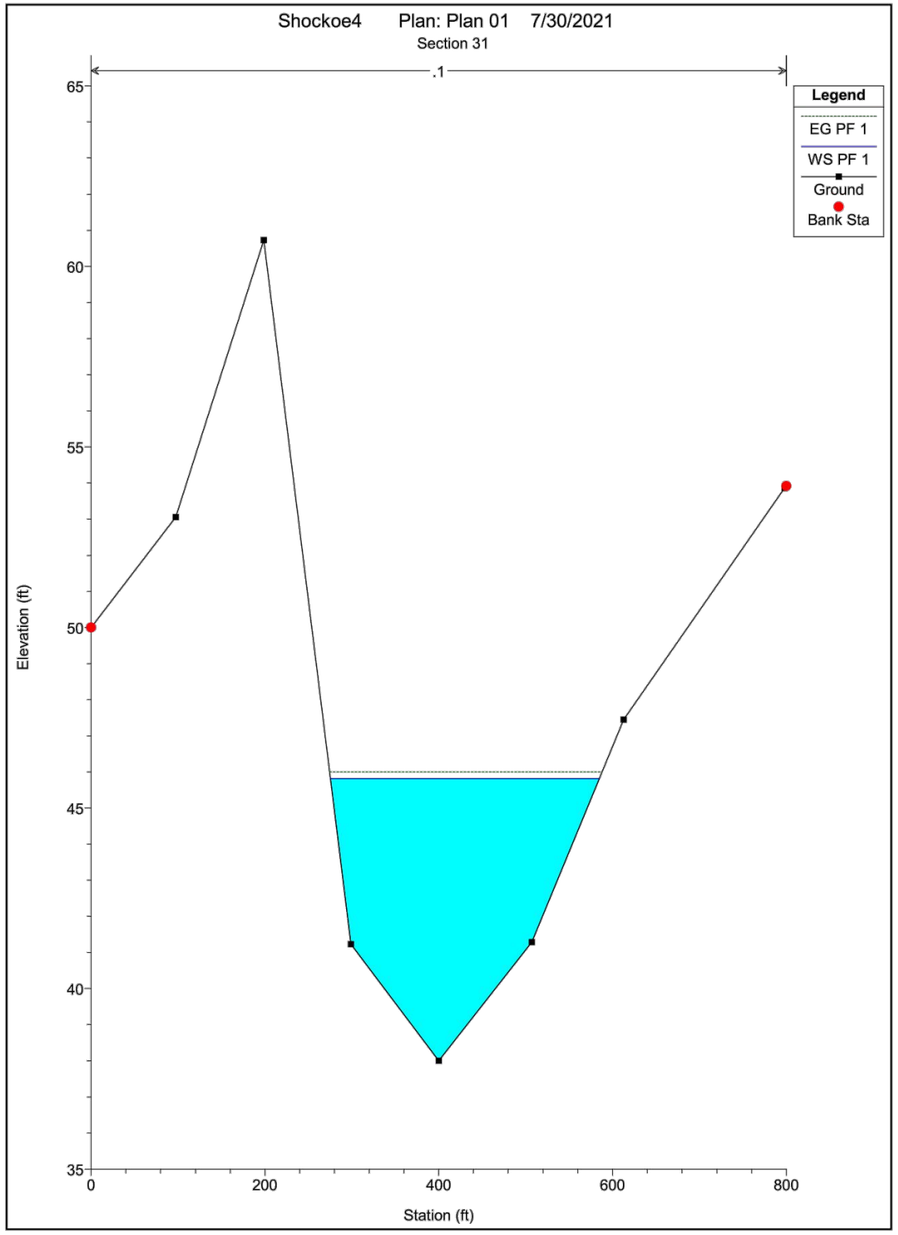


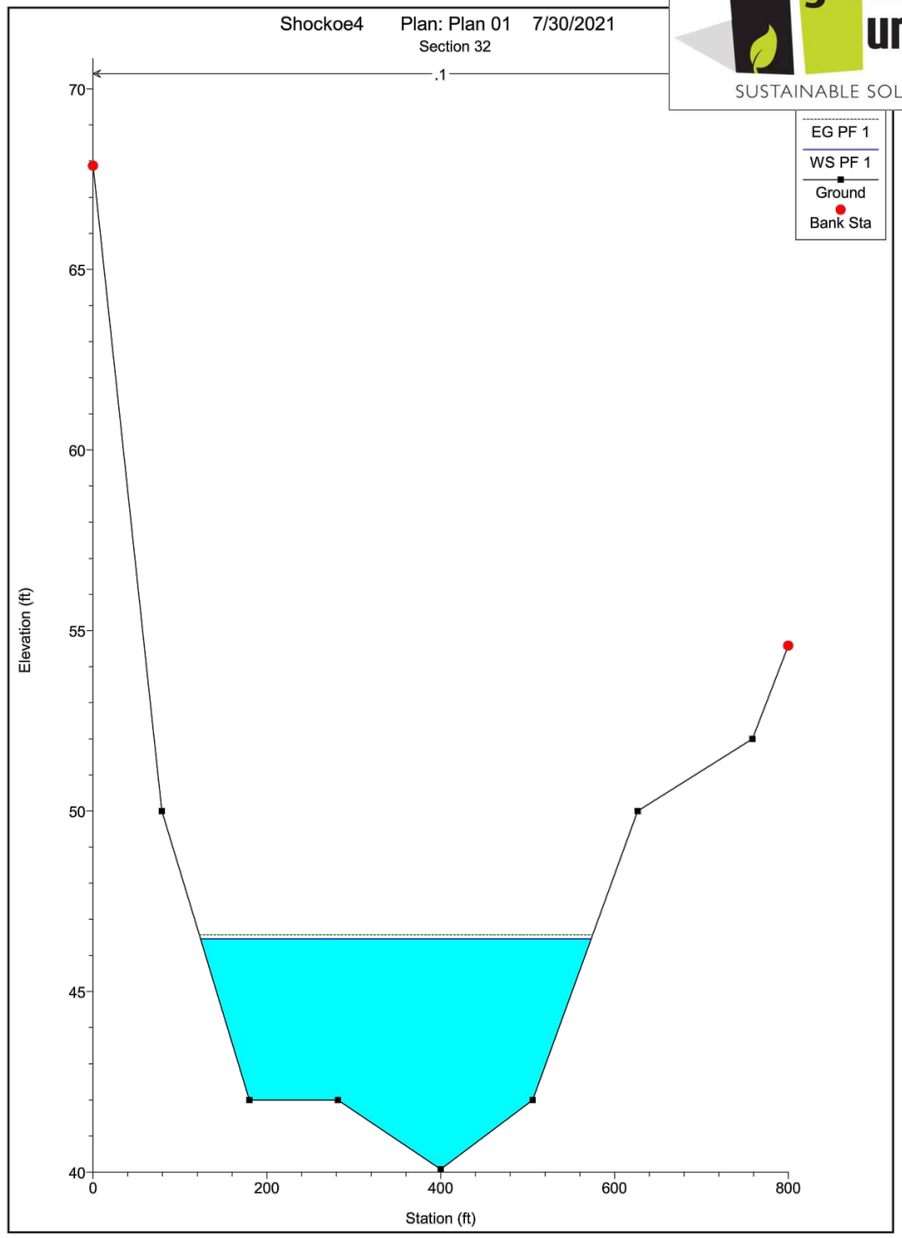

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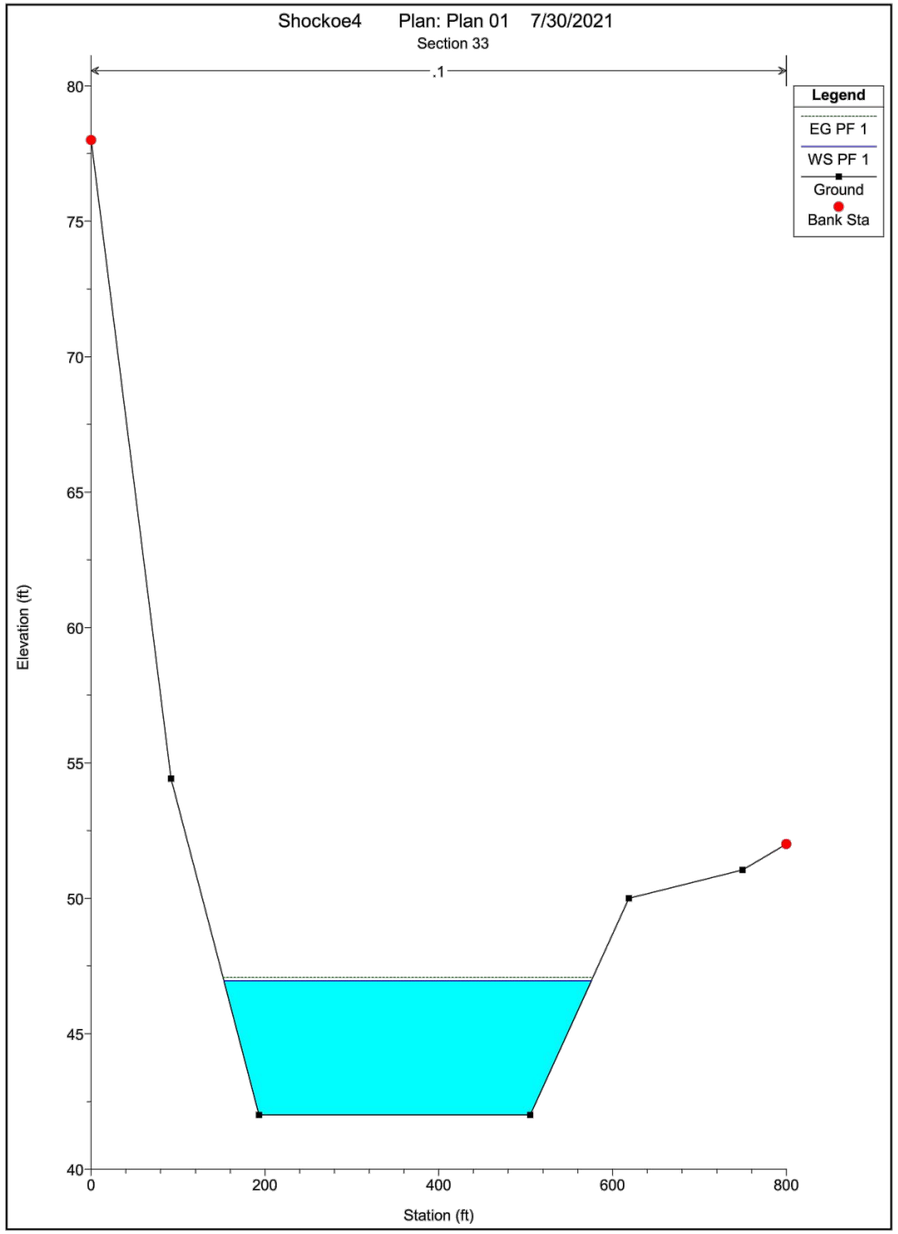


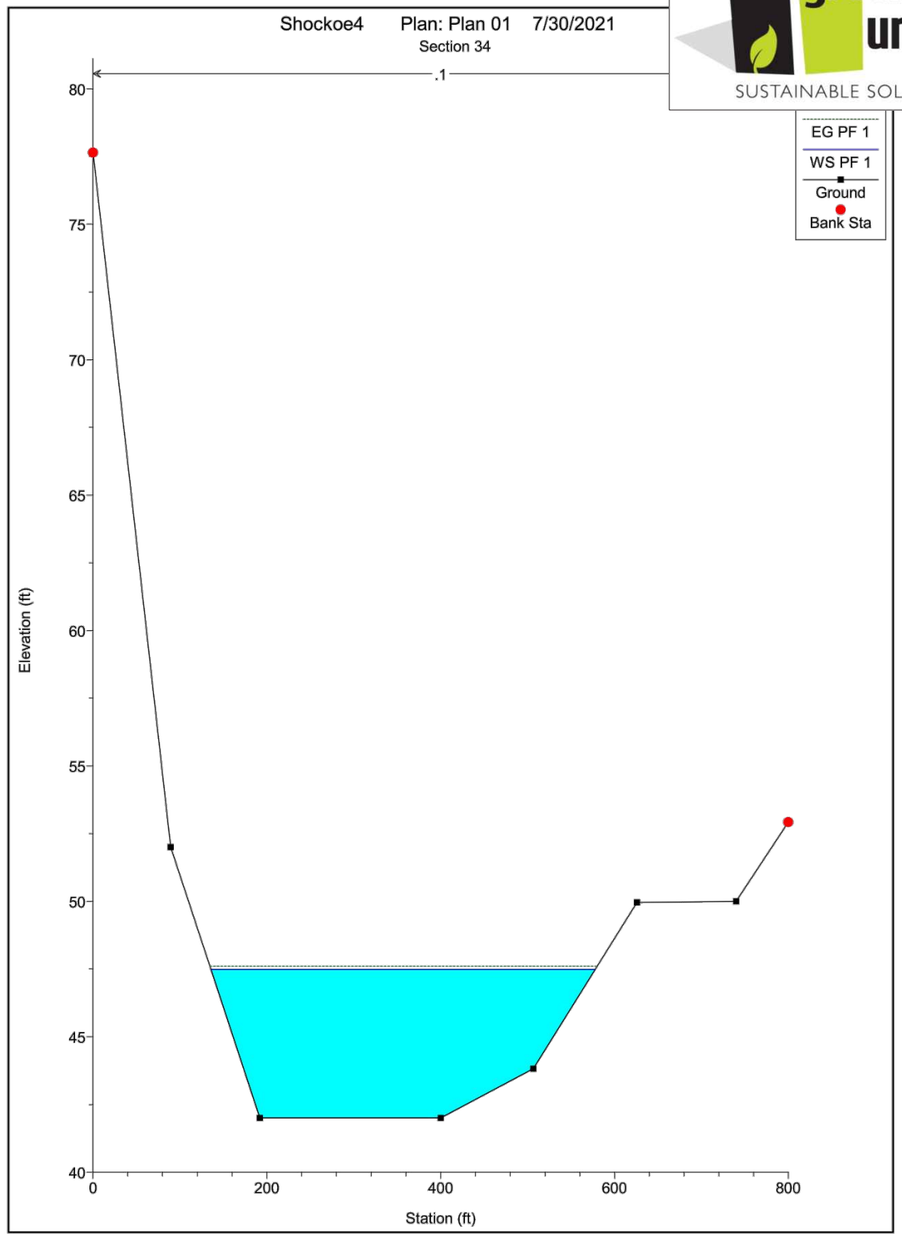

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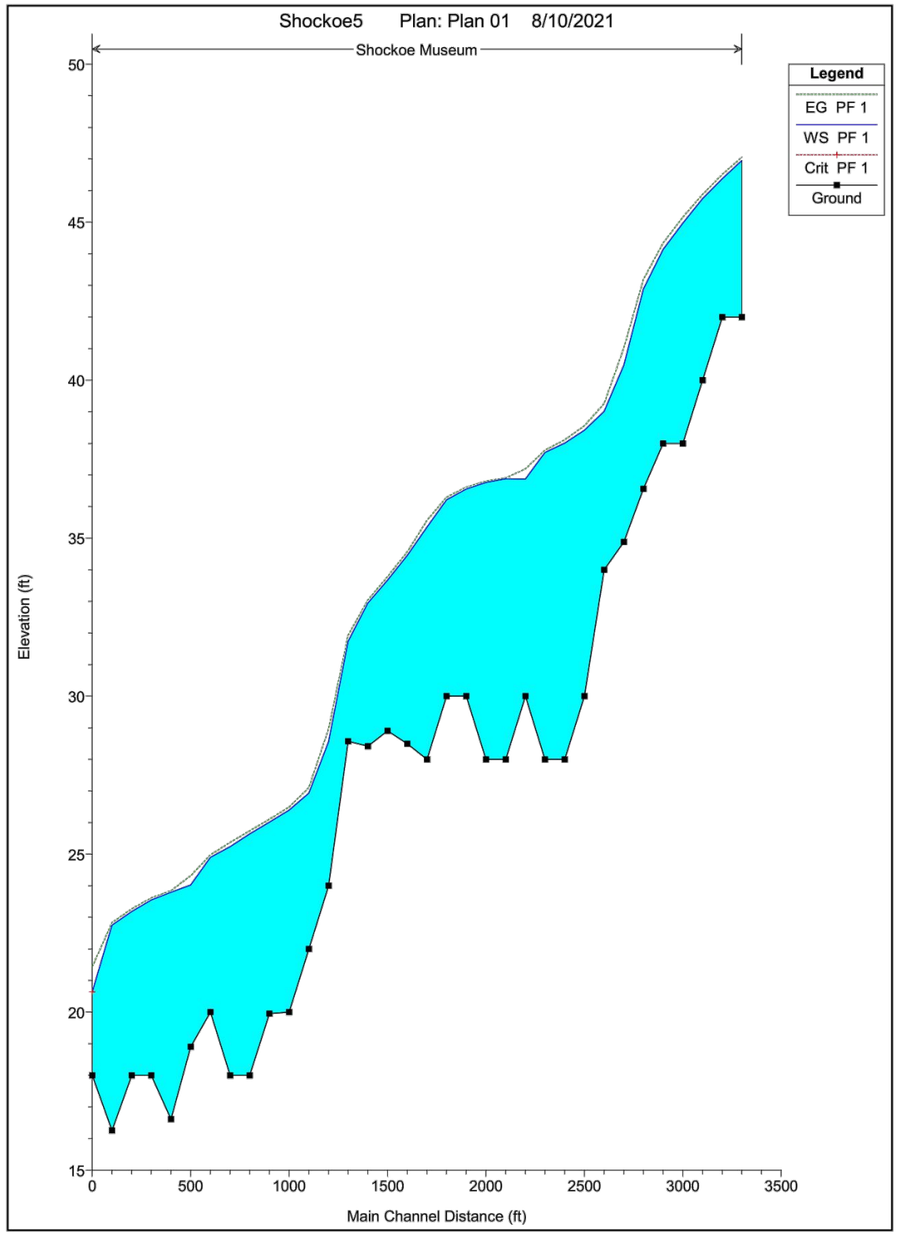

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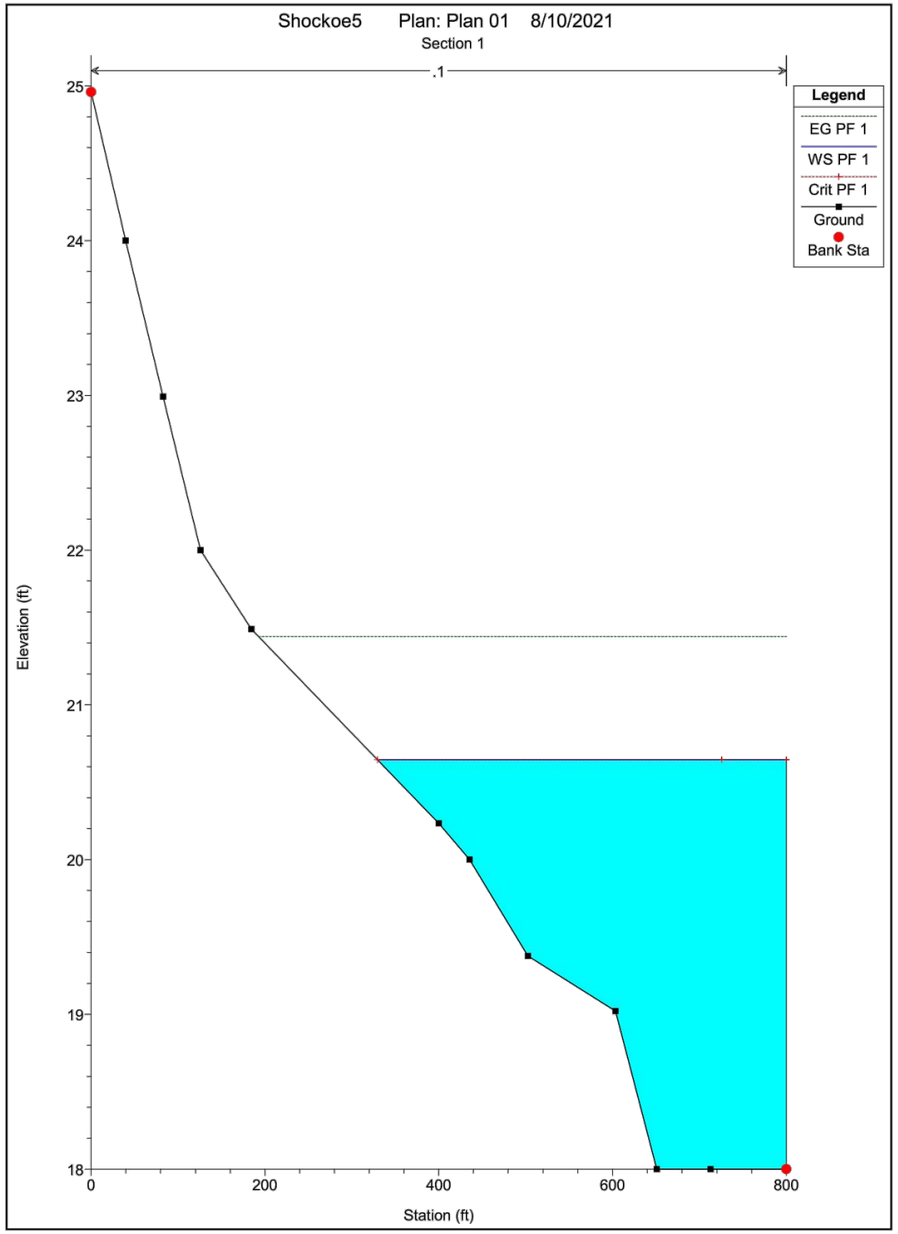


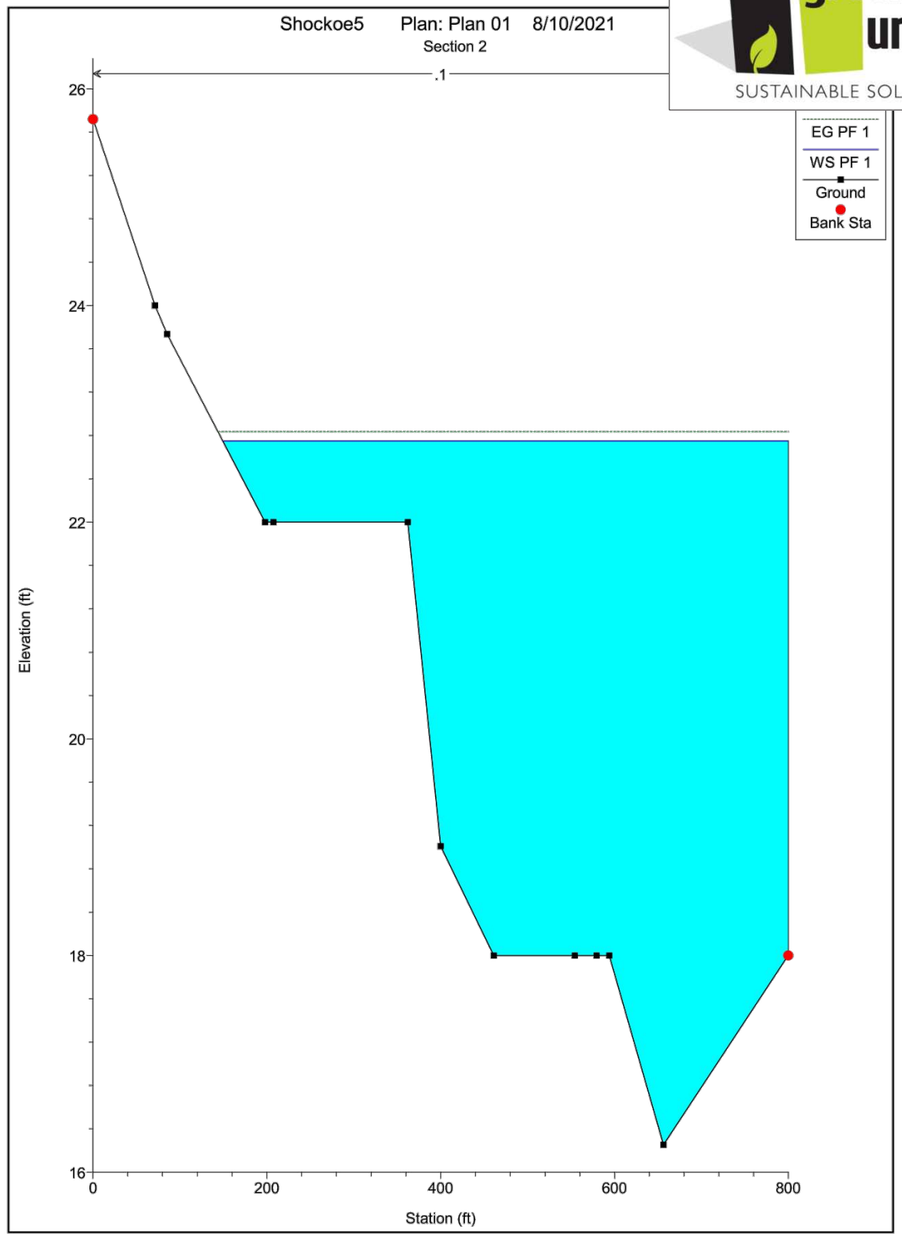

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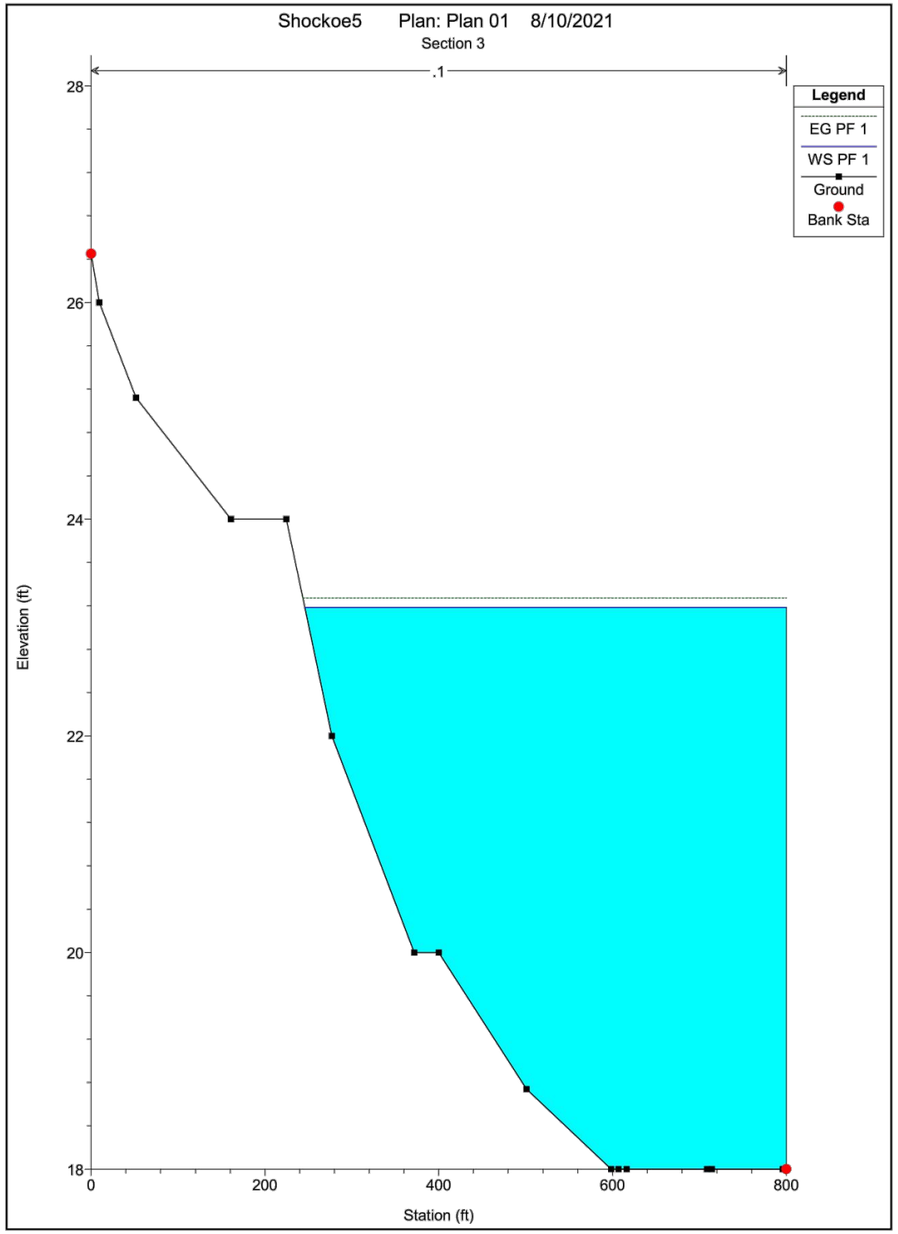


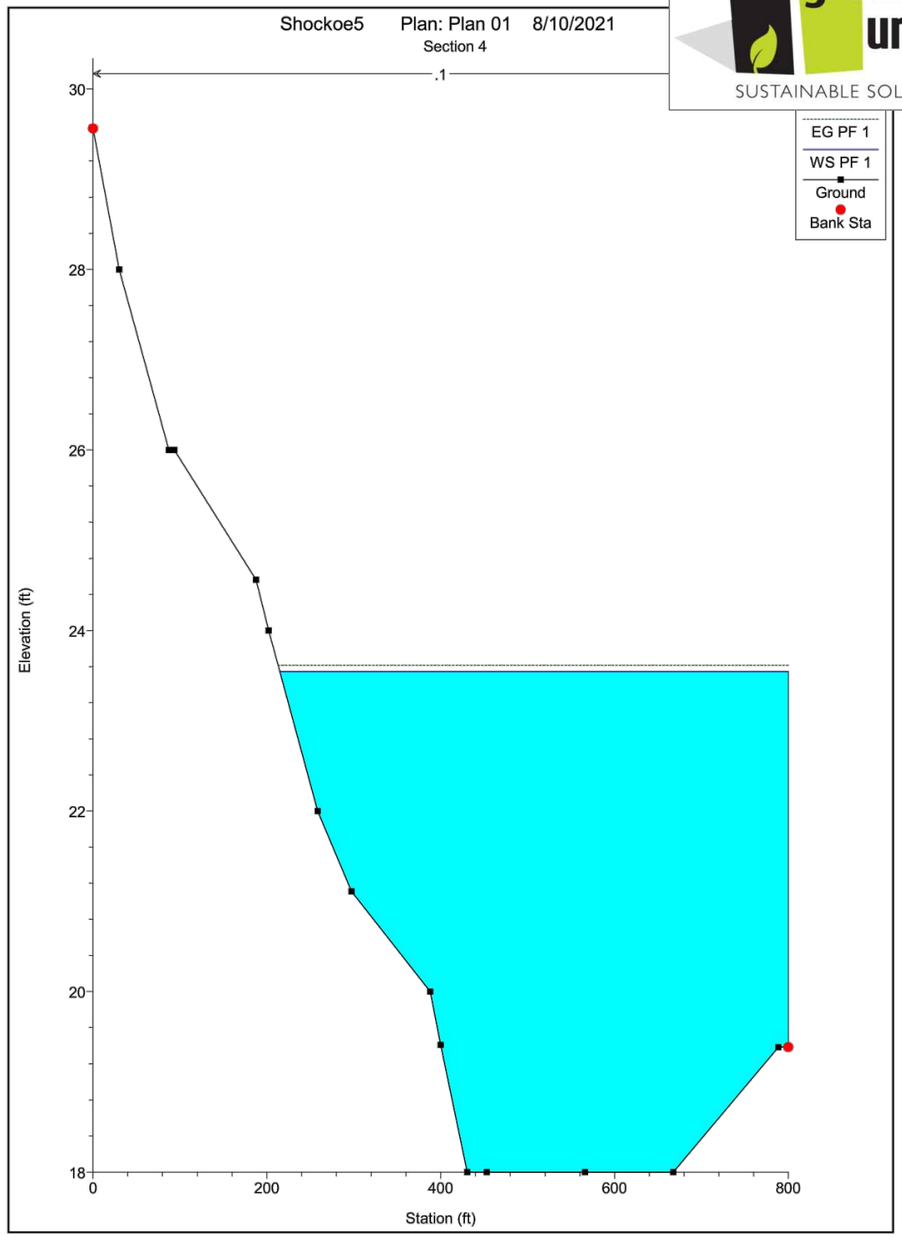

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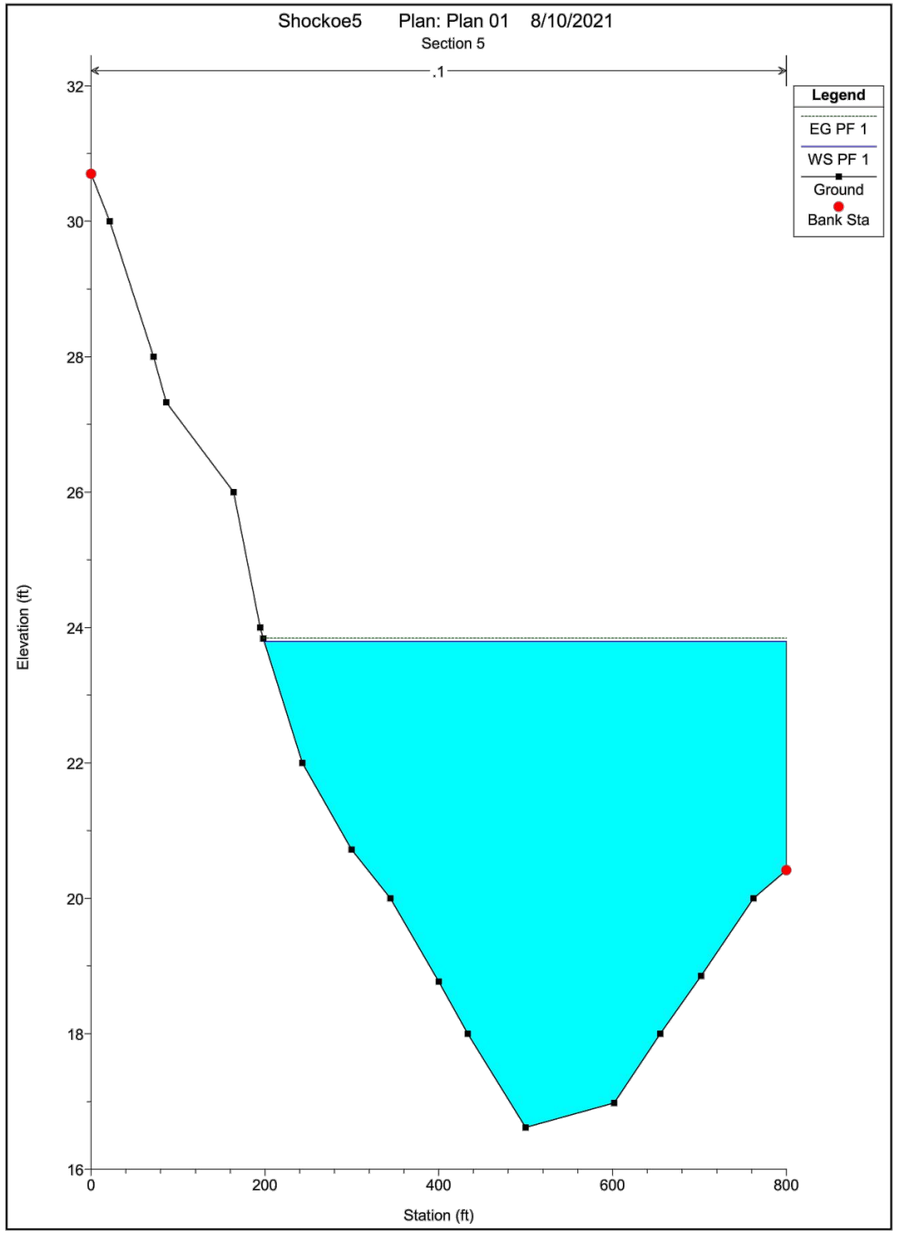


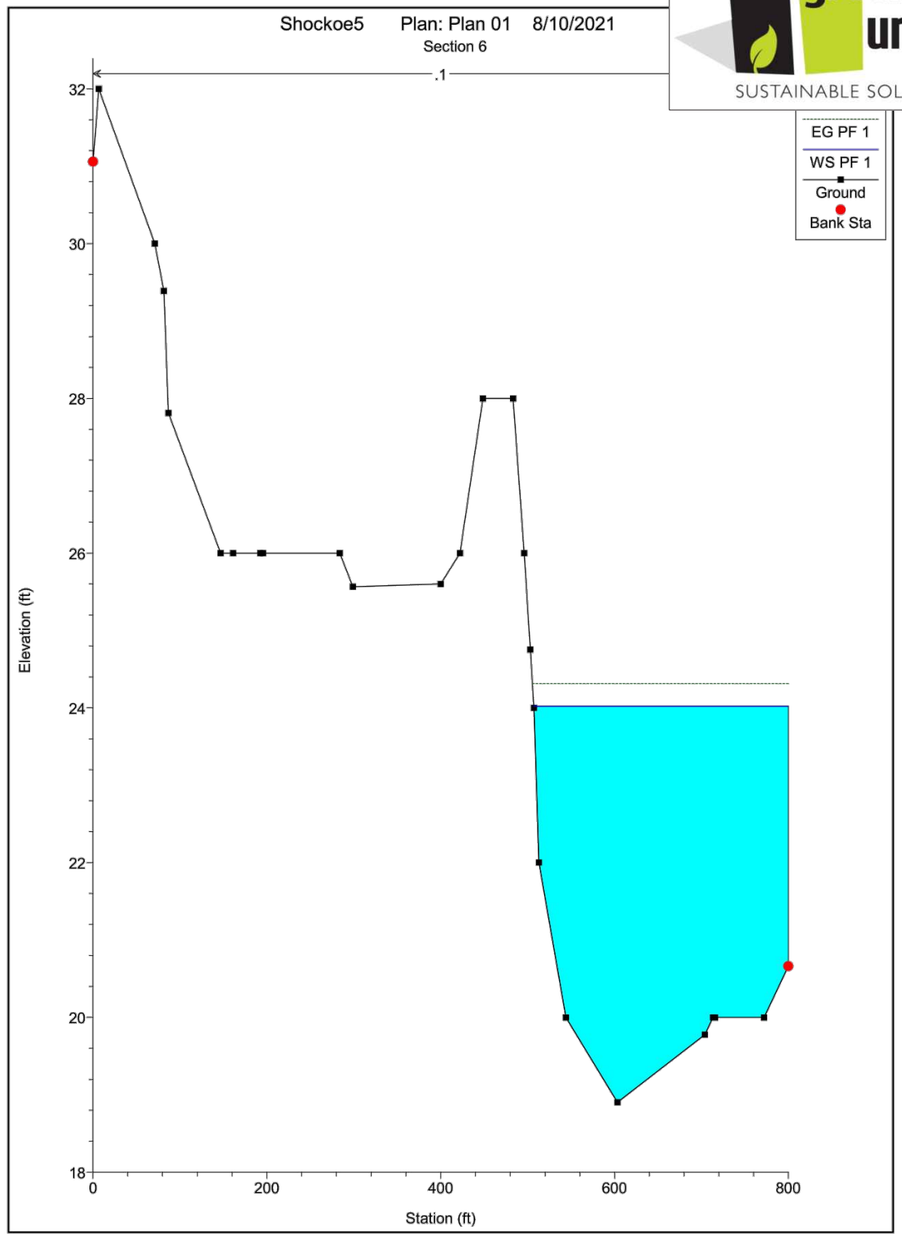

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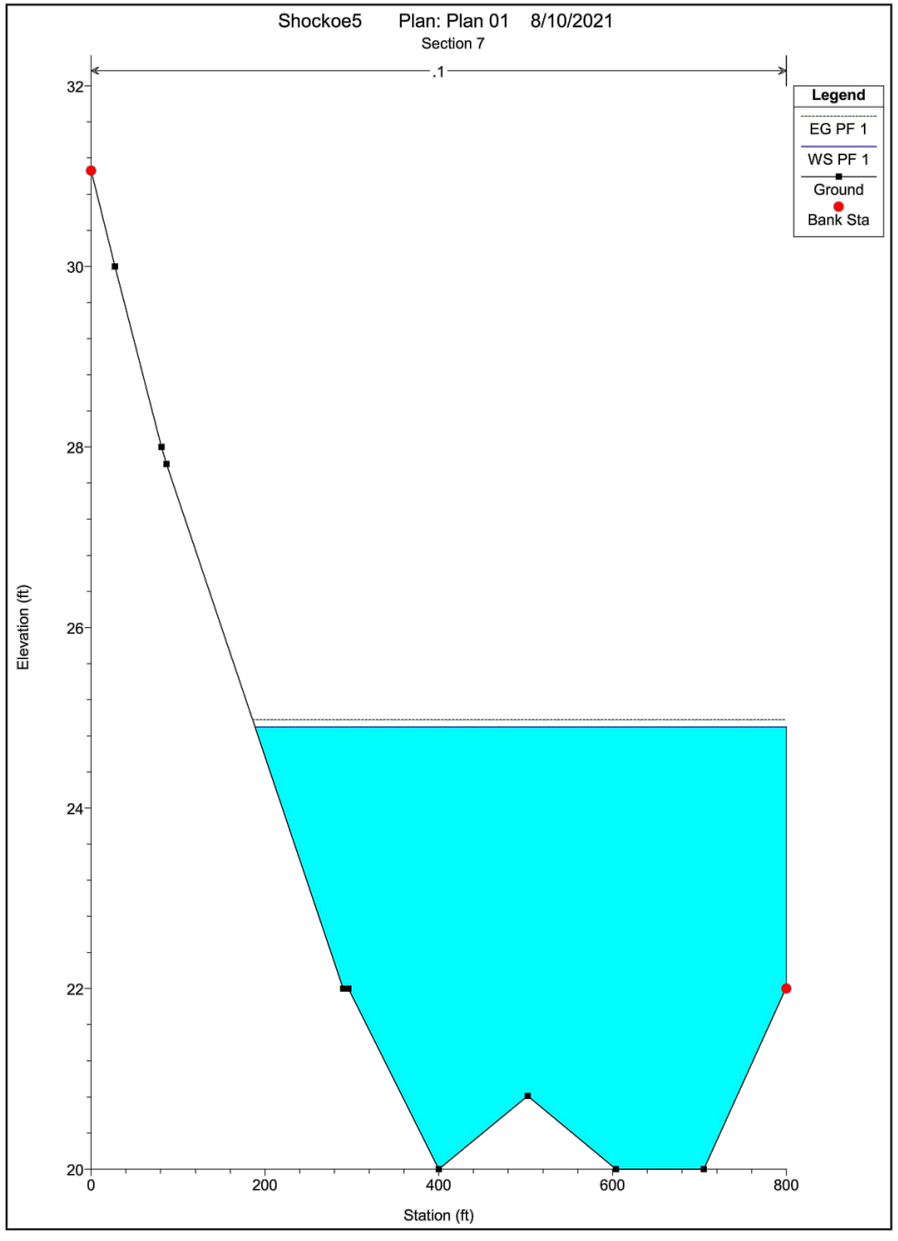


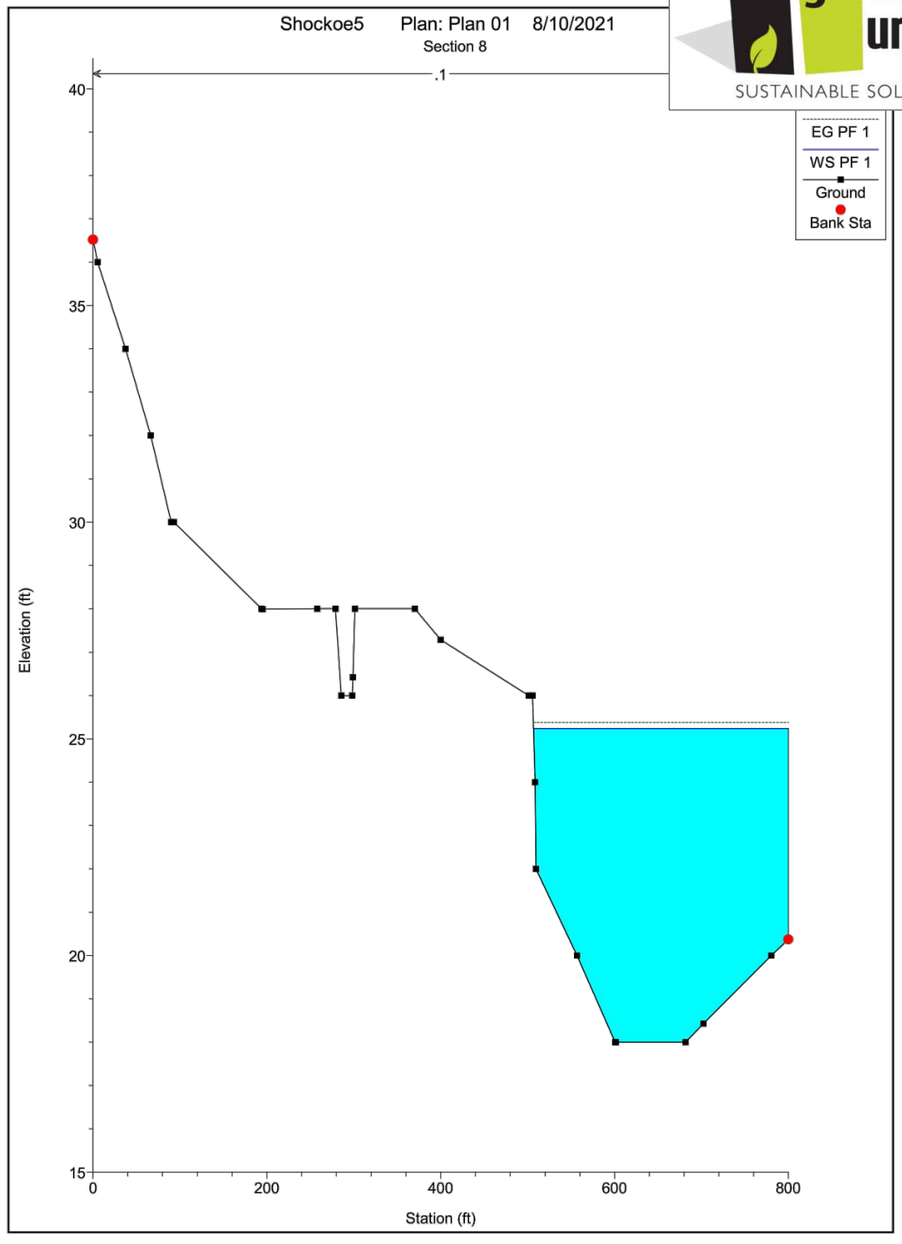

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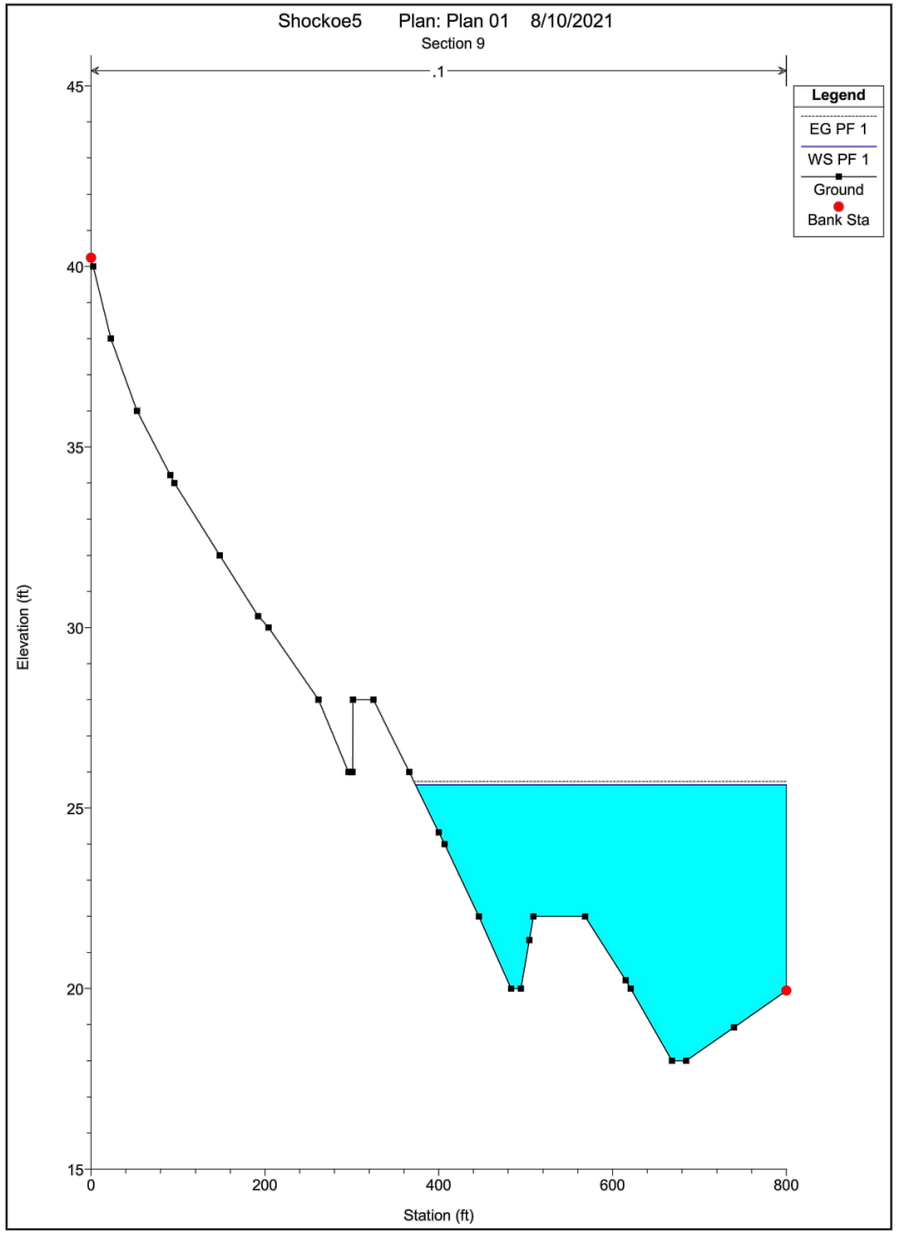


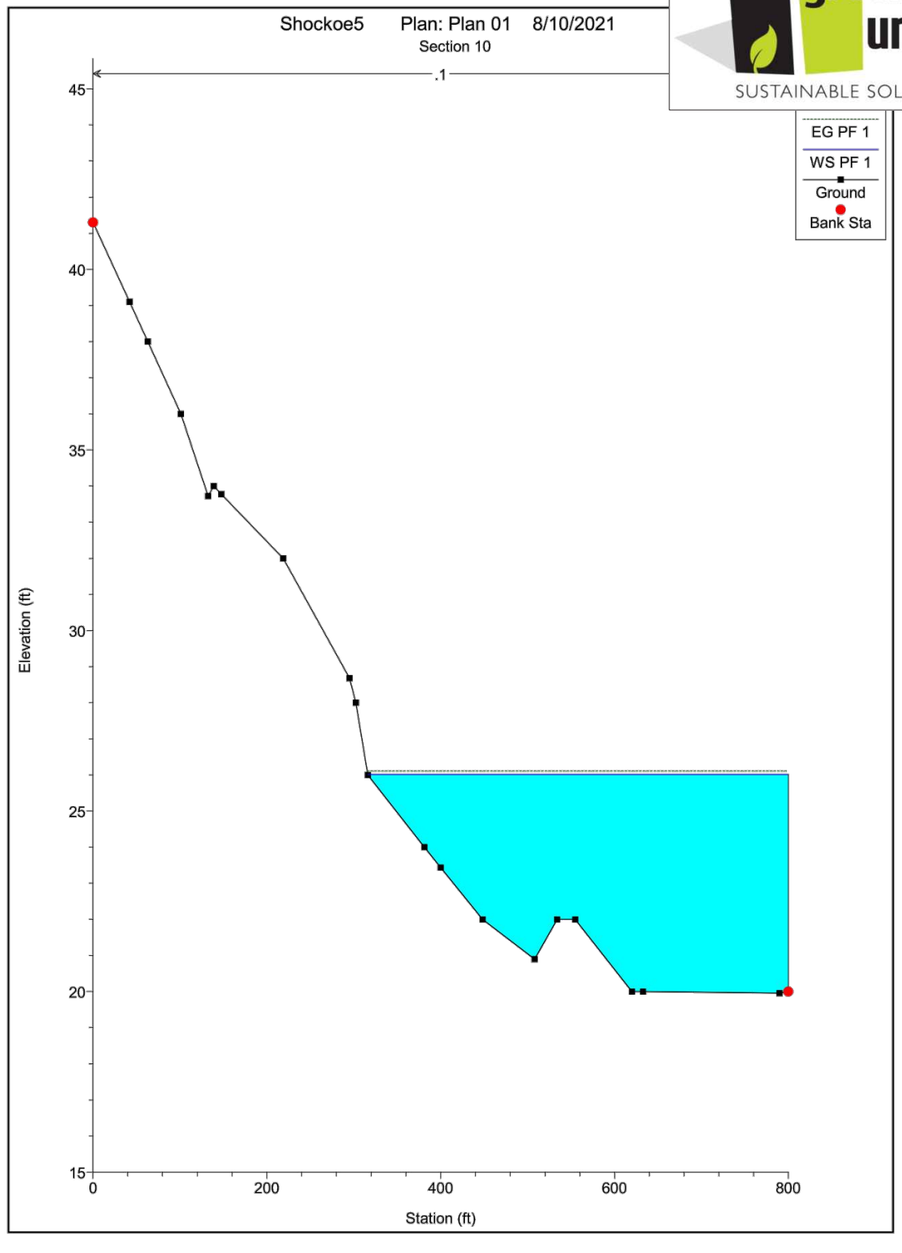

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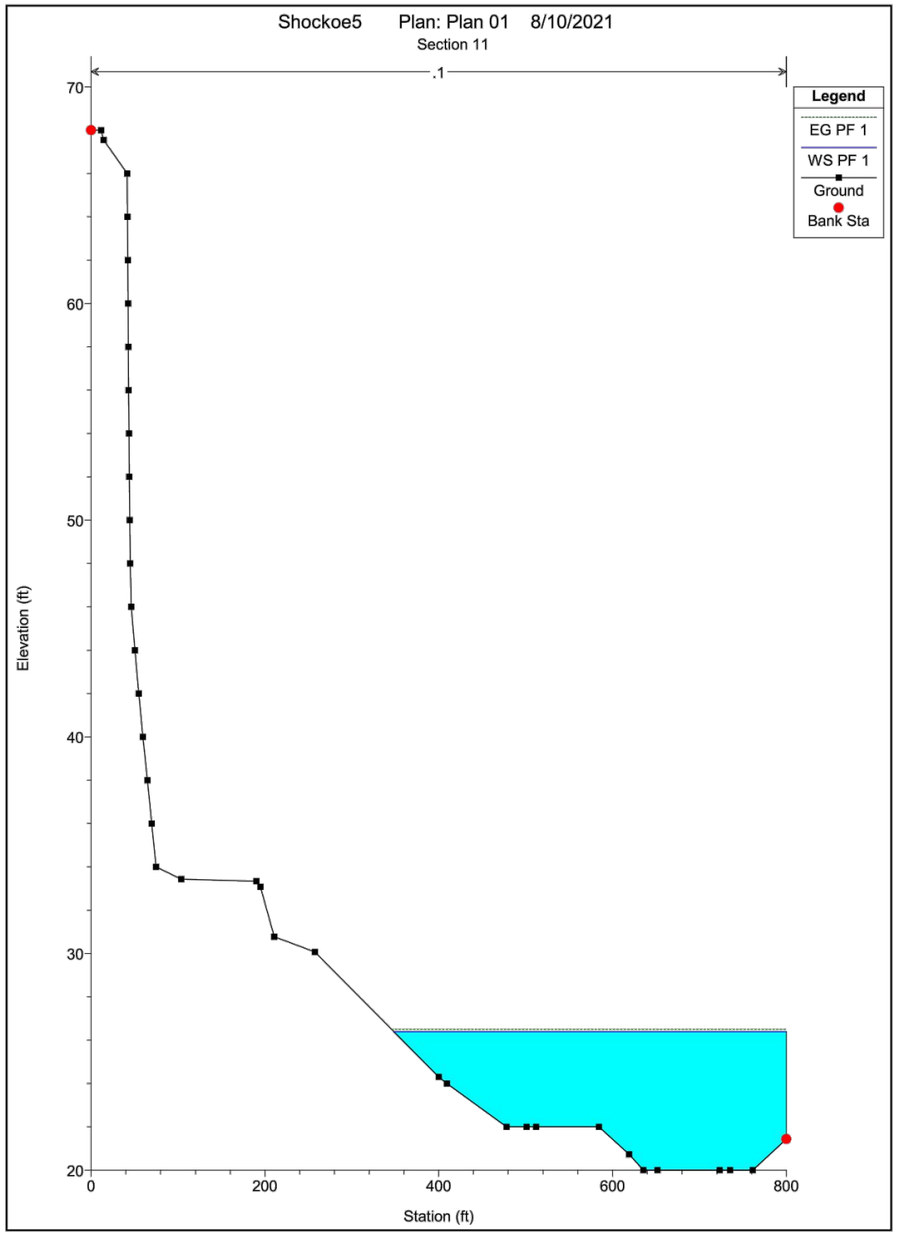


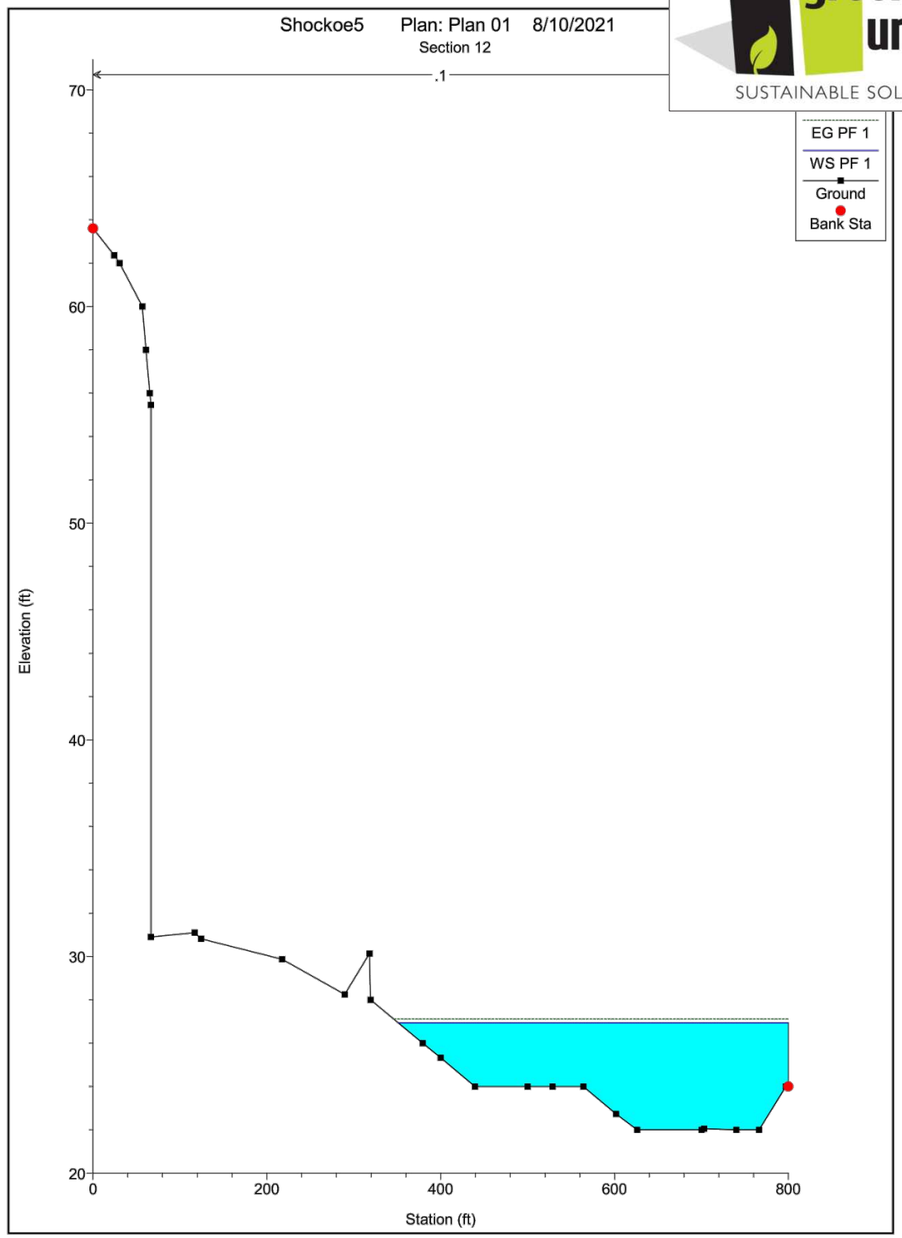

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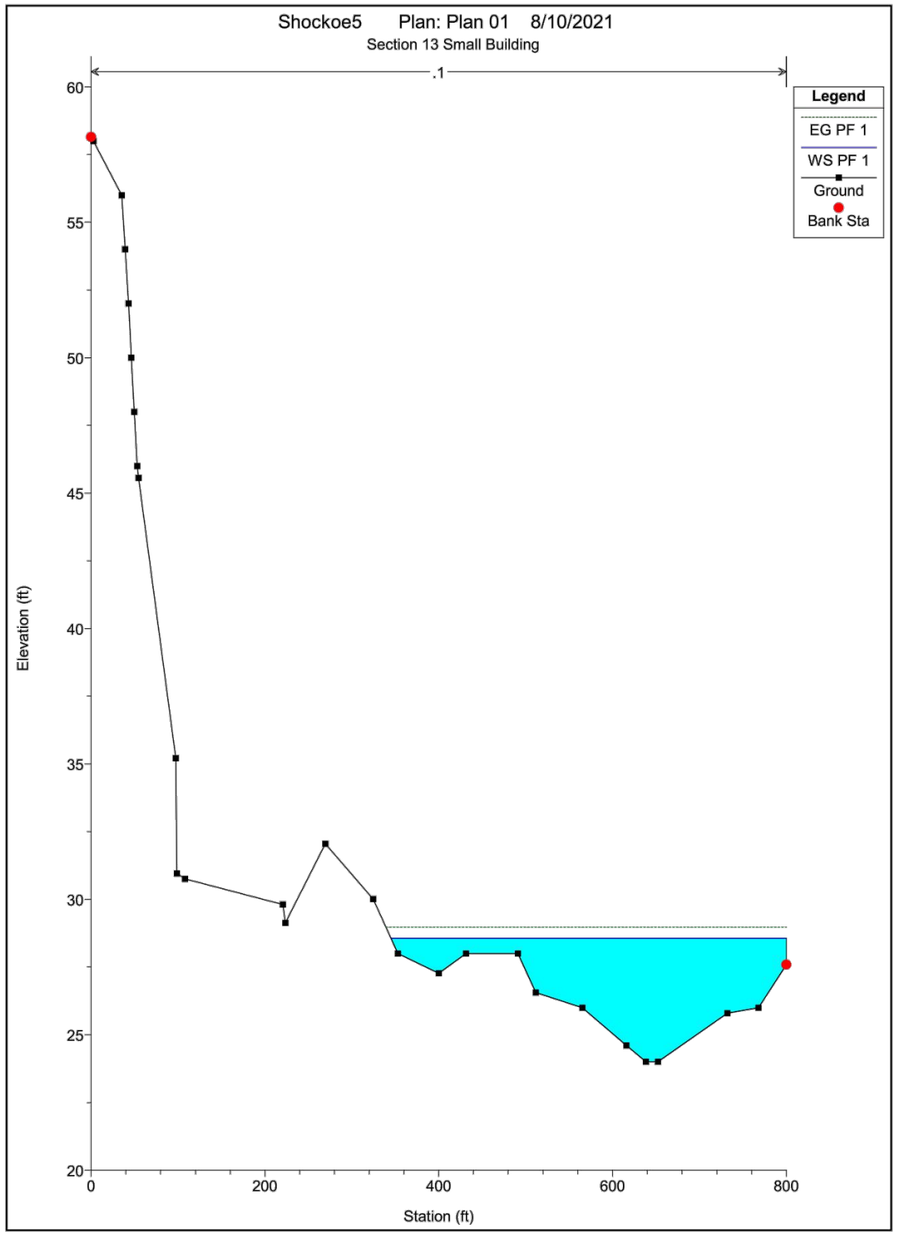


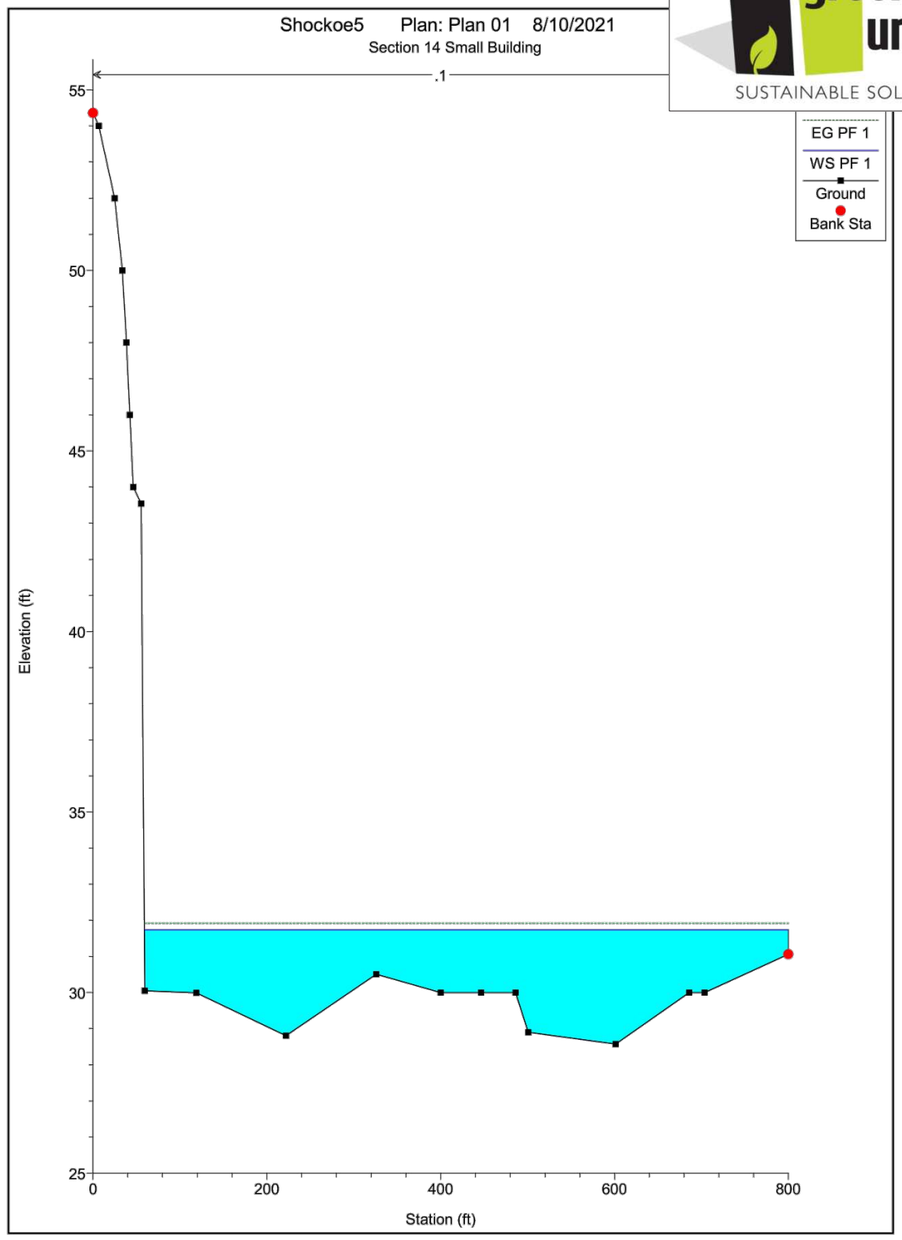

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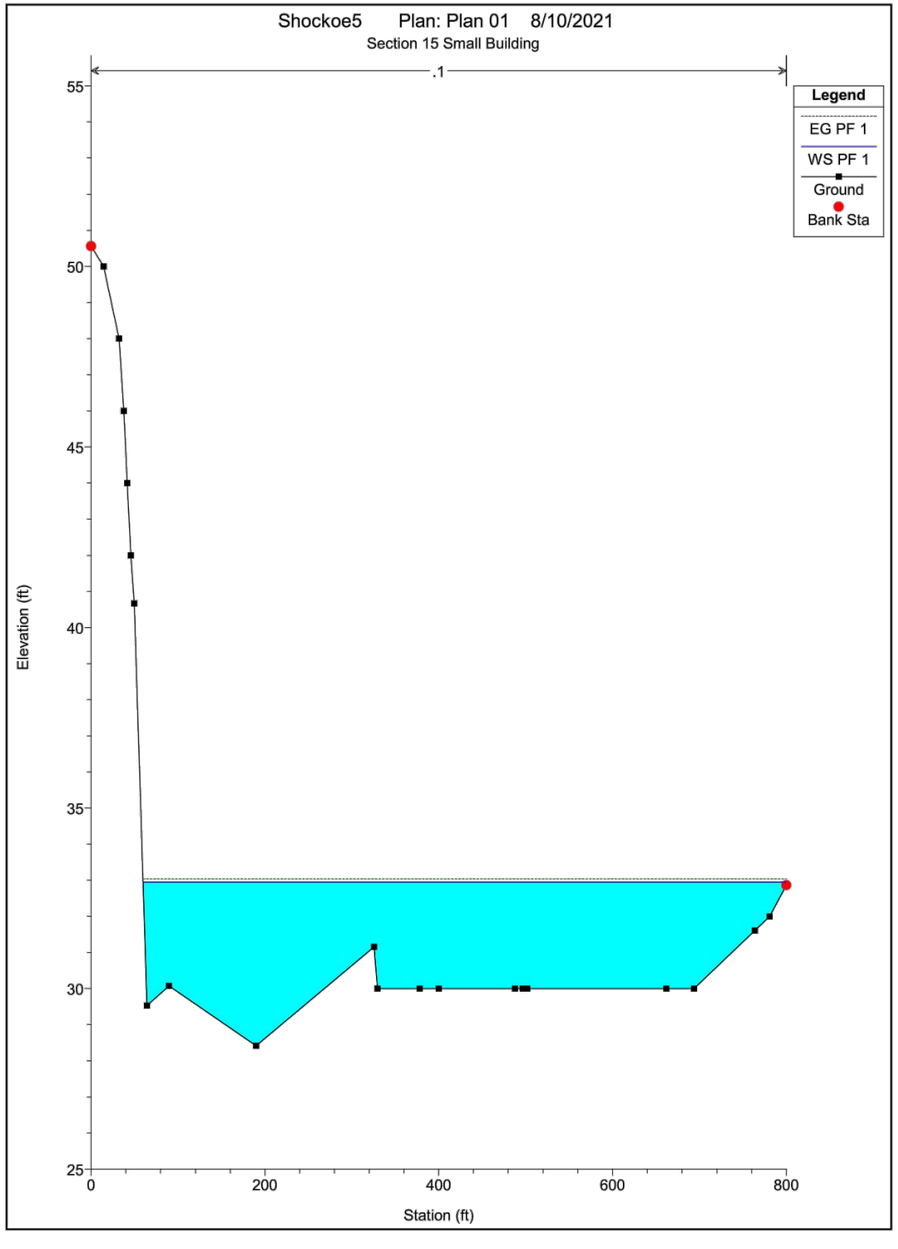


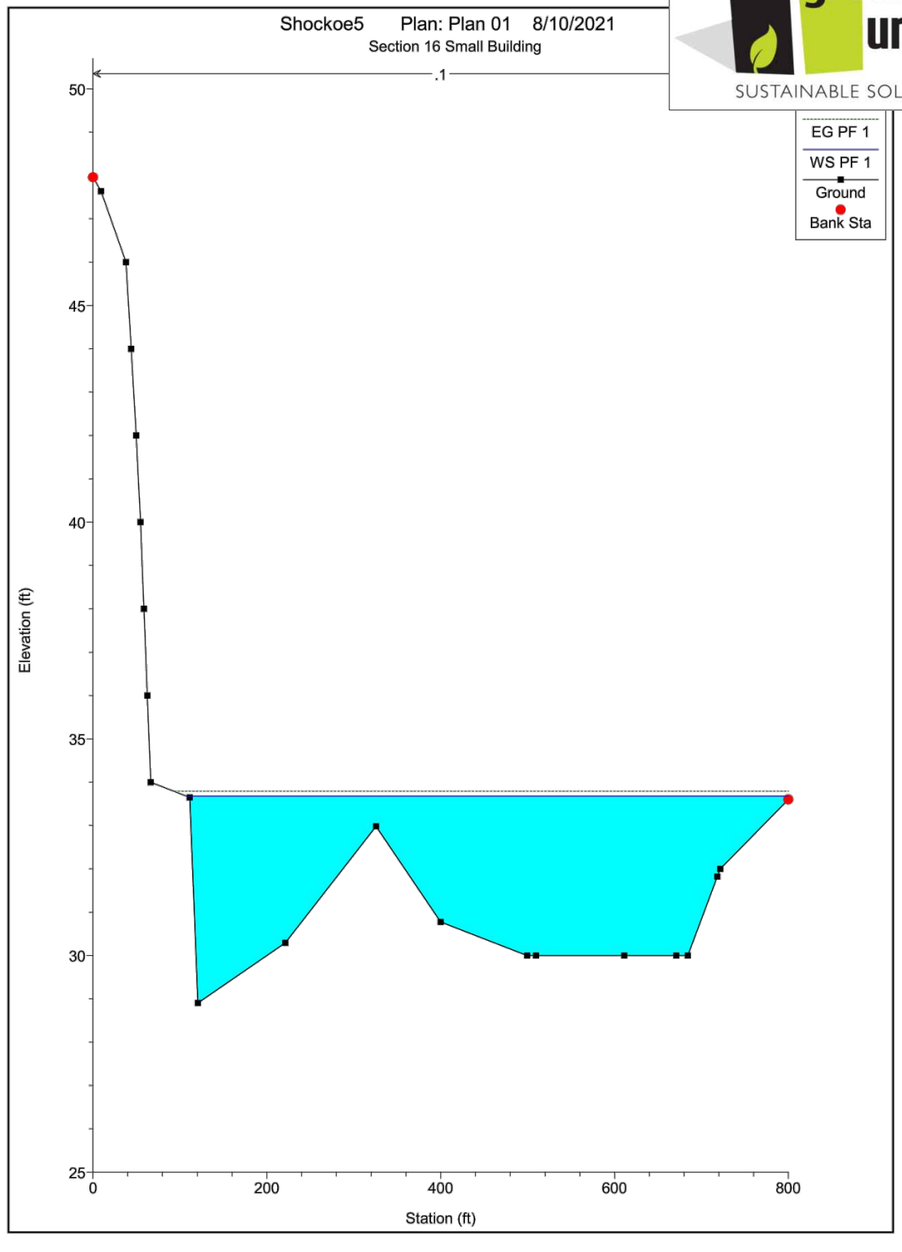

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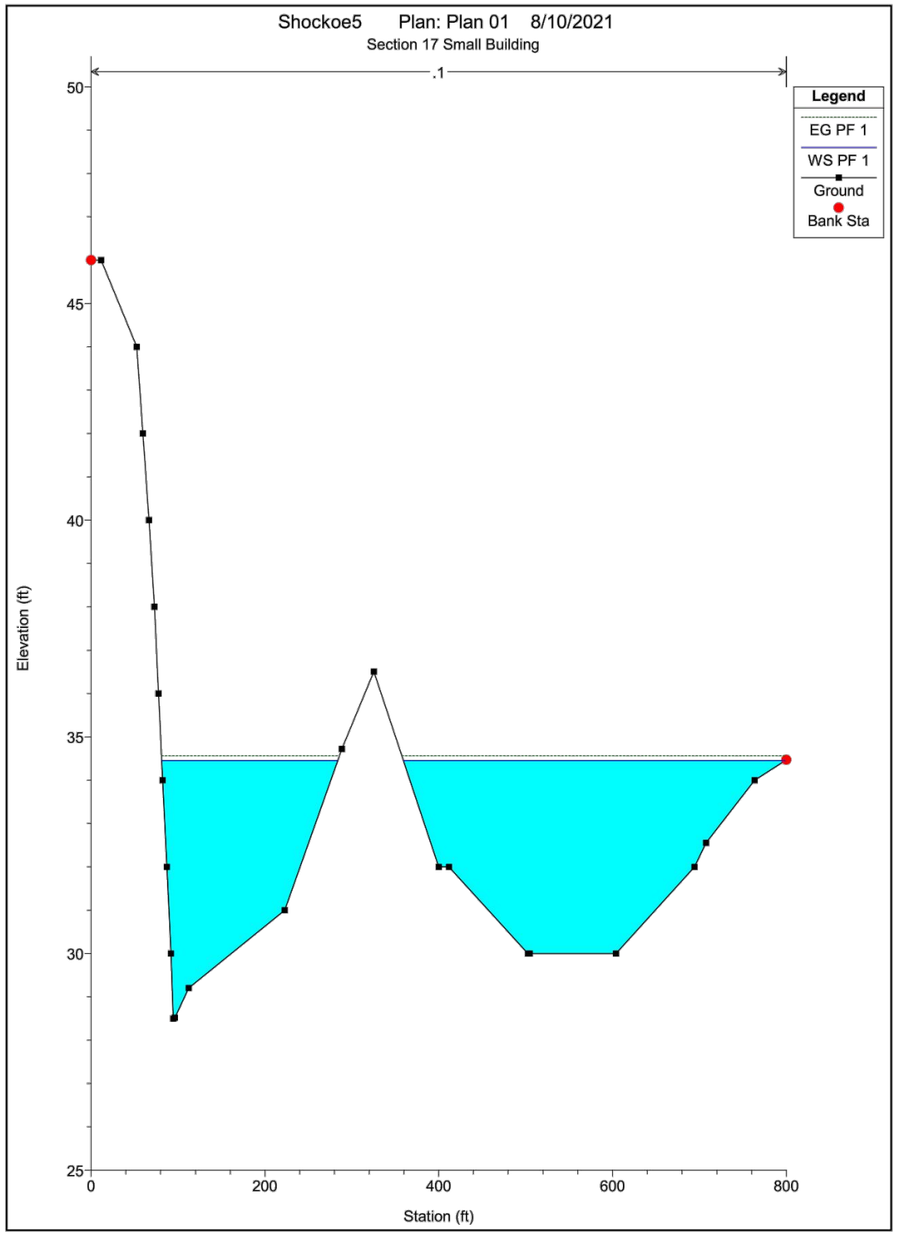


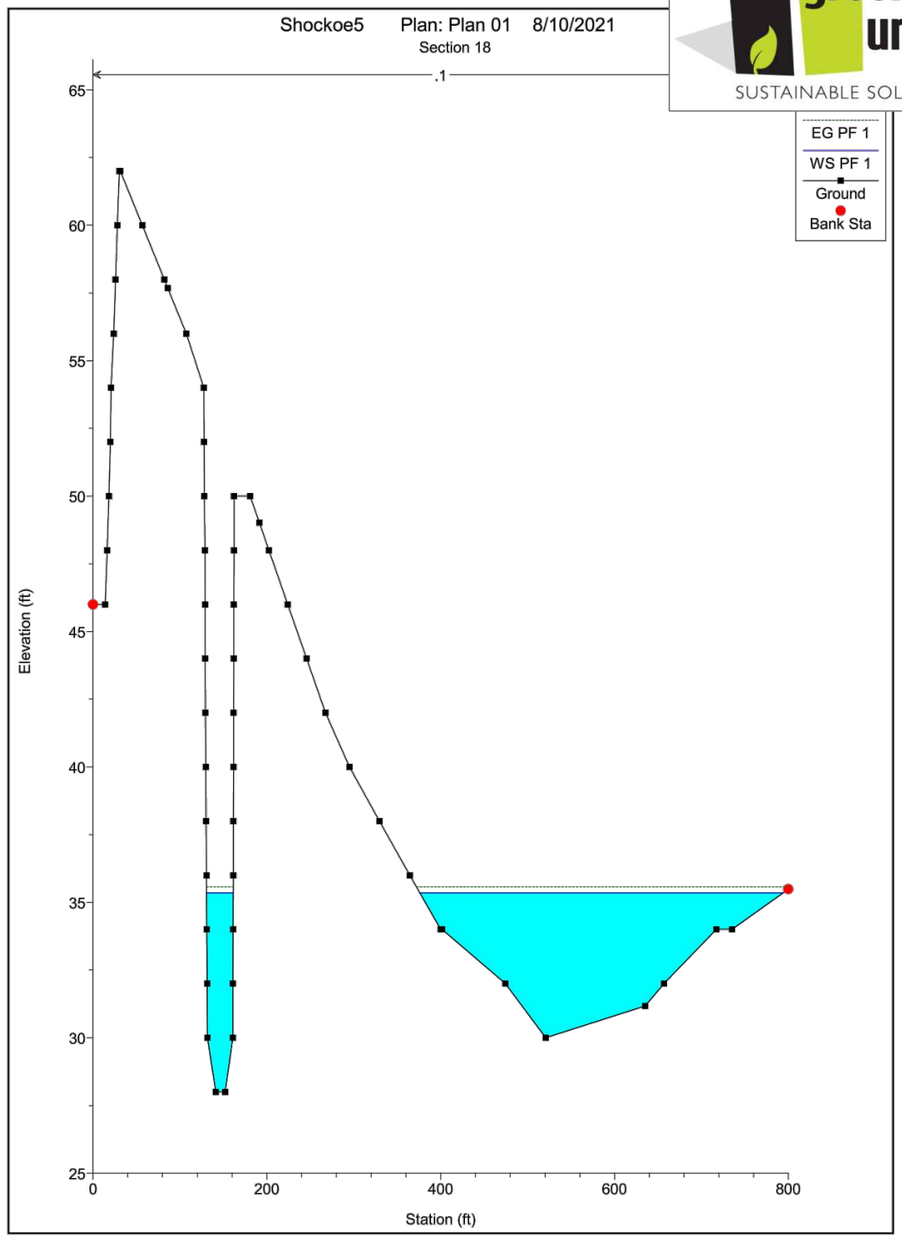

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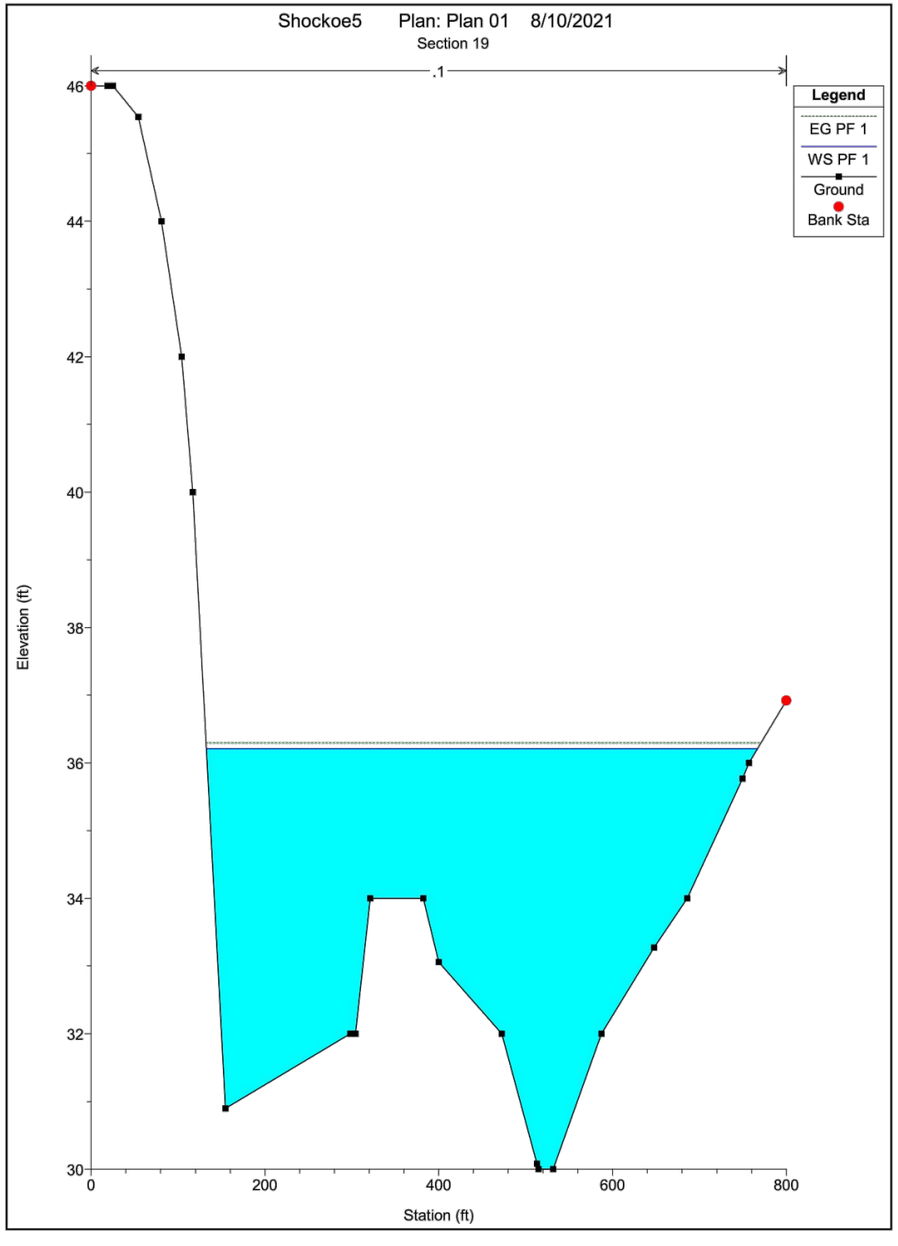


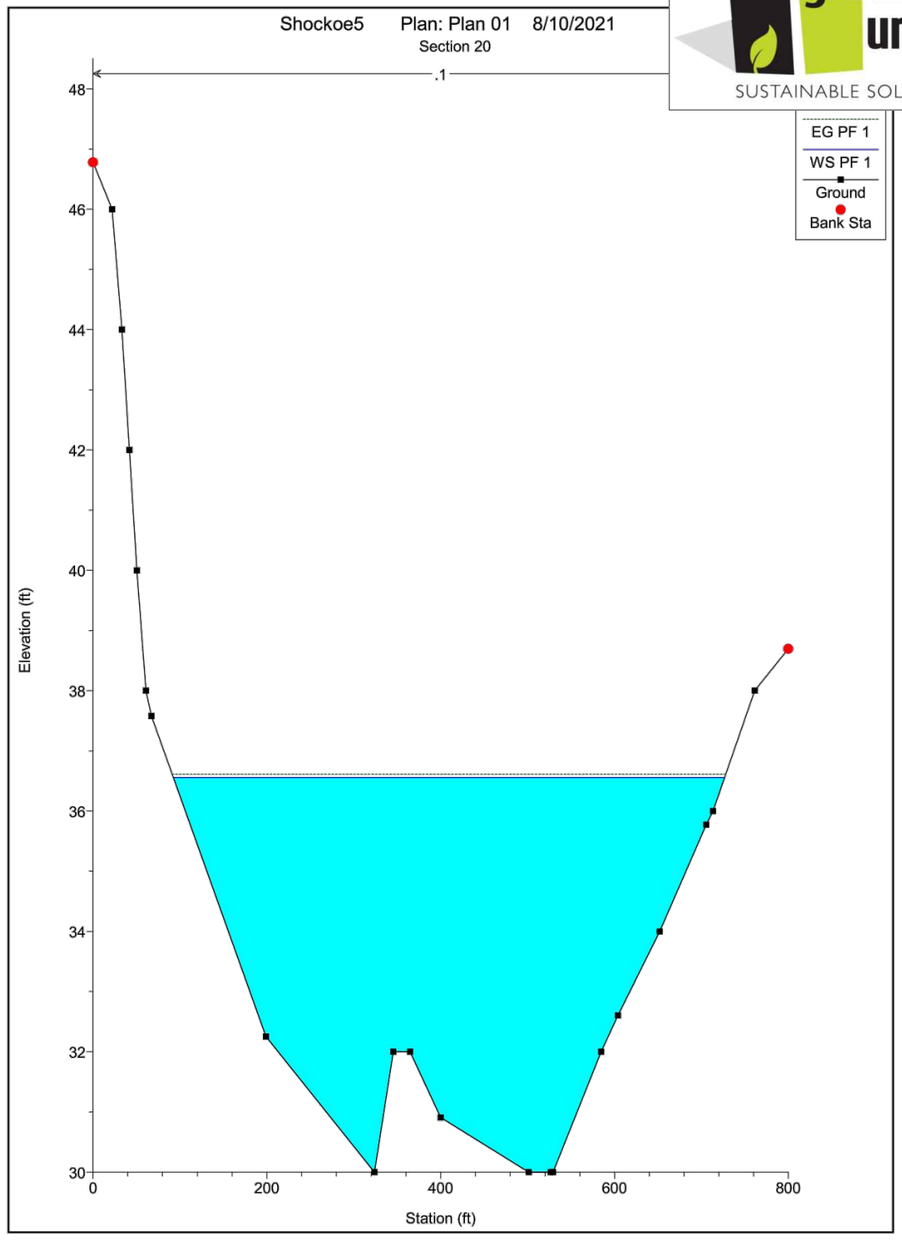

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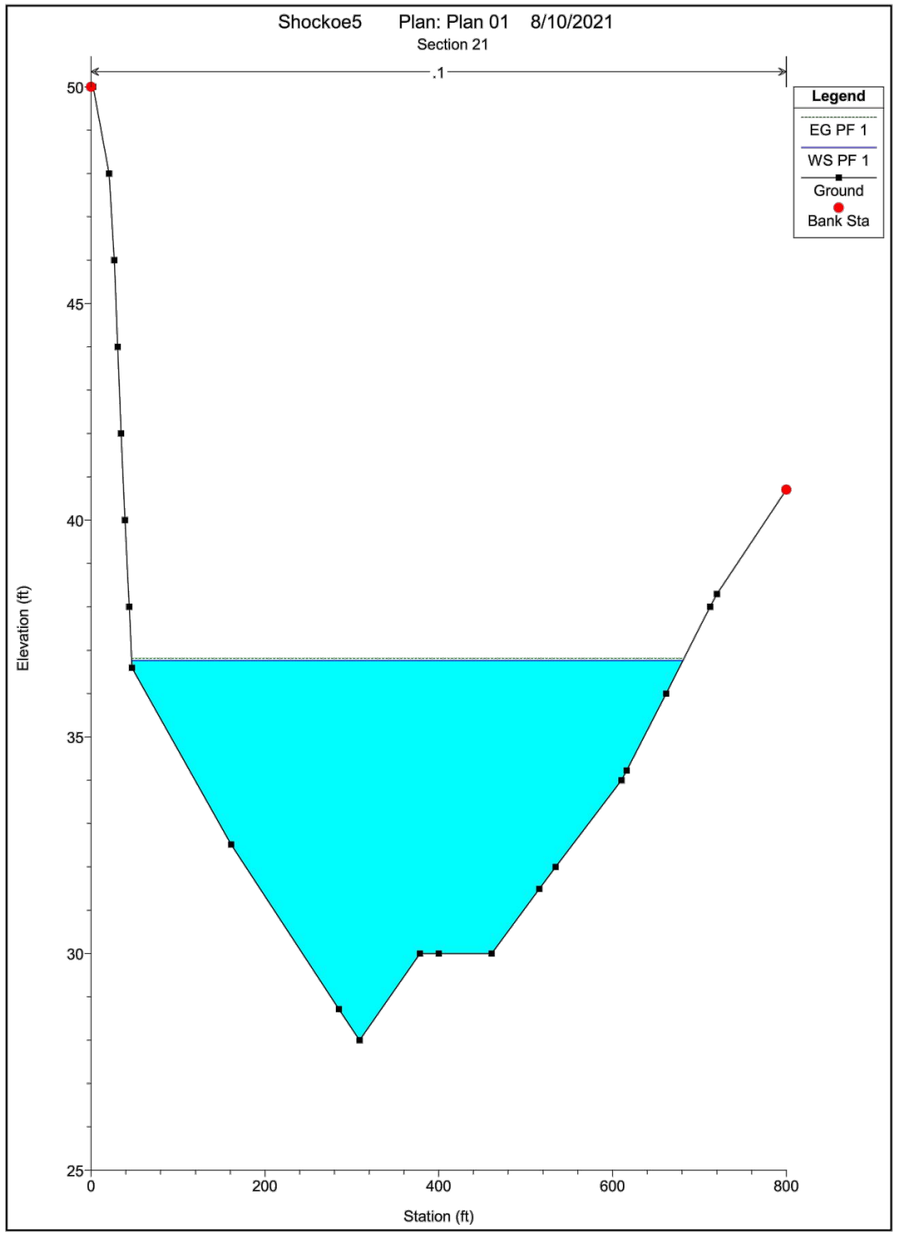


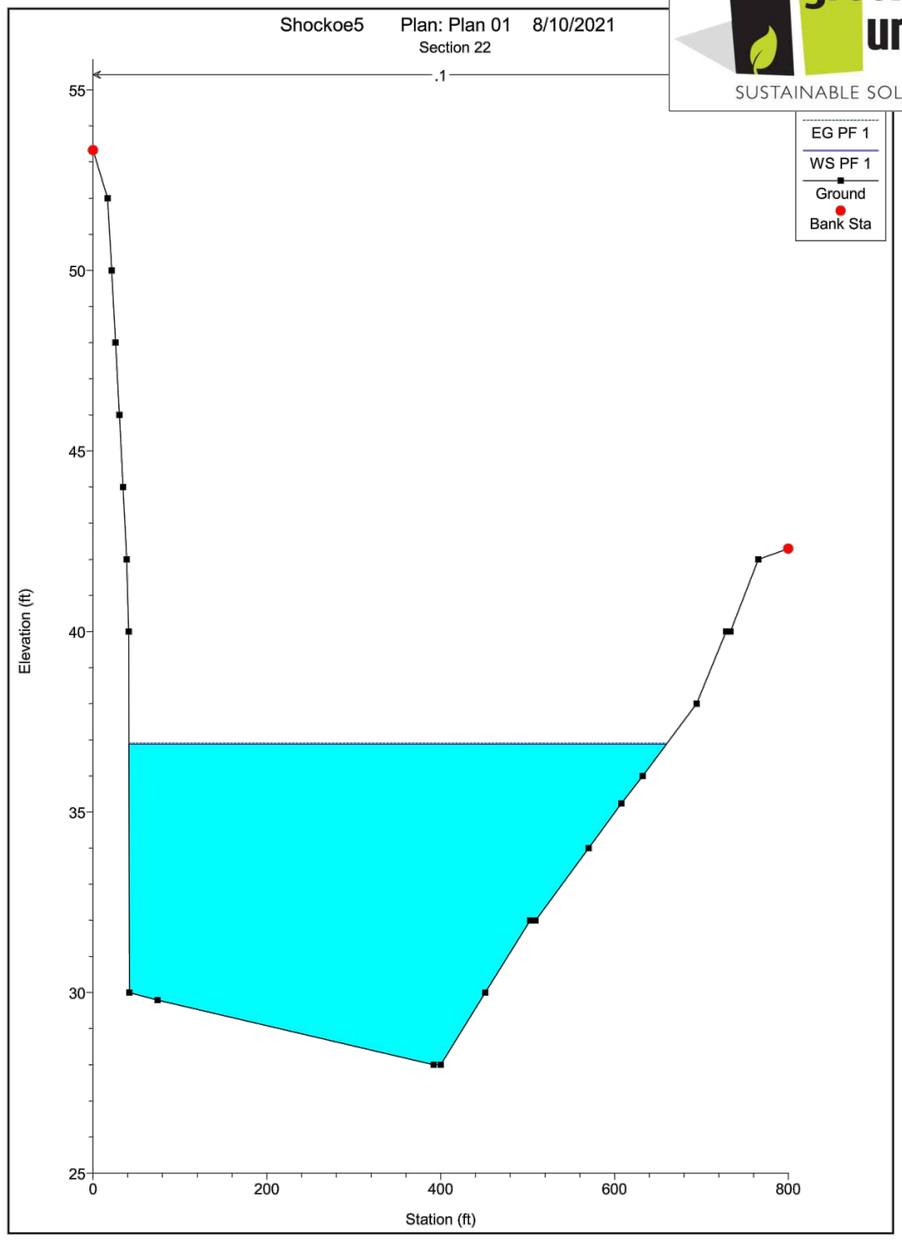

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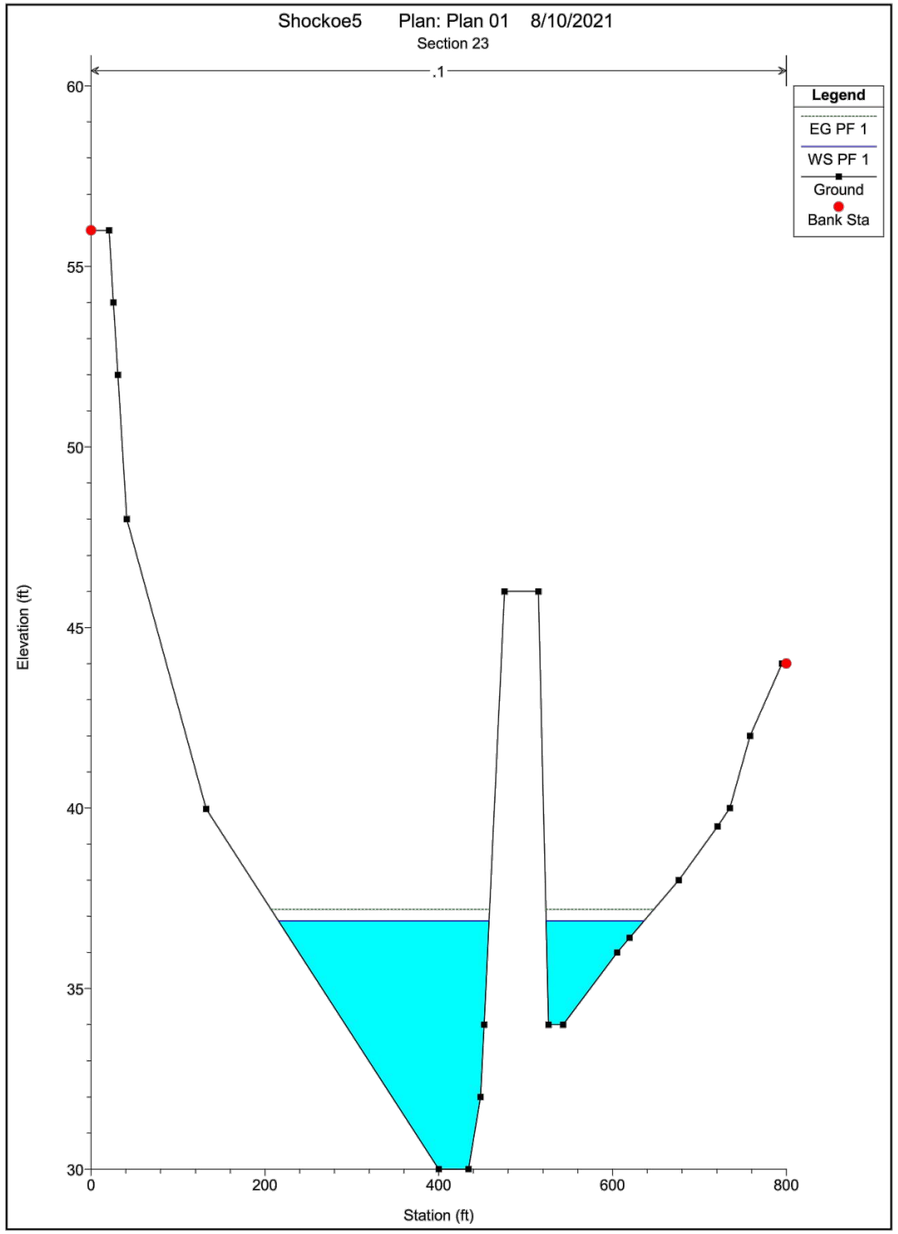


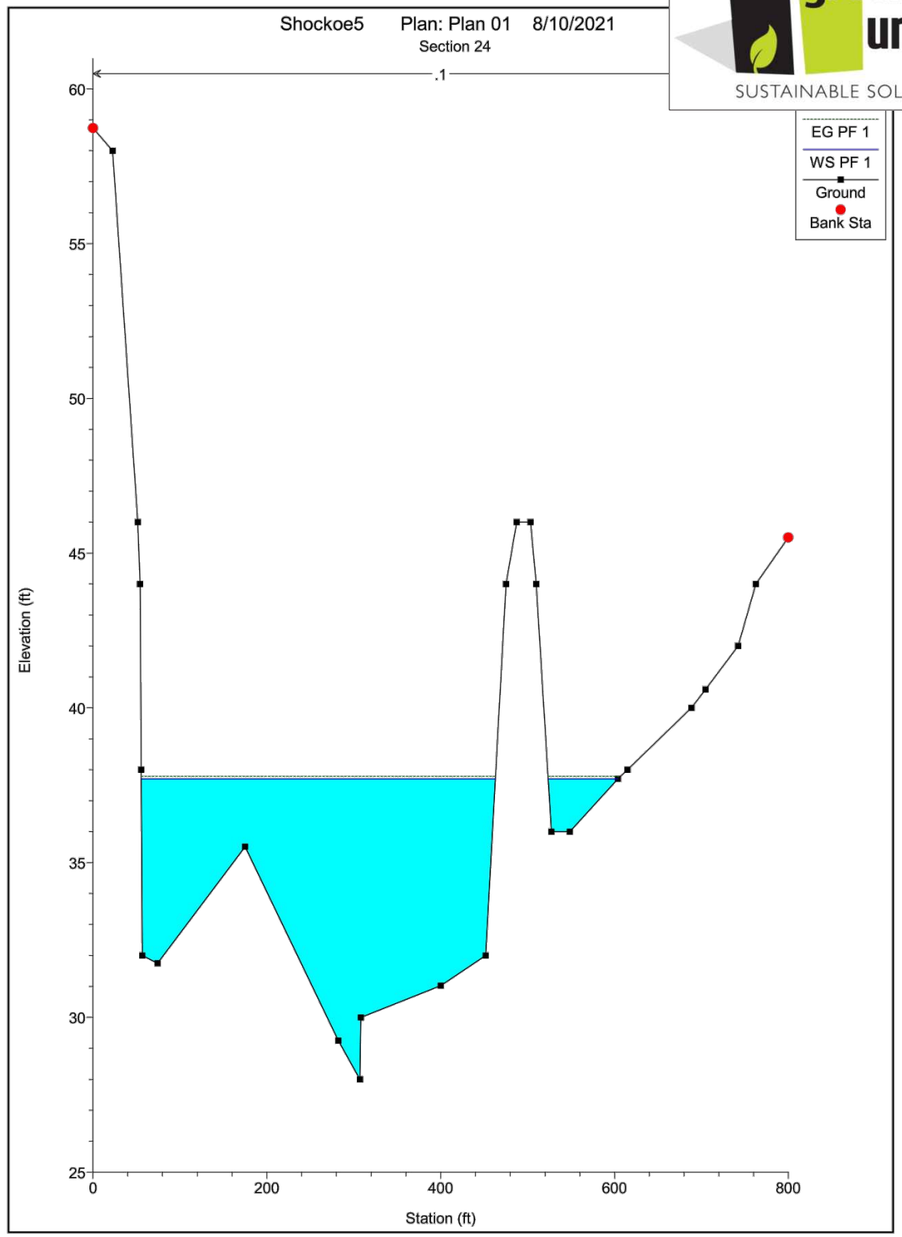

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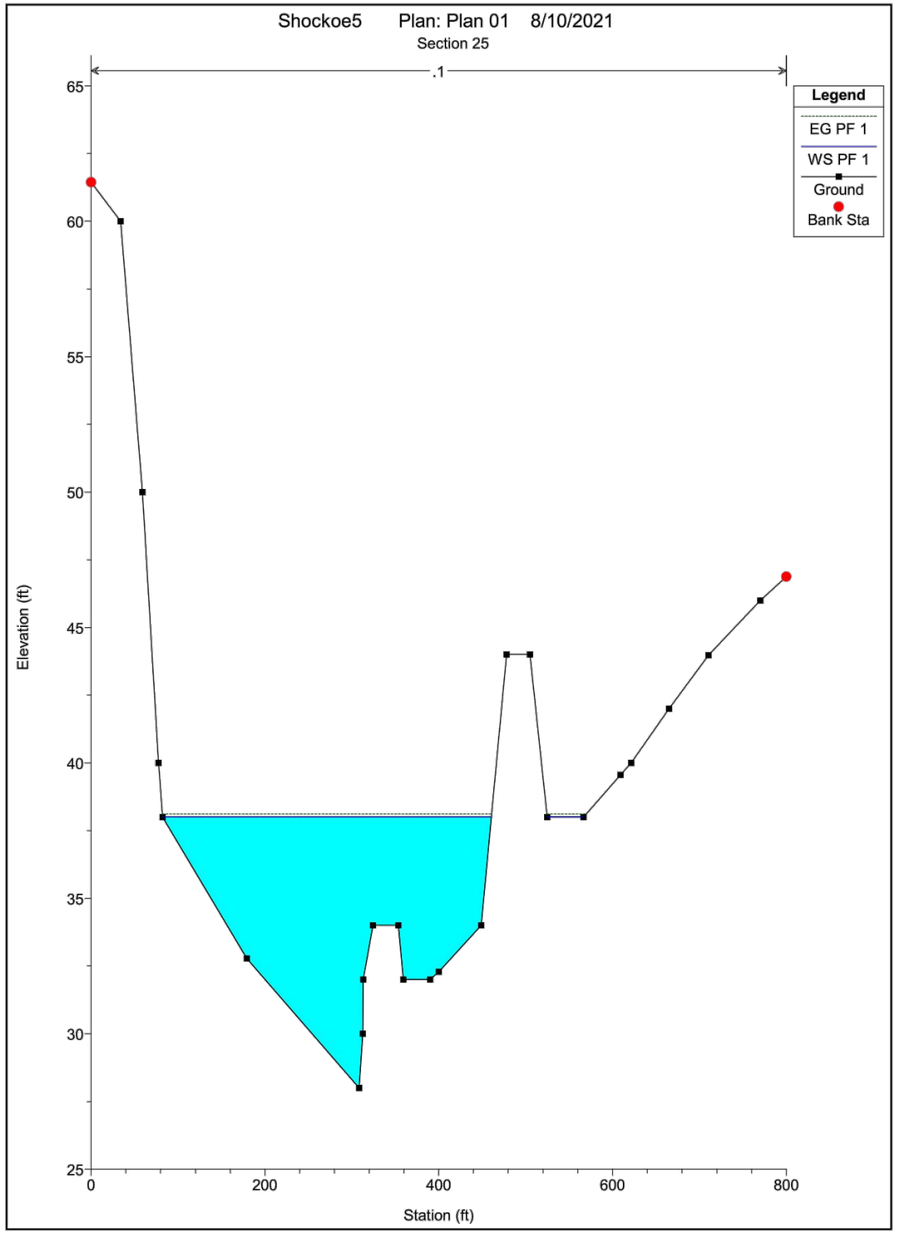


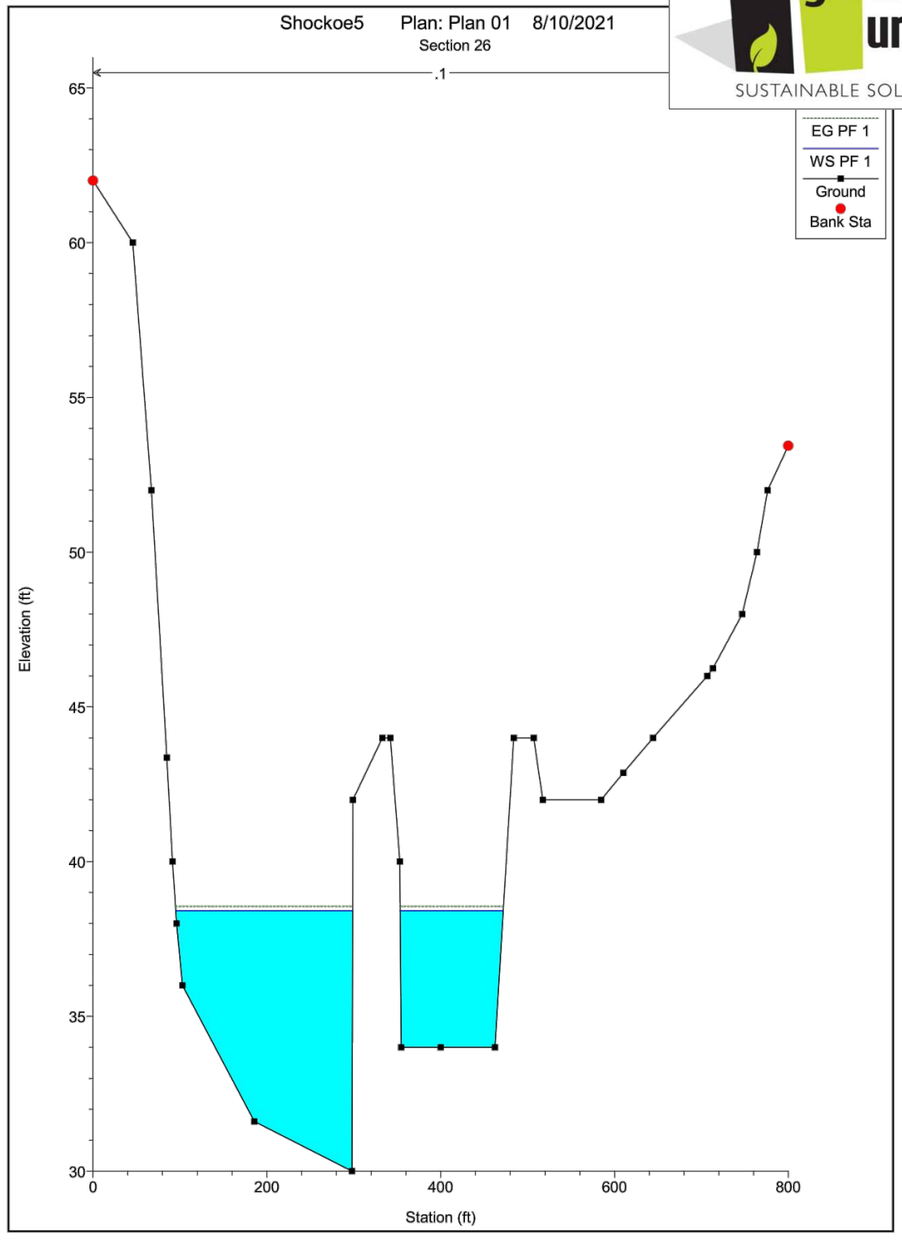

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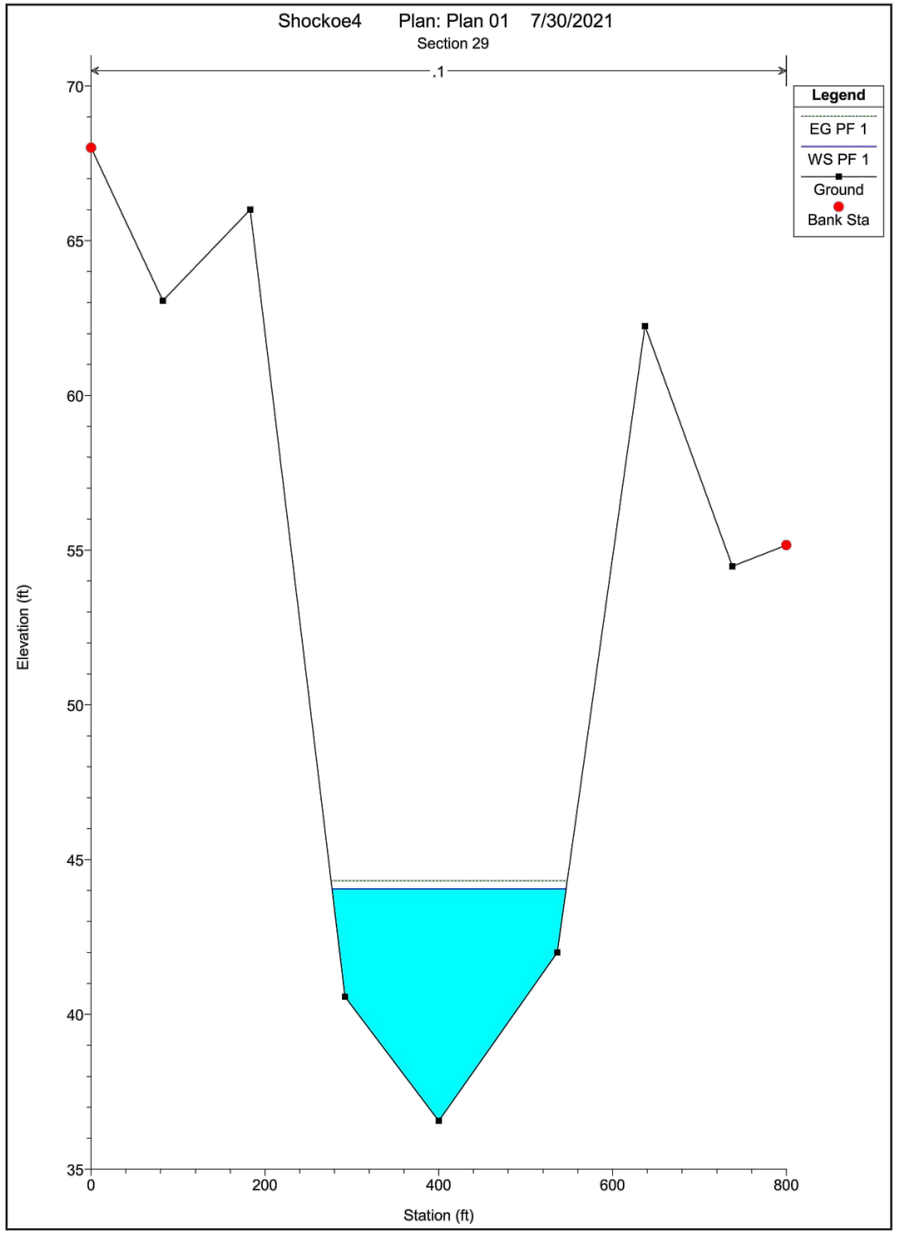


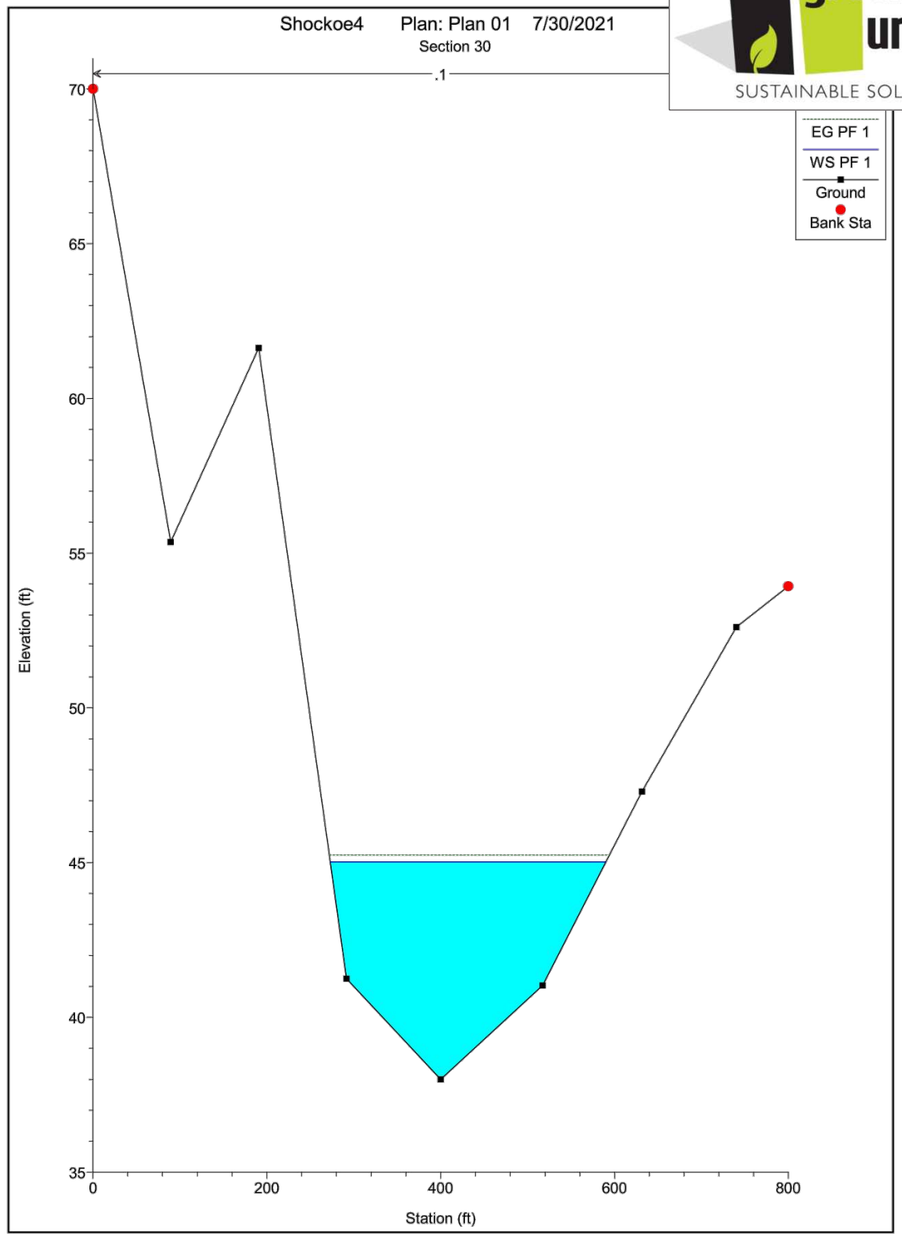

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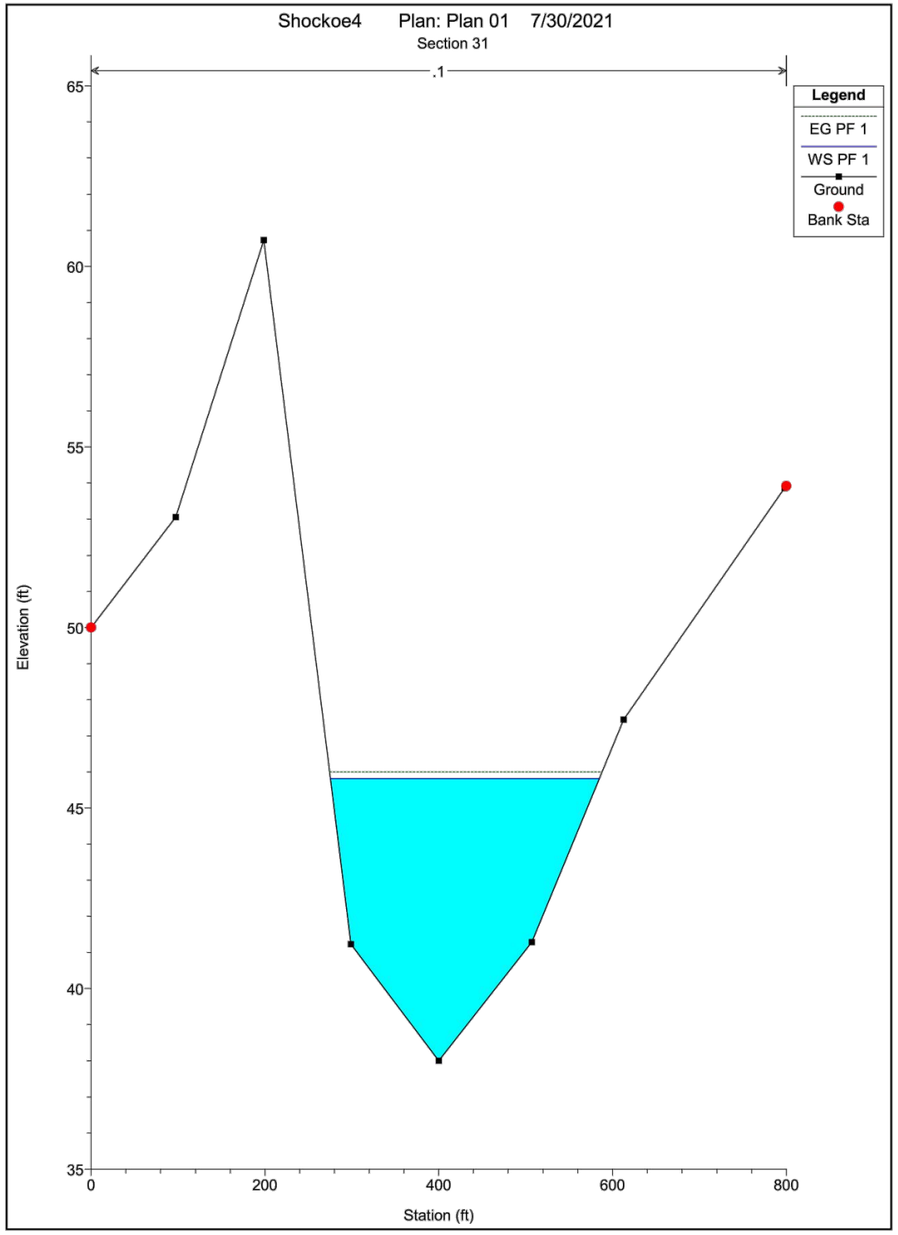


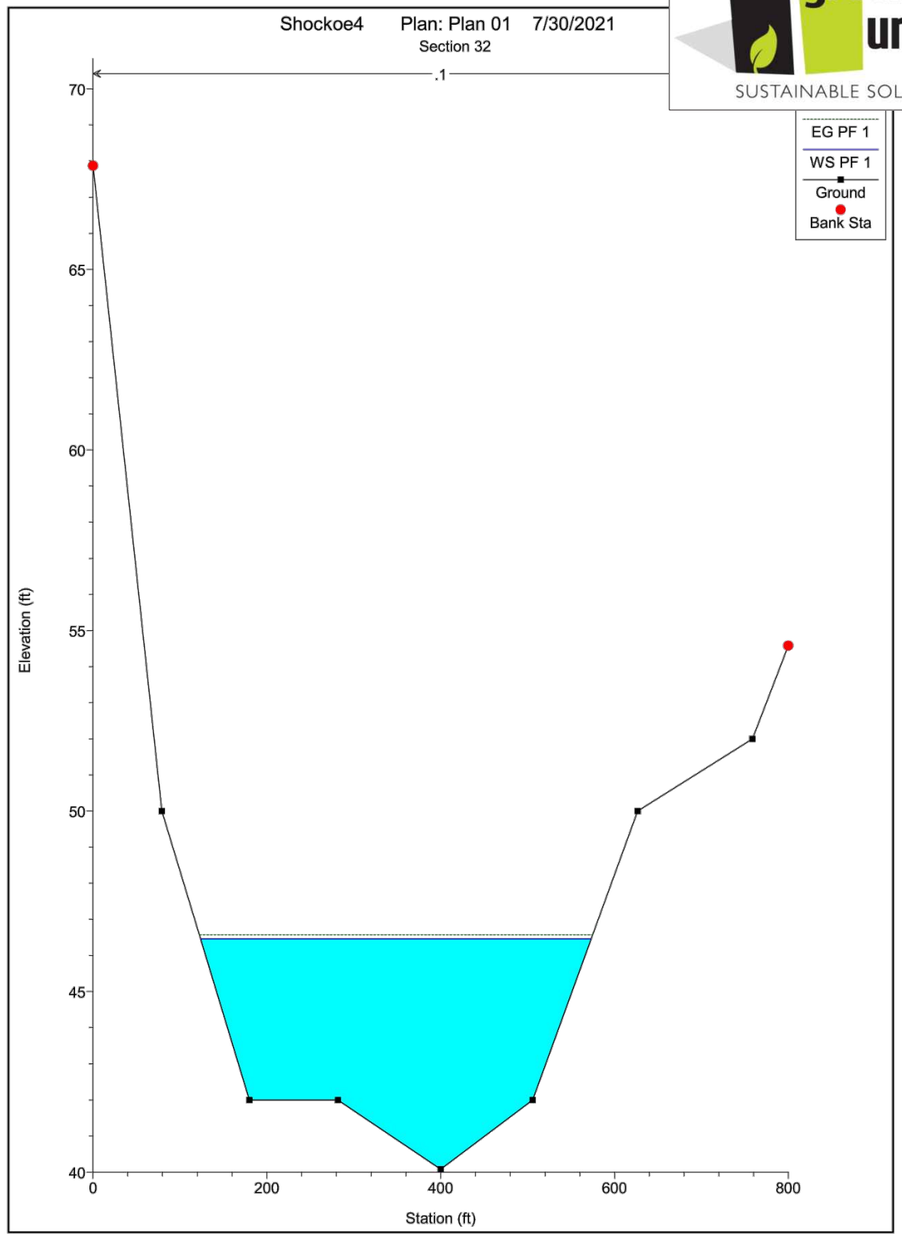

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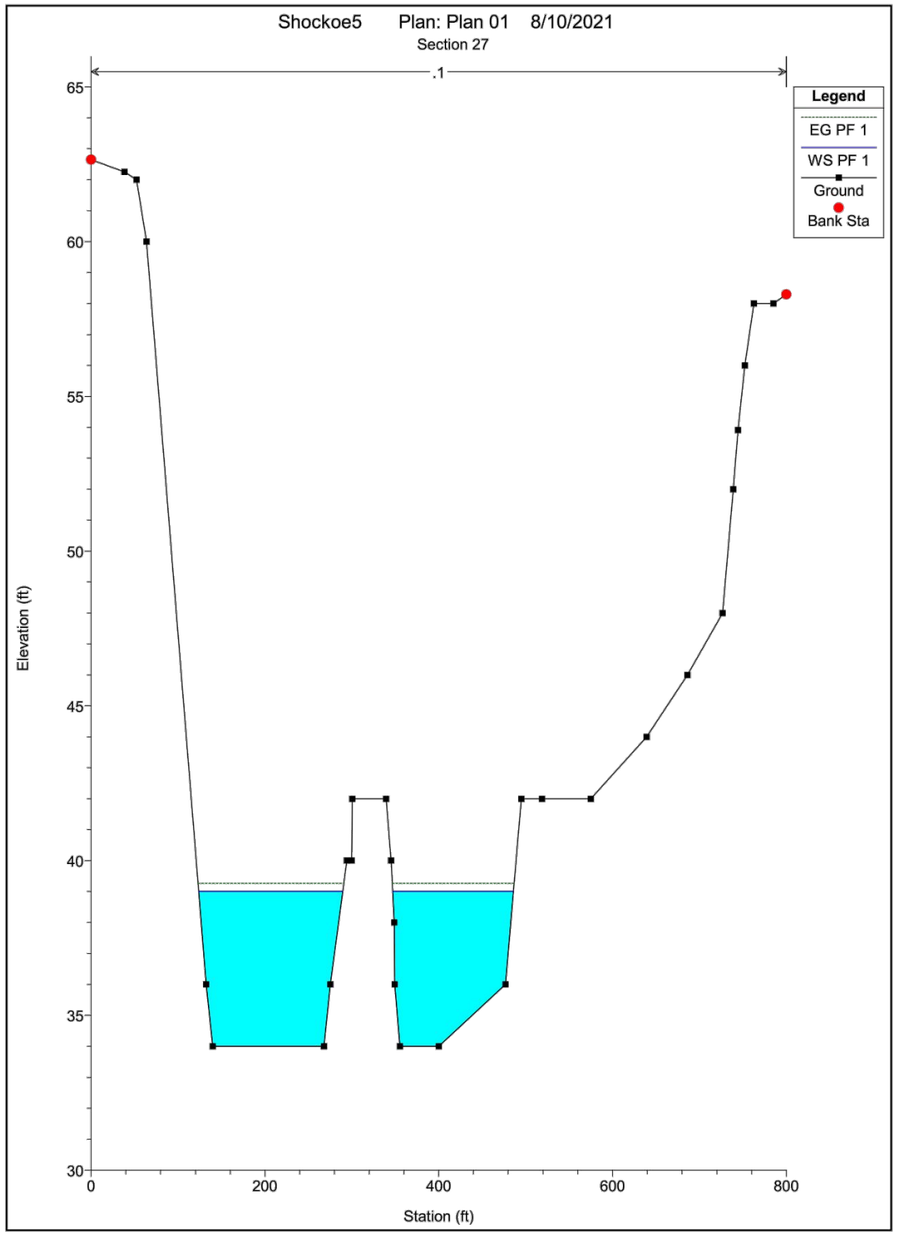


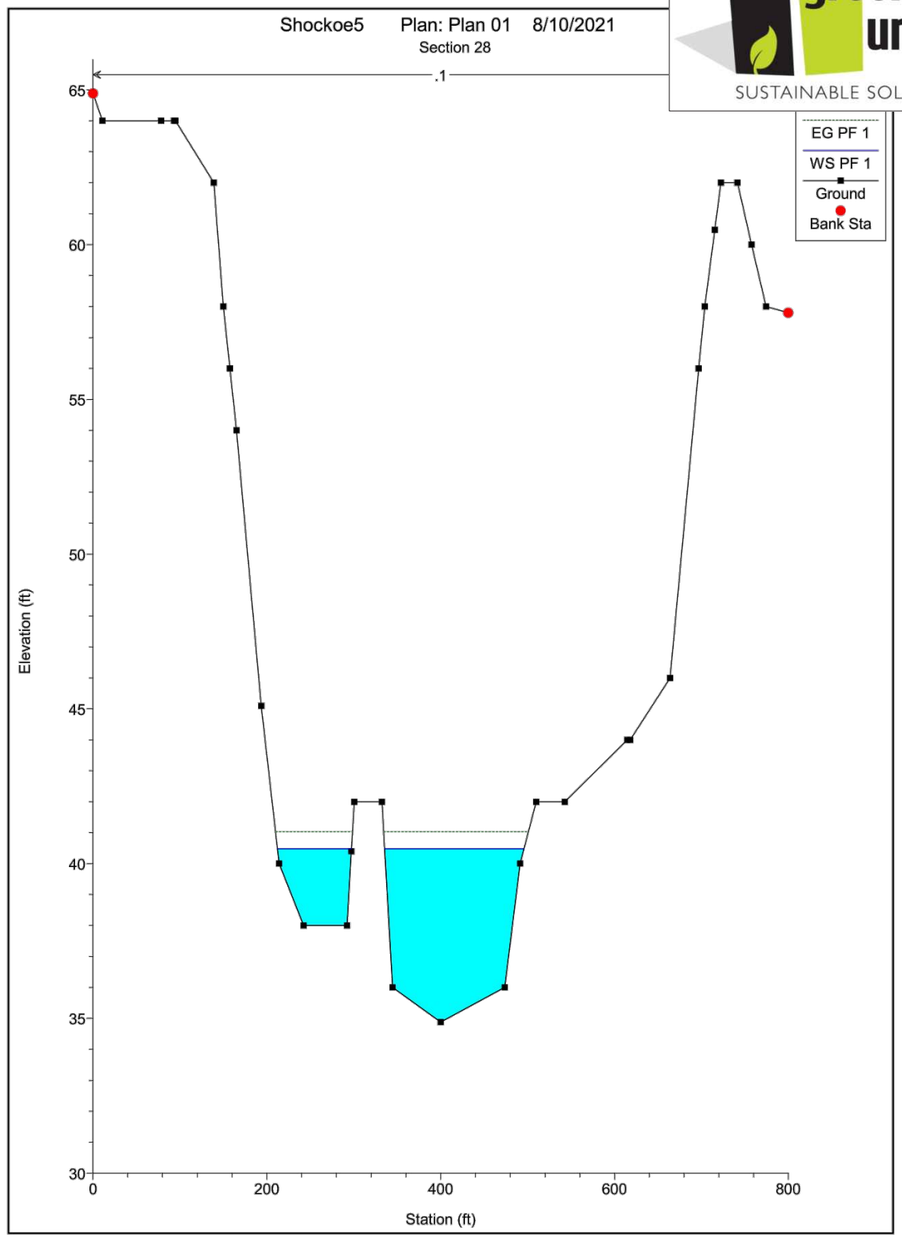

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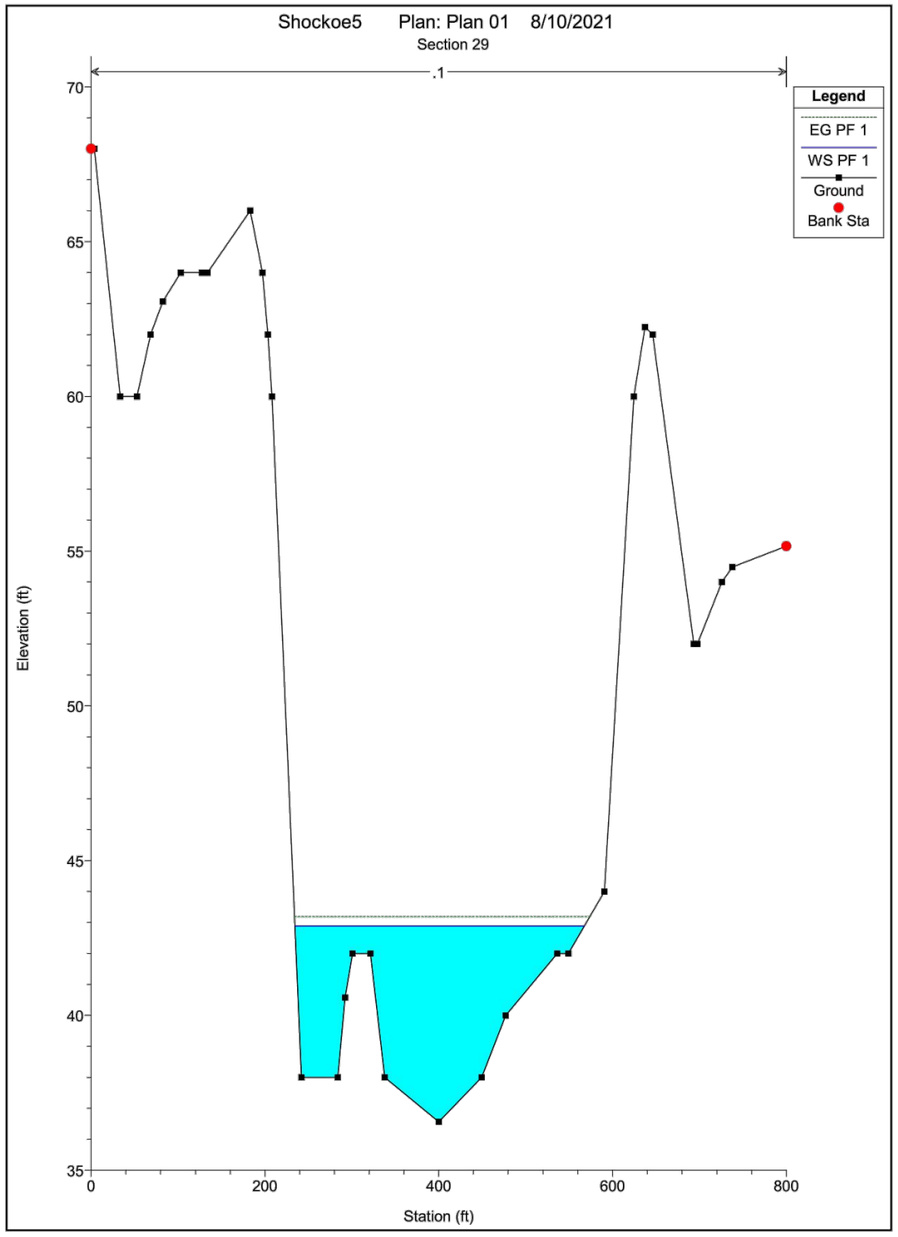


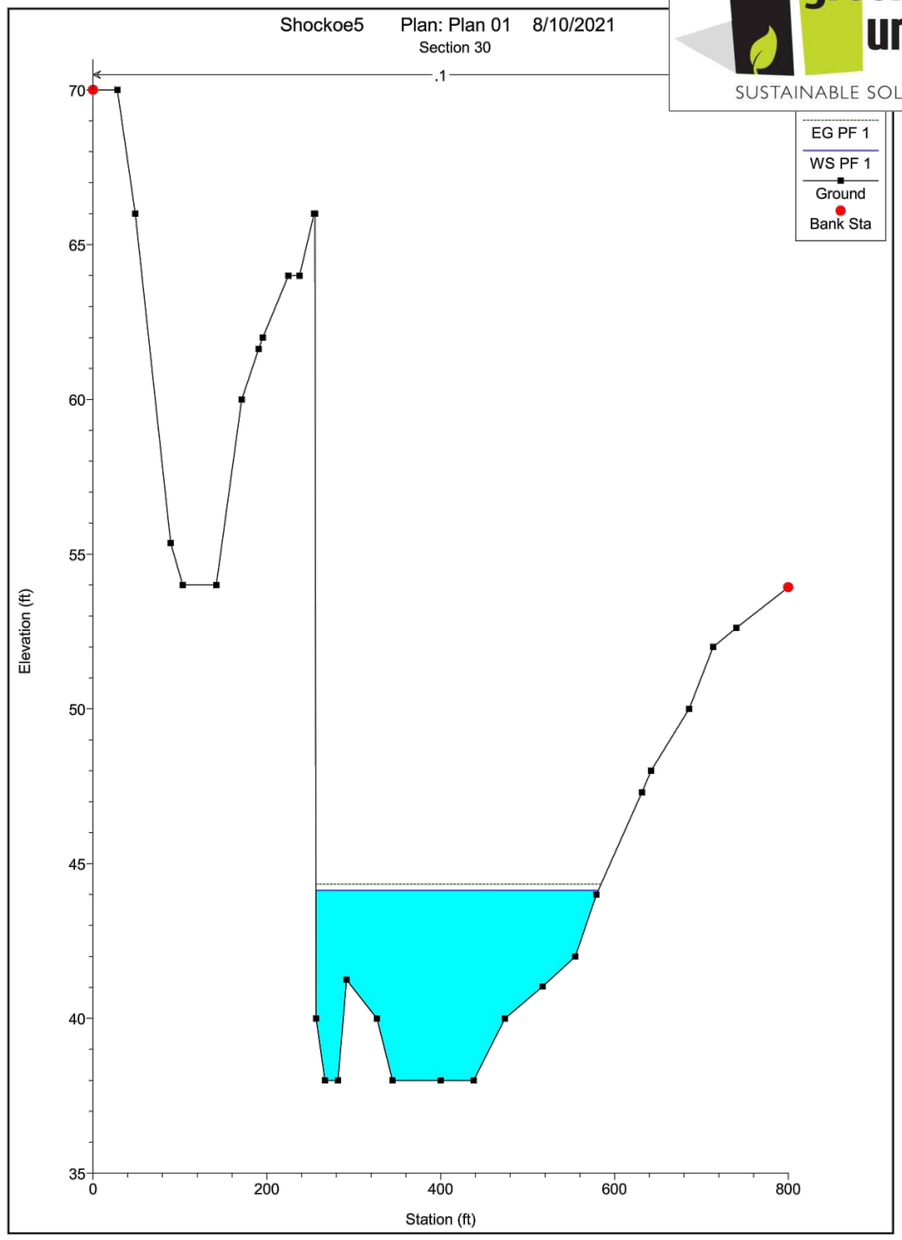

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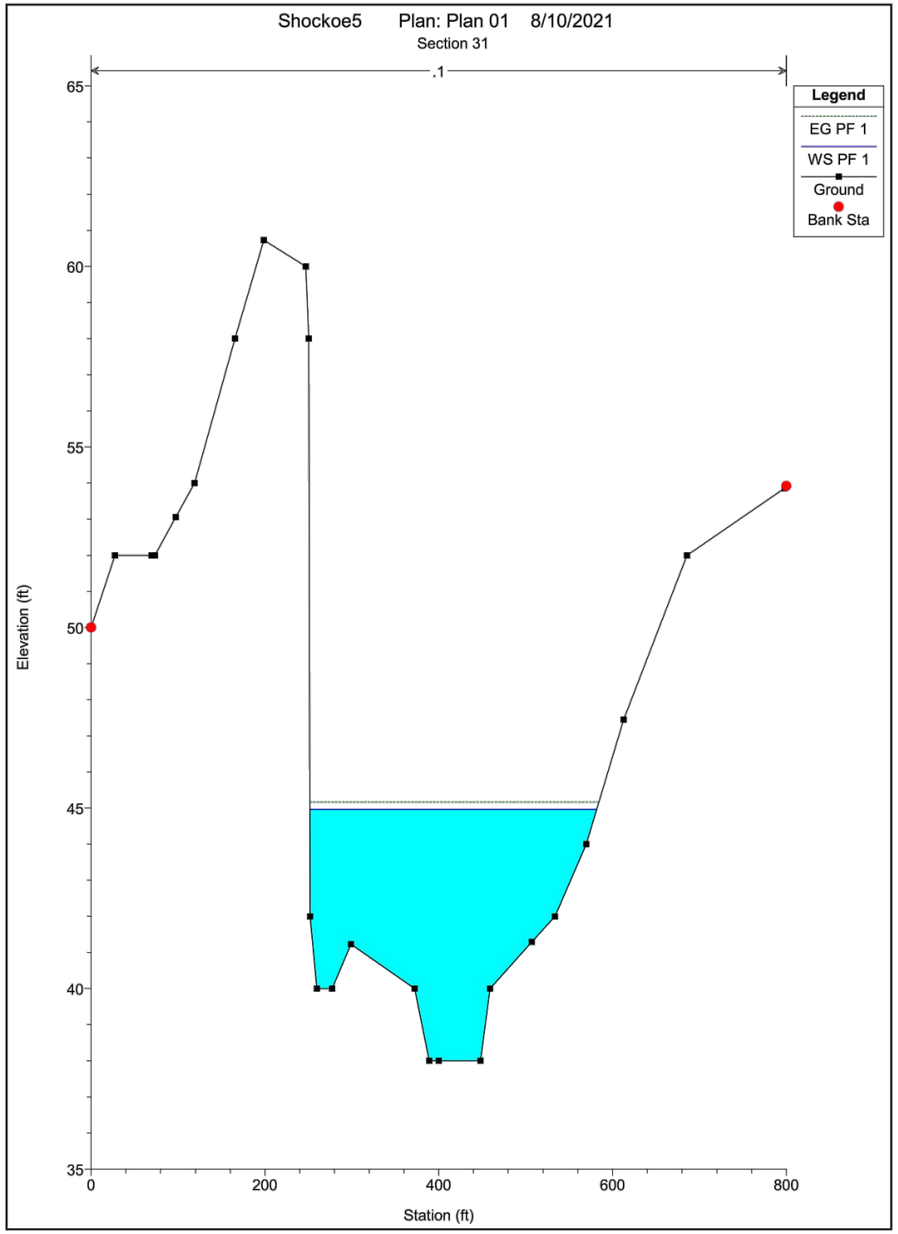


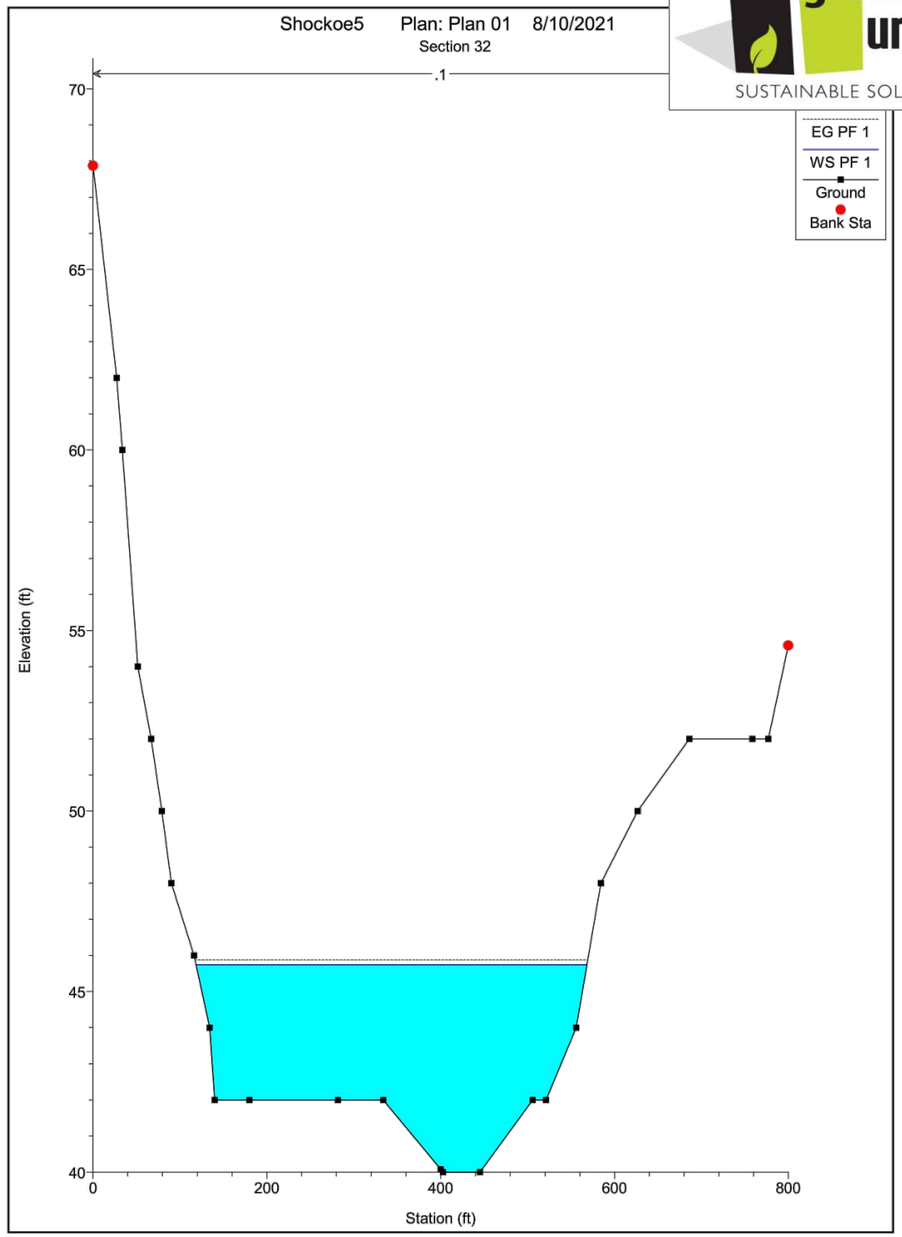

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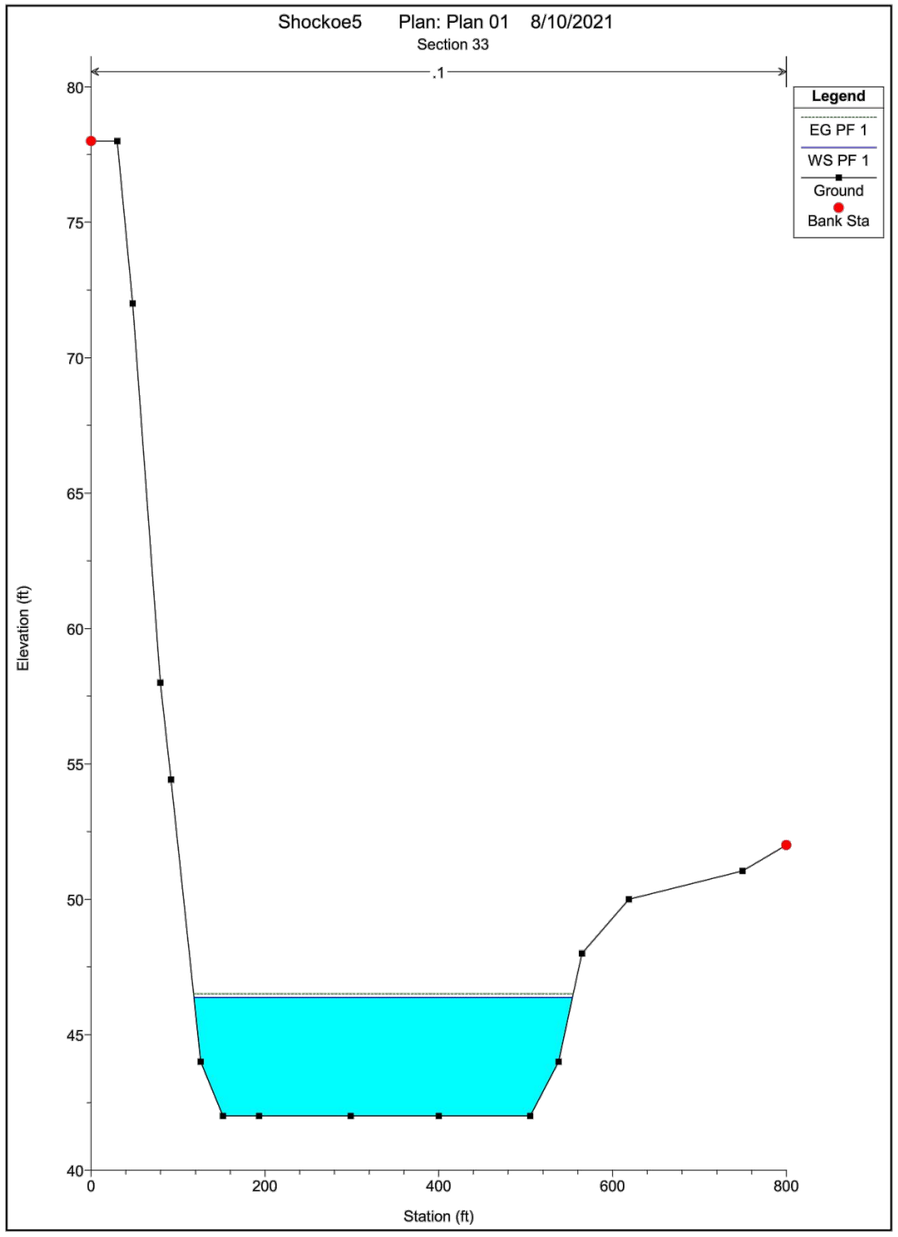
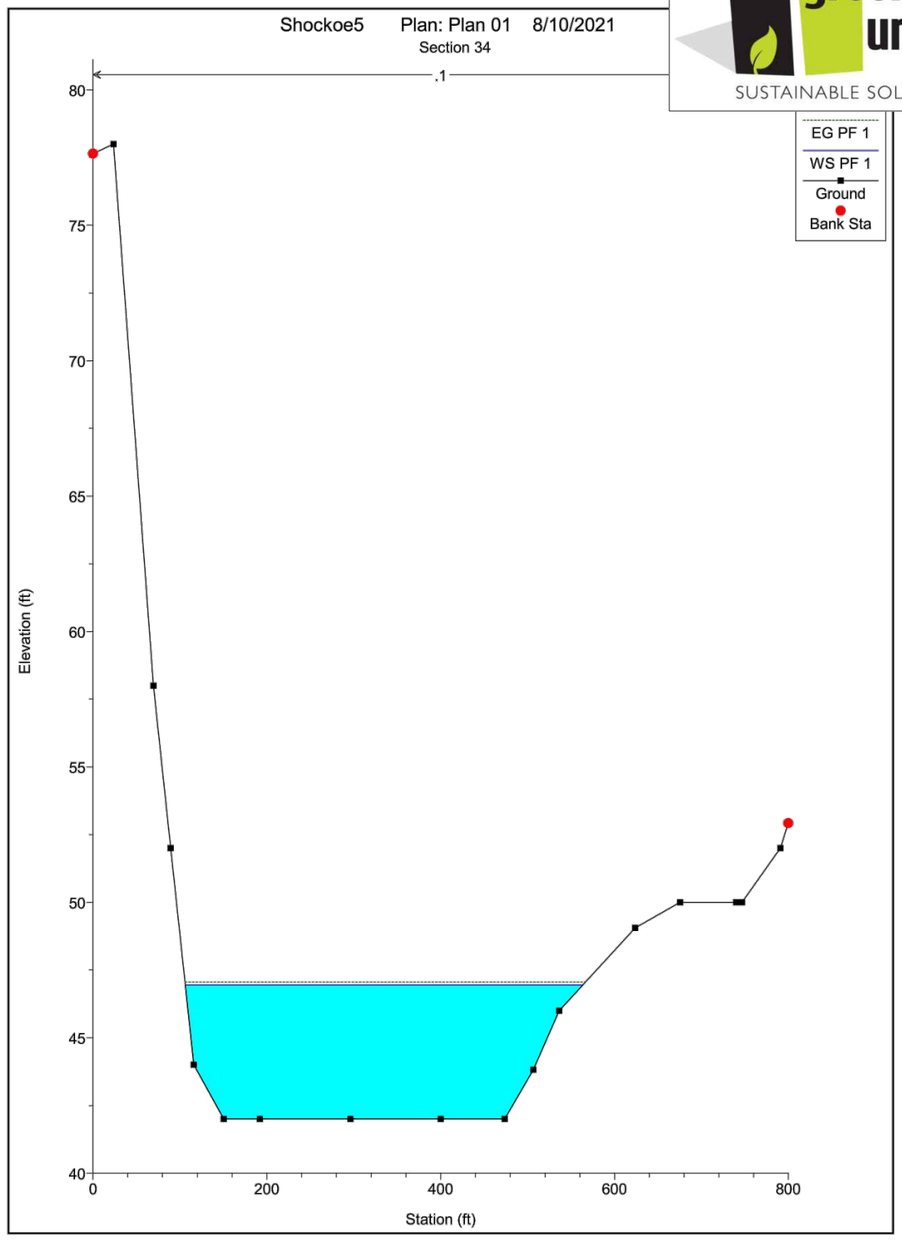


# APPENDIX C
## STORMWATER BMP EXAMPLES

Stormwater Facility Examples

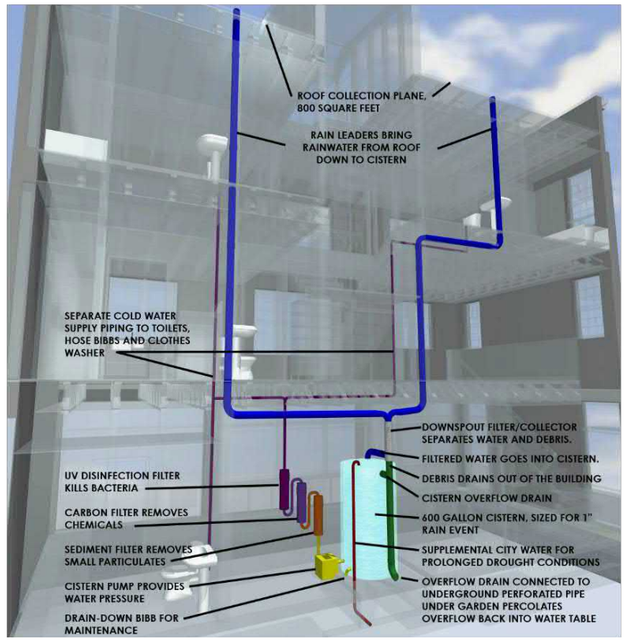
Detention Basin

Green Roof

# APPENDIX C
## STORMWATER BMP EXAMPLES

Pervious Pavement

Cistern



# CIVIL REPORT

## APPENDIX C
### STORMWATER BMP EXAMPLES

Exterior Above-Ground Cistern

NRCS Method – Option 1

10-year 24-hour rainfall
Event (P) 5.07 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-development CN (natural conditions) | 98 | 96 | 98 | 98 |
| Post-development CN | 98 | 79 | 98 | 94 |
| Area (sf) | 116253 | 37474 | 19211 | 172938 |
| Area (sq mile) | 0.00417 | 0.00134 | 0.00069 | 0.00620 |
| Pre-development S (in.) | 0.20 | 0.42 | 0.20 | 0.25 |
| Pre-development Q (in.) | 4.83 | 4.60 | 4.83 | 4.78 |
| Pre-development Q (ft) | 0.40 | 0.38 | 0.40 | 0.40 |
| Post-development S (in.) | 0.20 | 2.66 | 0.20 | 0.65 |
| Post-development Q (in.) | 4.83 | 2.86 | 4.83 | 4.36 |
| Post-development Q (ft) | 0.40 | 0.24 | 0.40 | 0.36 |
| Pre-development runoff (cf/storm) | 46821 | 14372 | 7737 | 68930 |
| BMP retention volume (cf) | 12720 | 13302 | 3560 | 29582 |
| Post-development runoff (cf/storm) | 34101 | 1070 | 4177 | 39348 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Post-Development Peak Discharge (cfs) |
|---|---|---|---|
| Post-Development | 2.73 | 0.00620 | 12.70 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Pre-Construction Peak Discharge (cfs) |
|---|---|---|---|
| Pre-Construction | 4.78 | 0.00620 | 22.25 |

NRCS Method

100-year 24-hour rainfall
Event (P) 8.4 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-project CN (current site conditions) | 98 | 96 | 98 | 98 |
| Post-development CN | 98 | 79 | 98 | 94 |
| Area (sf) | 116253 | 37474 | 19211 | 172938 |
| Area (sq mile) | 0.00417 | 0.00134 | 0.00069 | 0.00620 |
| Pre-project S (in.) | 0.20 | 0.42 | 0.20 | 0.25 |
| Pre-project Q (in.) | 8.16 | 7.92 | 8.16 | 8.11 |
| Pre-project Q (ft) | 0.68 | 0.66 | 0.68 | 0.68 |
| Post-development S (in.) | 0.20 | 2.66 | 0.20 | 0.65 |
| Post-development Q (in.) | 8.16 | 5.88 | 8.16 | 7.67 |
| Post-development Q (ft) | 0.68 | 0.49 | 0.68 | 0.64 |
| Pre-project runoff (cf/storm) | 79052 | 24732 | 13063 | 116848 |
| BMP retention volume (cf) | 12720 | 13302 | 3560 | 29582 |
| Post-development runoff (cf/storm) | 66332 | 11430 | 9503 | 87266 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Post-Development Peak Discharge (cfs) |
|---|---|---|---|
| Post-Development | 6.06 | 0.00620 | 28.17 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Pre-Project Peak Discharge (cfs) |
|---|---|---|---|
| Pre-Project | 8.11 | 0.00620 | 37.72 |

24-hour rainfall events from: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va

DA 1 Detention Basin Volume
Area = 2415 sf
Depth = 6 ft
Volume = 11610 cf

DA 1 Concrete Forebay Volume
Area = 185 sf
Depth = 6 ft
Volume = 1110 cf

DA 2 Green Roof Volume

Area = 30000 sf
Retention = 0.332 cf/sf
Volume = 9960 cf

Total DA 2
13302 cf

DA 2 25,000 gallon cistern
25000 gallons
3342 cf

DA 3 4,450 sf pervious pavement
3560 cf

NRCS Method – Option 2

10-year 24-hour rainfall
Event (P) 5.07 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-development CN (natural conditions) | 98 | 96 | 98 | 98 |
| Post-development CN | 98 | 78 | 98 | 94 |
| Area (sf) | 116887 | 36840 | 19211 | 172938 |
| Area (sq mile) | 0.00419 | 0.00132 | 0.00069 | 0.00620 |
| Pre-development S (in.) | 0.20 | 0.42 | 0.20 | 0.25 |
| Pre-development Q (in.) | 4.83 | 4.60 | 4.83 | 4.78 |
| Pre-development Q (ft) | 0.40 | 0.38 | 0.40 | 0.40 |
| Post-development S (in.) | 0.20 | 2.82 | 0.20 | 0.67 |
| Post-development Q (in.) | 4.83 | 2.77 | 4.83 | 4.35 |
| Post-development Q (ft) | 0.40 | 0.23 | 0.40 | 0.36 |
| Pre-development runoff (cf/storm) | 47077 | 14129 | 7737 | 68943 |
| BMP retention volume (cf) | 34396 | 13302 | 3560 | 51258 |
| Post-development runoff (cf/storm) | 12681 | 827 | 4177 | 17685 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Post-Development Peak Discharge (cfs) |
|---|---|---|---|
| Post-Development | 1.23 | 0.00620 | 5.71 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Pre-Construction Peak Discharge (cfs) |
|---|---|---|---|
| Pre-Construction | 4.78 | 0.00620 | 22.26 |

NRCS Method

100-year 24-hour rainfall
Event (P) 8.4 in.

| | DA 1 | DA 2 | DA 3 | Total |
|---|---|---|---|---|
| Pre-project CN (current site conditions) | 98 | 96 | 98 | 98 |
| Post-development CN | 98 | 78 | 98 | 94 |
| Area (sf) | 116887 | 36840 | 19211 | 172938 |
| Area (sq mile) | 0.00419 | 0.00132 | 0.00069 | 0.00620 |
| Pre-project S (in.) | 0.20 | 0.42 | 0.20 | 0.25 |
| Pre-project Q (in.) | 8.16 | 7.92 | 8.16 | 8.11 |
| Pre-project Q (ft) | 0.68 | 0.66 | 0.68 | 0.68 |
| Post-development S (in.) | 0.20 | 2.82 | 0.20 | 0.67 |
| Post-development Q (in.) | 8.16 | 5.76 | 8.16 | 7.65 |
| Post-development Q (ft) | 0.68 | 0.48 | 0.68 | 0.64 |
| Pre-project runoff (cf/storm) | 79483 | 24314 | 13063 | 116860 |
| BMP retention volume (cf) | 34396 | 13302 | 3560 | 51258 |
| Post-development runoff (cf/storm) | 45087 | 11012 | 9503 | 65602 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Post-Development Peak Discharge (cfs) |
|---|---|---|---|
| Post-Development | 4.55 | 0.00620 | 21.18 |

| Site Peak Discharge | Q (in) | A (sq mi) | Total Site Pre-Project Peak Discharge (cfs) |
|---|---|---|---|
| Pre-Project | 8.11 | 0.00620 | 37.73 |

24-hour rainfall events from: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va

DA 1 Detention Basin Volume
Area = 4326 sf
Depth = 6 ft
Volume = 21636 cf

DA 1 Concrete Forebay Volume
Area = 1323 sf
Depth = 6 ft
Volume = 7938 cf

DA 1 6,028 sf Pervious Pavement
4822 cf

DA 2 Green Roof Volume

Area = 30000 sf
Retention = 0.332 cf/sf
Volume = 9960 cf

Total DA 2
13302 cf

DA 2 25,000 gallon cistern
25000 gallons
3342 cf

DA 3 4,450 sf pervious pavement
3560 cf

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

## Archaeology and Historic Resources Constraints

There are a variety of known and potential archaeological resources in the immediate vicinity of the Lumpkin's Slave Jail/Devil's Half Acre project site. There also are several mapped resources in the area as well. In this section of the report, we review the potential archaeological and historic resources in the area. This research focuses on the study area illustrated in Figure 1. The research was conducted using online data available in the Virginia Department of Historic Resource's (VDHR) V-CRIS online GIS. The historic data were collected during the historic background research for this and other projects.

### The Boundaries of the Site 44HE1053 (the Lumpkin's Jail Site)

The exact location of the site (specifically the areas excavated in 2005 and 2008) is not clear, but the uncertainties over the location of the excavations is not a crippling problem. From the data that have been provided by the City and the previous site excavators, we know within approximately 5-10 feet where the excavations took place. There are several sources of data we have looked at:

- Corners of the property – Four corner points were provided by the City as coordinate data. We believe they reflect the outside corners of three adjacent parcels (#62-64) owned by Robert Lumpkin and that these coordinates represent the first, pre-excavation, estimation of the location of the parcels based on a historic map projection. While these coordinates may be relatively (within 5-10 feet in either direction) accurate, they do not reflect the entirety of Lumpkin's property.
- The 2008 Excavation Area – the 2008 excavations demonstrated that the archaeological site associated with Robert Lumpkin's enterprises extended well beyond the three parcels that were the initial focus of research. Lumpkin owned at minimum parcels #61 to #65 on the attached excerpt of the 1835 Bates map (Figure 2). Some references suggest that Lumpkin owned all of the parcels between Lumpkin's Alley and Shockoe Creek to Broad Street. At minimum, there were at least two parcels (Lot 7 and Lot 8) east of parcels #61-65, between the old bed of Shockoe Creek and the bed of Shockoe Creek during the second and third quarter of the nineteenth century owned by Lumpkin (Figure 3). It is on Lots 7 and 8 that the likely remains of the Lumpkin's Jail building were found in 2008.
- While far from an exact representation of the archaeological excavation in space, the attached overlay from Google Earth provides a sense of where the 2008 excavations were conducted, if the coordinate data shown above are accurate (Figure 4).
- Fieldnote Data – The 2005 and 2008 fieldnotes provided by the City do not appear to provide detailed mapping of the excavation areas to fixed datum points. The 2005 notes include a trench plan that shows a datum on the concrete base of a lamppost. But we are not certain that the referenced lamppost is still in the same location, because the trench plan mapping does not seem to relate to the existing site features.
- Current Approximation of Site Boundaries – The data collected in 2008 indicate that, at minimum, the site boundaries are those illustrated in Figure 5.


Figure 2. Study area

Current

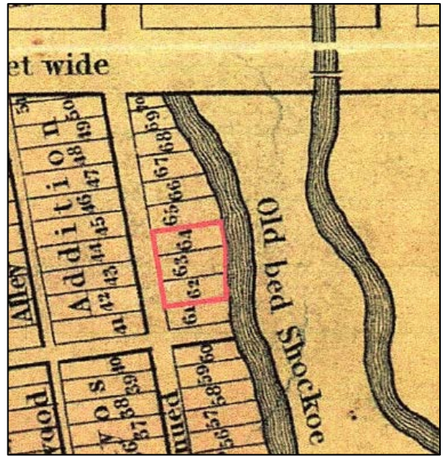



Figure 1, Excerpt from Bates 1835 Map of Richmond

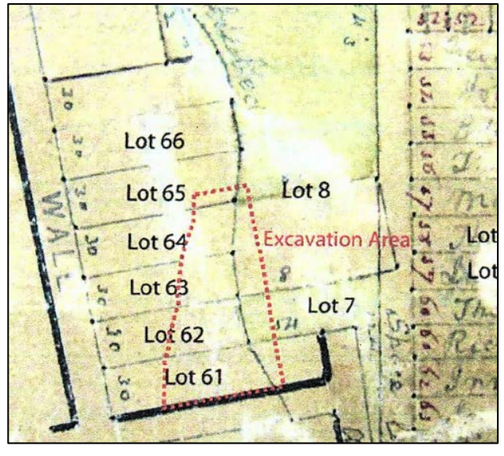



Figure 3. Excerpt from 2010 Excavation Report, Illustrating the Limits of Excavation (in red) on an 1850 parcel plan

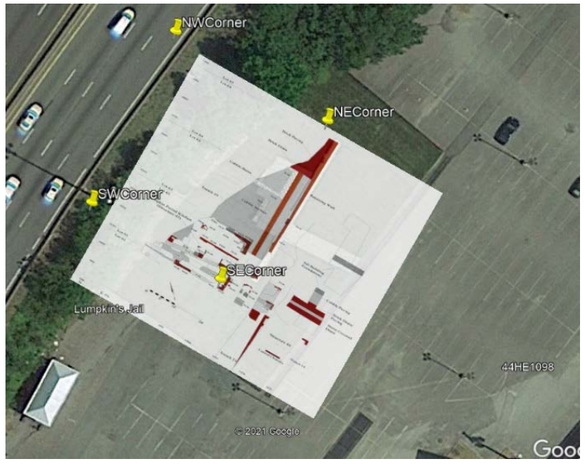



Figure 4. 2008 Excavation Plan Overlaid in Google Earth and Oriented with Coordinate Data

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

- The data collected in 2008 indicate that, at minimum, the site boundaries are those illustrated in Figure 5. However, the archaeological site associated with Robert Lumpkin's enterprises likely extends further to the northeast (to encompass parcels #65 and 66 on the Bates map) and to the south and east (to encompass all of Lots 7 and 8). That said, disturbances from the city's utilities on the north and east sides of the archaeological site likely truncate the archaeological site.

## Other Archaeological Sites

There are six other recorded archaeological sites in the study area (Figure 6). With the exception of the Lumpkin's Jail Site (44HE1053) and the African Burial Ground site (44HE1089), the known sites are of unknown significance and sensitivity. The level of archaeological investigation on each of these sites has been limited. All of them are deemed to be potentially eligible to the National Register of Historic Places. Additional archaeological study of these sites likely would be required by federal or state authorities, if the current project requires regulatory authorization.

## Potential Archaeological Sites

In addition, there may be unrecorded archaeological sites south and west of the Lumpkin's Jail Site, on the other side of what was known as Ross Alley in the mid to late nineteenth century. Ross Alley separated Robert Lumpkin's holdings on Lumpkin's Alley (or Wall Street) from other parcels owned by a number of his contemporaries. Although the historical research on the subject has not been fully vetted, several authors have indicated that Lumpkin's neighbors also were involved in the domestic slave trade, either directly or indirectly. The much referenced "Dutton study" illustrates many other participants in the trade along 15th Street (AKA, Wall Street and Lumpkin's Alley). A best fit overlay of the relevant figure from the Dutton Study shows parcels thought to be connected with the trade, as depicted on the 1835 Bates Map (Figure 7).

Figure 5. Minimum boundaries of the Lumpkin's Slave Jail Site

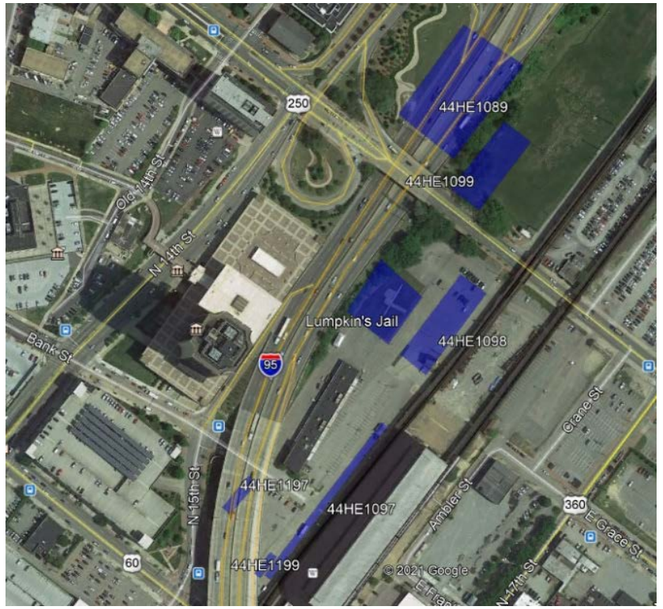



Figure 6. Recorded archaeological sites in the study area

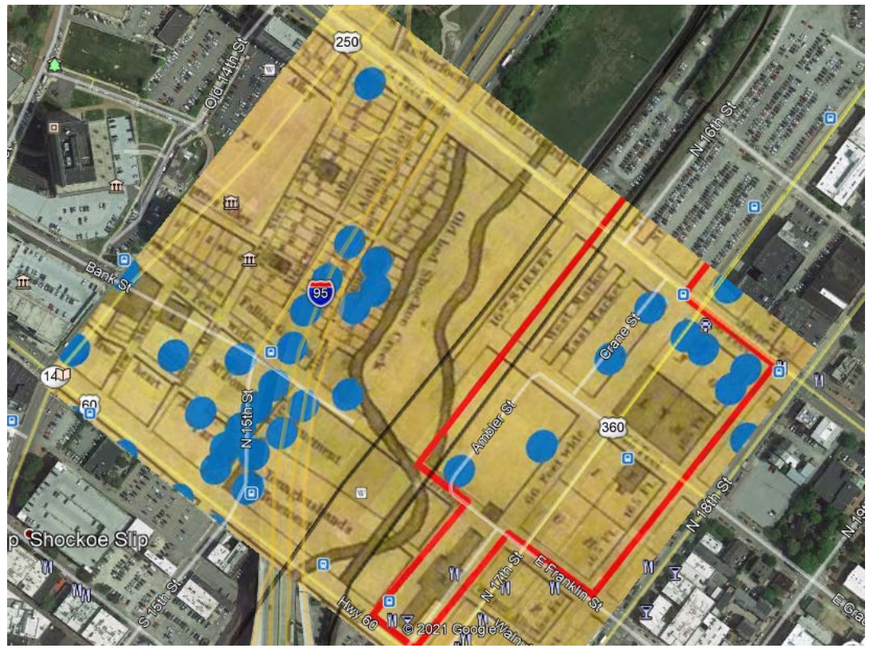



Figure 7. Excerpt from the Figure in the Dutton Study Depicting Properties Active in the Domestic Slave Trade

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

In an effort to understand the location of these other potential slave trade related parcels, we marked each of the possible sites in Google Earth Pro (Figure 8). It should be noted that the blue dots mark the centers of each parcel on the 1835 Bates Map. The area of archaeological sensitivity associated with each parcel would extend further beyond the illustrated dot. Hence, much of the area beneath and around the Seaboard Building should be considered archaeologically sensitive. Figure 9 illustrates these areas of archaeological sensitivity in relationship to the known, mapped archaeological sites.

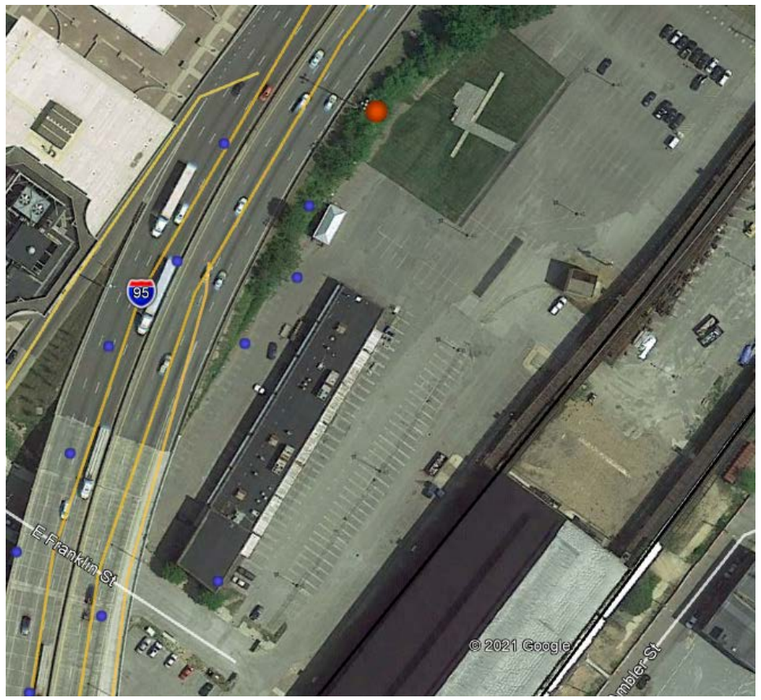



Figure 8. Parcels Depicted in the Dutton Study in the Vicinity of the Lumpkin's Jail Site.


Figure 9. Areas of mapped archaeological sites (in blue) and areas of archaeological sensitivity based on the Dutton Study data (in green)

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

## Built Resources Sites

There are a number of recorded built resources in the study area (Figure 10). The three most notable and relevant built resources are:

- Main Street Station and Trainshed (127-0172), which historically was known as the Seaboard Airline & Chesapeake & Ohio Railroad Depot and as New Union Station. This historic resource is listed on the National Register of Historic Places (NRHP), it is a National Historic Landmark (NHL), and it is a contributing element to the Shockoe Valley & Tobacco Row Historic District.
- Seaboard Building (127-0344-0054), historically known as the Seaboard Air Line Freight Depot. This historic resource is not individually eligible for the NRHP, but it is a contributing element to the Shockoe Valley & Tobacco Row Historic District.
- Shockoe Valley & Tobacco Row Historic District (127-0344). This NRHP-listed historic district encompasses all of the study area. As seen in Figure 11, the historic district's western boundary is Interstate 95, or immediately west of the Lumpkin's Slave Jail archaeological site.

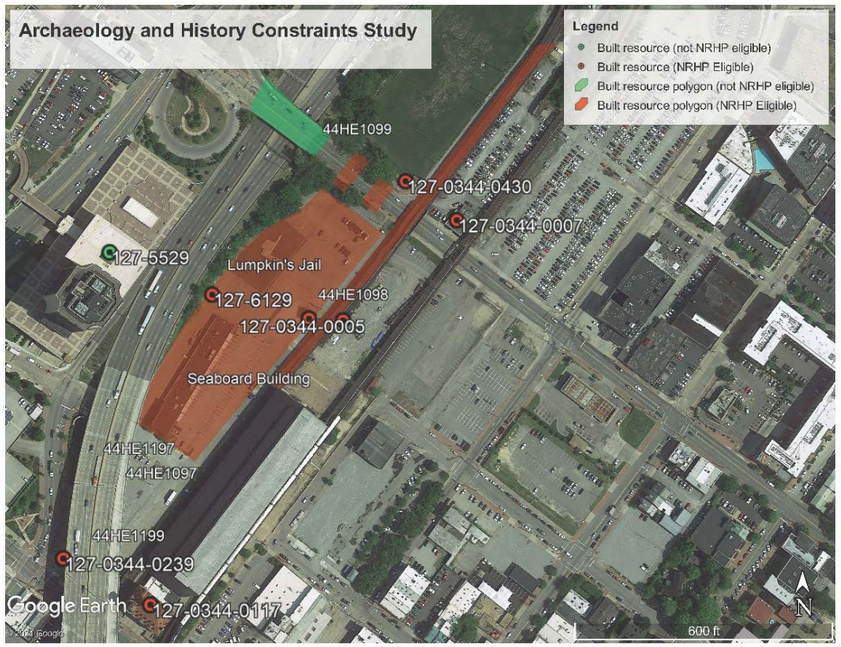



Figure 10. Recorded built resources in and near the study area

Figure 11. The boundaries of the Shockoe Valley & Tobacco Row Historic District

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

## Additional Historic Preservation Data

In order to prepare this feasibility study and to fully understand relevant historic preservation issues, the project team requested in April 2021 copies of all agreement documents, correspondence, and other components of past consultation between the City, the VDHR, and from federal agencies. Specifically, we requested these materials as relevant to the Main Street Station and Trainshed, to the Seaboard Building, and to federal grants received by the City that were used to acquire any of the properties in the study area.

To date, we have received no agreement documents or documentation of previous consultation with VDHR. We have received the following:

- A letter from the Regional Administrator of the Federal Transit Administration to Jeannie Welliver, Project Development Manager with the City of Richmond, dated November 2, 2016. The letter was in response to a query from Ms. Welliver and explains that Section 106 of the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA) would not apply to development of the property containing the Lumpkin's Jail site, if the project was developed using non-federal funding.
- A letter from Marc Holma of VDHR to Kim Chen, of the City's DCAO, dated March 15, 2021. The letter provides an informal review and comments on the conceptual design and site plans for the National Slavery Museum at the Lumpkin's Slave Jail. In the letter, Mr. Holma makes clear that the comments are to provide technical assistance only, as no federal undertaking pertaining to Section 106 of the NHPA had been defined for the project. Mr. Holma's comments currently are relevant only so far as they highlight the need for appropriate consultation between the City, the VDHR, and other potential consulting parties, if Section 106 applies to the project at some future date.
- Two City ordinances (dated to 2000 and 2004) related to the acquisition by the City from the Commonwealth of the parcels that contain the Main Street Station Headhouse (2000) and an additional parcel containing the Seaboard Building (2004). The files appended to these ordinances contain details on the agreements with the Commonwealth. However, the appendix to both ordinances that would have contained the plat of the parcels in question was not included in the transmittal. From our review of the ordinances, there is nothing in either agreement that pertains to historic preservation directly. They state that these agreements represent all of the covenants between the City and the Commonwealth, but:
    - They can be amended through a formal amendment to the agreement signed by all of the relevant parties.
    - The agreements are subject to and contingent upon the approval of FTA.

    So, the ordinances contain no information to indicate that there were agreements between the City and the Commonwealth pertaining to the management of the historic resources that were known to exist (e.g., Main Street Station and Trainshed and the Seaboard Building) included in the property transfers. The need for FTA approval is not clear. Was it because FTA provided the $10,000,000 that the City used to make the two purchases? If so, we still would need to understand if the FTA placed any restrictions on the use and development of the properties acquired with the $10,000,000 grant.

Follow on requests to the City for additional data related to agreement documents or other documentation of consultation has not been forthcoming. Consequently, we are not able to determine if there are any historic preservation-related restrictions on the use of the parcels in the study area.

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

Details Related to Site 44HE1053 (the Lumpkin's Jail Site)

As noted previously, the exact location and horizontal boundaries of the Lumpkin's Jail Site are not currently known, although we believe that we can place most of the excavated features within a 5-10 foot margin of error. We can say with greater certainty that future excavation work at the site can rely on the results of the 2008 excavations for planning. This is especially the case on the site's "upper terrace," where the tavern/kitchen and the cobble courtyard were excavated at a depth of about 7 feet below surface (Figure 12). The results of the 2008 excavations will be a bit less helpful for future excavations on the site's "lower terrace," where the excavators believe they found the foundations of the jail building. This "lower terrace" is at a depth of approximately 14 feet below surface and the excavations there in 2008 were hampered by incoming groundwater (Figure 13). On this lower portion of the site, the excavators identified numerous features and another possible cobble courtyard. These features, however, were sampled minimally. Contemporary photographs that include the site suggest that there be additional structures on this "lower terrace" that were not sampled in 2008.

Another key point that will guide future excavations is that the excavators in 2008 understandably did not sample below any of the features on the "upper terrace" or the "lower terrace." The features that were revealed archaeologically were exposed for documentation and backfilled, in accordance with good practice. From a practical standpoint, this means that future excavators do not know if there are additional archaeological features or archaeological deposits below the features and deposits sampled in 2008. If there are any still buried features or deposits, they might tell us a great deal about the use of the site during its three generations of use. And, perhaps most significantly, buried features and deposits might contain artifacts that can be tied directly to the enslaved people that worked within the site for Robert Lumpkin or were imprisoned within the site.

Figure 13. Excavations on the "lower terrace

# ARCHAEOLOGY & HISTORIC RESOURCES REPORT

Summary - Constraints and Site Knowledge

Our research to date highlights the archaeological sensitivity of the area around the Lumpkin's Slave Jail site. The site itself has been determined eligible to the NRHP. Previous archaeological studies have revealed several additional archaeological sites in the study area adjacent to Main Street Station and the Seaboard Building. And, historic and cartographic data suggest that there may be additional contemporary slave trade-related archaeological sites nearby. These additional sites would have been located along historic Wall Street, the epicenter of the domestic slave trade in Richmond. If these sites exist, they may also be well preserved, like Lumpkin's Jail archaeological site, because they are deeply buried under the Seaboard Building and under the parking lots in the study area.

We believe that additional archaeological data are critically needed to guide the design of any interpretive venue that incorporates the site into the interpretation. We need to better know the boundaries of the site, so that engineering features (i.e., groundwater cutoff walls) can be designed and planned to minimize archaeological impacts. We need to have better data on how much water infiltrates the site's "lower terrace" once archaeological features are exposed. And we need to know if the site contains deeper archaeological features and deposits that relate to its use by the Lumpkins and their predecessors. Any yet to be discovered features and deposits might provide very important data and artifacts related to the site's use prior to the Civil War.

We know already that future excavations of the site will have challenges related to groundwater infiltration, the abnormal depth of the excavations, and the related health and safety risks that come from archaeological work under these conditions. While not common challenges, archaeologists have addressed these and other issues for decades at sites around the world. We will discuss these issues elsewhere in this report.

The study area also is sensitive from a historic resource and preservation planning perspective. It includes Main Street Station and the Trainshed, the Seaboard Building, and falls within the Shockoe Valley & Tobacco Row Historic District. It is likely that the Lumpkin's Jail archaeological site, as well as any other contemporary slave trade-related archaeological sites in the area, would be judged to be contributing components to the historic district. Future consultation with appropriate regulators and stakeholders will help inform how the current project can be built within this sensitive setting.

# ARCHAEOLOGICAL PROTECTIVE MEASURES

# ARCHAEOLOGICAL PROTECTIVE MEASURES

## Archaeological Protective Measures

Archaeological sites require protective measures during excavation and in instances where there is a desire to preserve the site and interpret it *in situ*. Given the environmental conditions within the project area as well as the long-term project goals to potential preserve the Lumpkin's Jail Site for public viewing, Gray & Pape has been asked to identify steps needed to protect and manage the site to allow for temporary re-excavation as well as for permeant exposure to facilitate interpretation. Permanent exposure approaches considered include being left exposed to the elements, partially protected under a pavilion, or within a permanently enclosed space.

### Short Term Protections During Excavation

Shoring and dewatering during excavation

In low lying areas, areas with high water tables, and along waterways, archaeologists often need to use a variety of methods to allow safe, deep excavation and to remove water in order to make archaeological excavation feasible. Such is the case at the Lumpkin's Jail site, where the 2008 excavations needed to contend with excavations to a depth of up to 14 feet and where groundwater seriously hampered work on the "lower terrace." Future excavations need to address these issues. Fortunately, archaeologists have an extensive tool kit to address these challenges.

Standard excavation using safety practices, such as the stepping of excavation walls, disposal of spoil, and regular monitoring of walls for collapse need to be planned for, engineered, and maintained throughout the course of a deep (generally more than 4 feet) excavation. Stepped excavations, such as were used during the excavation in 2008, require that a much larger area be opened to allow for the archaeologists to reach significant depths, often more than twice the distance along the margins of the excavations as the intended depth of the excavations.

During previous excavations at the Lumpkin's Jail site, two different approaches were employed to support the deep excavations. In Figure 1, we can see the use of a trench box during the 2006 initial testing of the site. Trench boxes allow for excavations without risk of wall collapse, but they greatly limit the amount of area that can be exposed and sampled through excavation. They also make it almost impossible to examine soil profiles, an important aspect of site recordation. In 2008, with aa goal of opening a large percentage of the site for excavation, the excavation team from James River Institute for Archaeology worked with the City to have a contractor step back the side walls. This approach was successful in allowing for a broad exposure of the site's "upper terrace" at a depth of approximately 7 feet below surface. But as can be seen in this photo, the area available for excavation was increasingly limited as the excavations progressed to the "lower terrace." This is one of the great limitations of a stepped excavation; the area available at significant depths is greatly constrained, unless the archaeologists are prepared to expose a very large area at the surface. The other significant challenge to stepped excavation is that it increases the challenge of managing spoil dirt. All that stepped back soil needs to be placed somewhere. Removing from the site completely is not a useful approach, if the site will be backfilled after the excavations.

One alternative to trench boxes and stepped excavations is a designed shoring system (Figure 3). Shoring systems are commonly designed to project specifications, allowing for greater control on how the excavations can interface with the site, its profiles. Shoring systems also can provide a partial barrier to groundwater infiltration. While more expensive, they are safe, limit groundwater infiltration, and reduce the challenges associated with spoils management.

Figure 1. Use of a trench box during the 2006 initial testing of the site.

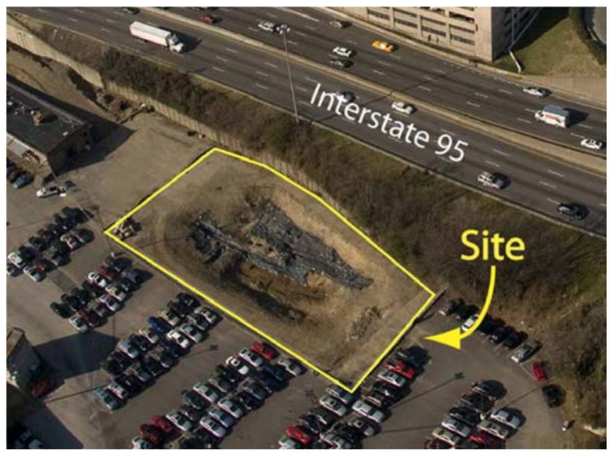



Figure 2. Stepped back site exposure during the 2008 excavations.

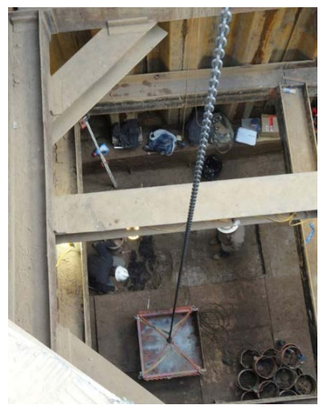


Figure 3. Use of a designed, engineered shoring system during Gray & Pape's excavations at Willows Island, WV.

# ARCHAEOLOGICAL PROTECTIVE MEASURES

The presence of infiltrating groundwater in the Lumpkin's Jail site is fully understandable, given its depth of approximately 14 feet below surface and its location on the buried floodplain of Shockoe Creek. Any future excavations of the site will need to manage the presence of groundwater in the short term. If the site is to be exposed for interpretation, groundwater management likely will be a significant engineering challenge. In the short term, during the actual excavations, groundwater may be managed through the use of a sump trench and pumps to continually draw water away from the excavation area. A smaller sump trench can be placed adjacent to and lower than the primary area of excavation and separated by a narrow baulk. Using this approach, the larger, higher trench area can be excavated using traditional dry soil methods (although conditions may still be "damp"). The limits of this approach are reached when the amount of water expelled by the pumps is equaled by the water entering the excavation (Hernandez 2017). In some wet sites, excavation test units are excavated in tandem with narrow drainage trenches, draining water away from the test unit (Croes et al. 2007). In those instances where a sump trench or drainage trench are used, it is important to note that the areas of the sump or drainage trench need to be examined archaeologically, with excavated soils for artifacts. Some archaeologists have found that a standard Shop Vac can be used to remove water from smaller areas, usually in conjunction with other methods. This approach has the advantage of using a tool that is readily available and easy to use (Austin 2012).

Without proper groundwater controls, excavations may flood, excavation walls can collapse due to seepage and water pressure, and groundwater uplift may cause the floors of an excavation area to heave causing damage to archaeological features (Calin et al. 2017). A well point drainage system can be used in areas with a high-water table to pull water from the target area and dry out water-logged sediments. Perforated pipes are driven into the ground, connected in sequence and in turn connected to a pump. The number of well points and pumps required vary based on the water table level and size of the project area (Ehrenhard 1979; Lynch 2008). At other archaeological sites a horizontal dewatering system has been implemented (Marquardt and Walker 2001). In this system a horizontal drainpipe connected to a pump is installed surrounding the target area. The primary advantage to the horizontal system versus a well point system is that most of the system is underground, leaving the surface relatively obstacle free for the movement of machine and material.

An example of how groundwater issues can be managed during archaeological excavations can be seen in Gray & Pape's work in the Port of Galveston in search of the remains of the Republic of Texas' steamship-of-war, the *Zavala*. The site's location in the port made water infiltration into the excavation areas a key hurdle. The study area consisted entirely of land built up from unconsolidated fill material and was located adjacent to Galveston Bay. Water flooded into any archaeological test unit more than 3 feet in depth. Dewatering of the archaeologists' deep test pits, which were up to 23 feet in depth, was accomplished using a single 4-inch, diesel powered water pump. The pump head was placed inside the excavation pit, the pump itself located away from the excavation and water was discharged directly back into the harbor. The method allowed for the identification and recording of earlier harbor works, buried on meters of fill used to construct the modern harbor, that otherwise would not have been accessible. Unfortunately, the remains of the *Zavala* were not found during the study.

### Flood protections

Given that the project is located in the Shockoe Bottom area, a low-lying area vulnerable to localized flooding, flood protection strategies also should be incorporated into the excavation plan. Temporary flood protections during excavation can be as simple as the construction of sandbag barriers or may include a more substantial water filled dam or bladder surrounding the excavation site. These systems work best against low level flooding of limited duration. In any temporary system some level of leakage should be anticipated, with pumps available to be used to remove water from behind the barrier. Whatever temporary flood protection system is selected, the materials required to implement that system should be stored on site. If stored off site, a plan put in place to allow proper deployment in the even of a flood event (Eggleston et al. 2021). Any protective flood barrier should be deployed at an appropriate distance from the exposed site so that the weight of both the barrier and flood waters do not compromise the site walls. If recovered artifacts and excavation records are to be stored on site during the excavation, these items should also be incorporated in the development of the flood protection plan.

### Soil and feature degradation

The methods employed for the temporary protection of archaeological features during excavation and recording depend on the nature and condition of the feature in question. If archaeological remains require isolation from construction activities, such as dewatering, a containment system may be installed. Containment systems entail the use of a membrane or barrier around the archaeological material. Barrier types include geotextiles, made of synthetic fabrics, which can effectively protect the remains (Davis et al. 2004). A temporary shelter also may be constructed, which would provide mitigation against the effects of direct sunlight.

### Monitoring system requirements

Monitoring during excavation should primarily consist of visual inspection of all exposed archaeological features and wall exposures at regular predetermined intervals. The results of these visual inspections should be recorded on standardized forms and supplemented with regular photo documentation. This baseline data will allow archaeologists to regularly determine if any archaeological feature or exposure is experiencing negative environmental effects. Early recognition is a critical factor in being able to properly stabilize impacted archaeological features (Versar, Inc. 2011).

# ARCHAEOLOGICAL PROTECTIVE MEASURES

## Long Term Protections Supporting Permanent Exposure

### Dewatering

Depending on the environmental conditions and structure design, long term dewatering options may be required to prevent groundwater impacts to the archaeological site and protective structure. Long term solutions often involve exclusionary measures as well as the extractive measures discussed above. Exclusionary methods include the installation of sheet pilings, diaphragm walls, grouting, and slurry walls. Not all methods are suitable for all soil and environmental conditions, for example slurry walls often are not compatible with clayey soils. From an archaeological perspective sheet piling is often the preferred option as it typically results in less ground disturbance than some of the other methods, which require may require extensive trenching (Davis et al. 2004). A full understanding of the extent and nature of the archaeological deposits across the work site is required prior to the installation of any dewatering system, so as to avoid negatively impacting the archaeological remains.

### Flood protections

The Shockoe Bottom area is the lowest point on the north side of the James River and vulnerable to river flooding and localized flooding from rainfall and runoff (Steidel et al. 2006). Long term site flood protections should be coordinated with city-wide or regional flood protection and natural disaster plans to ensure the best results and avoid unintentional negative impacts to neighboring properties (Rumbach et al. 2020). Protections can be broken down into three categories. Those that physically prevent water from entering the site, such as berms and floodwalls. These can be equipped with removable or retractable flood gates. Other measures allow flood waters to be safely held on site, such as cisterns, bioswales, green roofing, and detention ponds. Finally, drains and channels carry water away from the site and structure. The most effective long term flood protection system may need to incorporate a combination of measures (Eggleston et al. 2021).

Smaller scale protections can be incorporated into the design of any structure placed over or around the exposed site. Temporary flood gates can be installed across any opening allowing access to the structure protecting the site; these can then be removed after flood water recede. Long term flood protections can be supplemented by short term solutions. Any long-term flood protection plan should account for the established flood risk level. Whenever possible, flood protections also should account for increased future flood risk. This might involve designs that can easily be raised in the future to meet additional flood risks (Eggleston et al. 2021,

### Soil and Feature Degradation

Urban historic building remains are subjected to atmospheric pollution and weathering of stone surfaces.  Air pollution also can influence the growth of sulfur-oxidizing bacteria leading to the production of sulfuric acid, which can negatively impact cultural material (Webster and May 2006). The physical and chemical attributes of surfaces are changed by airborne pollutants. Acidic rain can produce soluble salts such as gypsum. Eventually, this process can lead to superficial detachment and blistering (Henry et al. 2015). Bioremediation can be used to protect and preserve historic archaeological remains (Webster and May 2006). Biocidal protection is also necessary for the removal of biological patinas from stone remains in order to prevent surface deterioration (Schiavon 2014). Bioremediation involves the removal of pollutants through the use of microorganisms. In cultural heritage settings, bioremediation has been successfully used on many lithotypes to remove sulphates and other harmful compounds.

Long-term environmental impacts negatively affect excavated sites and increase their vulnerability to deterioration. Humidity, rain, groundwater, temperature, wind, and plant growth can cause archaeological features and soils to destabilize. Preventative measures, such as temporary and permanent shelter structures, site stabilization, wall caps, drainage, biological controls, water repellents, and consolidants can reduce site deterioration (Oliver 2008). Analyses conducted on the biofilm present on the interior and exterior of stone archaeological remains have shown that algae, fungi, and molds are major contributors to biological weathering. Various biocides, including new eco-friendly formulas, have been developed to eliminate this issue and help preserve and maintain site integrity (Jeong et al. 2017). The benefits of biocleaning include low cost, no effects on health, homogeneity of the removal of deposits, and no pollution (Cappitelli 2016). This technology is relatively new; results of various tests show a success rate comparable to previous methods (Webster and May 2006).

Crystallization is one of the most problematic causes of deterioration in brick, mortar, stone, plaster, and concrete. Water escape and the resupply of solution determine the site of crystallization. The rate by which water escapes from the surface is determined by humidity, temperature, and air currents. The rate of resupply of solution at that site is dependent on viscosity, surface tension, pore radii, and the distance between the solution source to the evaporation area. This then affects the type of decay that will result. Another deteriorating effect on exposed stone and masonry is mechanical erosion (Lewin 1982). Water can chemically dissolve the matrix of brick. Exfoliation occurs in bricks that have been exposed to freeze-thaw cycles and high amounts of soluble salts (Hewat 1996). Consolidants, such as acrylic and epoxy resins, may be applied to deteriorated brick. Consolidation is the physical addition or application of adhesive or supportive materials into the actual fabric of cultural property in order to ensure its continued durability or structural integrity (Feilden 1982).

Air-conditioners and dehumidifiers can be used for active environmental control. Ventilation and air movement are also important for humidity control and the prevention of mold growth (Aslan 2007). Protective structures, which can be categorized as shelters and enclosures, may be constructed to shield remains. Enclosures provide a robust protection for archaeological sites. Fully enclosed structures protect remains from sunlight, rain, animals, and have a more controlled climatic environment. Proper design is essential for the success of the structure (Funda 2013).

# ARCHAEOLOGICAL PROTECTIVE MEASURES

Monitoring system requirements

Regular visual monitoring of exposed archaeological features, using standardized forms and photo documentation, should be continued after the completion of any protective structure. Particular attention should be paid to the development of cracks in exposed masonry, sloughing of soils, color decolorization, and the build up salts, molds, or other organics. In some cases, photogrammetric documentation has been used to create digital elevation drawings that can help identify floor and surface movements of preserved archaeological features, such as walls and floors. With the increasing sophistication and affordability of high-resolution 3D photogrammetry, these methods are likely to become more common in cultural preservation environments (Aslan 2007).

Instruments for measuring environmental conditions around any exposed archaeological features ensure that responsible parties can be aware of any changes in conditions that might negatively affect. Ongoing environmental monitoring is crucial to understanding and assessing the rate of decay at archaeological sites through the methods of geotechnical, hydrological, and geochemical analysis. The chemical, physical, and hydrological factors determine the environmental preservation conditions of the remains. Oxidation and reduction processes affect the rate of decay of organic material. This then affects the composition of the groundwater. The quantity and chemistry of groundwater, as well as moisture content within the soil, must be measured (De Beer et al. 2012). Organic matter is the most reactive element within the soil; it determines the impacts of oxidation on the processes of degradation. The degree of clay and sand in the soil affects the transportation of water and reactive elements (Van Os et al. 2012). Quantifying the natural and anthropogenic impacts of the environment surrounding the site allows for the development of a successful mitigation design. Environmental changes caused by urban development must also be considered in order to make *in situ* preservation feasible (De Beer and Boogaard 2017).

In instances where long term or extensive dewatering is required, it may be necessary to monitor groundwater levels via piezometers, which monitor groundwater pressure, to ensure that the dewatering is working as intended (Calin et al 2017). Depending on desired depth and soil conditions, monitoring boreholes can be sunk manually or may require a motor driven auger. A standard installation consists of the placement of a plastic pipe within a bore hole. A slotted lower section of pipe allows groundwater to flow freely. The slotted section can be wrapped in a fine mesh to prevent sediment buildup and a secured removal cap placed over the pipe at the surface. An automatic groundwater level and pressure recorder can then be suspended within the pipe. In some instances, these sensors can be left in place for extended periods of time and accessed via data loggers at the surface. Regular manual measurements can confirm and calibrate the logged data (Historic England 2016).

## Exemplars

As laid out in the preceding discussion there are numerous and unique challenges that face the *in situ* preservation and long term exposure of archaeological resources. However, there are numerous examples that demonstrate that these challenges can be met with proper planning. *In situ* preservation has been achieved in numerous ways at archaeological sites around the world. European exemplars include the London Mithraeum in England, the Medieval Foundations at the Louvre in France, Iovia in Croatia, the Latenium Archaeological Museum in Switzerland, Fiave and the Tridentum/S.A.S.S. Underground Archaeological Space in Italy, the Ciutadella Iberica at Calafell and the El Born Centre de Cultura I Memoria in Spain. Extraordinary *in situ* preservation can be found around the Mediterranean at Ephesus in Turkey, the site of Herculaneum in Italy, the Acropolis in Greece, the Ta' Bistra Catacombs and the Tarxien Temples in Malta, and Tel Megiddo and Caesarea in Israel. Some of the sites preserved in place and open to the public in the Americas consist of the Mound House in Florida, the Pointe-á-Callière Montreal Museum of Archaeology and History, St. John's Site Museum in Maryland, the Spiro Mounds in Oklahoma, the Cahokia Mounds in Illinois, Jamestown in Virginia, Templo Mayor Archaeological Site and Museum and the Museo Maya de Cancun in Mexico, and the Museo de Sitio in Chile. Other *in situ* exhibits include Jinsha in China, the Christian Monastic complex on Sir Bani Yas Island in Abu Dhabi, and the Memphis Open air museum in Egypt.

Detailed descriptions of the processes, challenges, and resolutions experienced at certain sites will be provided below for the Pointe-á-Callière Montreal Museum of Archaeology and History, the Tarxien Temples of Malta, the London Mithraeum, Herculaneum in Italy, the Ephesus Terrace Houses in Turkey, Jinsha in China, and the Christian Monastic complex on Sir Bani Yas Island in Abu Dhabi. The following case studies were chosen due to the abundance of reference material regarding the development of their *in situ* preservation processes. The common environmental concerns at the exemplar sites include rainfall, vegetation growth, wind, thermal stress, humidity, and erosion. The most successful forms of mitigation observed at these places involve a detailed conservation plan that is enacted as soon as possible to preserve the archaeological remains. The design of a protective structure must account for all climatic factors.

Point-á-Callière Montreal Museum of Archaeology and History – Canada

The Pointe-á-Callière Montreal Museum of Archaeology and History includes three *in situ* archaeological sites subsuming thousands of square meters; Fort Ville-Marie, the William collector sewer from the 1830s, and the 19th century architectural remains of the Royal Insurance Company building erected in 1861. These conserved and exhibited archaeological remains are largely comprised of paving stones and slabs, stone and brick masonry, wood, and horizontal and vertical soils. In some areas of the museum, a glass floor looks over the original Fort Ville-Marie remains (Pointe-à-Callière 2021).

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The Royal Insurance Company building, constructed in 1861 and demolished in 1951, was excavated from the late 1980s to 1991, which led to some challenges regarding the preservation of wood pilings and the architecture of the building. Wood had been used to reinforce the original foundations and had deteriorated over the years due to wet and dry cycles and microbial activity in the surrounding soil. Conservation measures were developed to remedy this issue; *in situ* preserved pilings were treated with polyethylene glycol, while other pilings were removed, treated, and reinserted (Pointe-à-Callière 2021).

The water table at the site has been a major concern, as water is drawn upward resulting in salt deposits that fracture the soil surface and erode the base of the remains. The archaeological remains located in the basement of the Éperon building at the museum, including the collector sewer and the archaeological crypt, are subjected to fluctuations in the water table, changes in the conditions underground throughout the seasons, and potential underground infrastructure damage near the museum. The soil between the stones in the crypt has been affected by moisture on the paved surface. Air conditioning and heating in the basement as well as visitor attendance also impact the site integrity (Pointe-à-Callière 2021).

In order to mitigate the various preservation issues encountered, a specific conservation program was developed by the museum. Annual maintenance is performed, which includes securing any loose stones or bricks, reapplying consolidating products to the remains, and routine dust removal. Conservation work has been conducted since 1992, and a monitoring program was implemented in 2009. The monitoring program consists of obtaining 3D surveys of the archaeological remains and the installation of thermohygrographs around the sites (Figure 4). These measures collect valuable information on the remains, identify changes in their condition, and allow for problems to be detected and addressed early (Pointe-à-Callière 2021).

Tarxien Temples - Malta

The megalithic Tarxien Temples of Malta is a World Heritage site, located in an urban setting, consisting of limestone structures that date to approximately 3,500 B.C. and that were utilized until 2,500 B.C. Various climatic factors have negatively impacted the site, which led to a protective shelter being constructed over the ancient remains in 2015 (Valantinavicius et al. 2020; Cassar et al. 2018). The weathering processes affecting the site prior to the installation of the shelter included rainfall, wind, solar radiation, temperature, and humidity. A conservation plan that included building the current shelter and a continual monitoring program was put in place to manage the environmental effects (Valantinavicius et al. 2020).

One of the initial negative impacts of major concern was that heavy rain would erode the surface of the remains and the soil. Portions of the site had experienced collapses in the past as a result of intense rainfall. Ground surface runoff, stagnation, and increased instability from the loss of infill around the site were also problematic. Other issues included abrasion of the remains by windblown soil, thermal stress from intense cycles of heating and cooling of the stone, exfoliation, plant growth, biodeteriogens such as algae and birds, pollution, condensation, and fluctuations in humidity and air temperature (Valantinavicius et al. 2020).

Figure 4. Monitoring of in situ archaeological features in the Pointe-à-Callière museum

Figure 5. Flooding from heavy rains was a problem at Tarxien before a sheltering system was installed (from Cassar et al. 2018).

# ARCHAEOLOGICAL PROTECTIVE MEASURES

Environmental monitoring based on previously-identified weathering issues began four years before the construction of the Tarxien shelter. The goal of this effort was to establish a baseline of the pre-shelter conditions of the site (Valantinavicius et al. 2020). Measurements and thermal infrared images were recorded, and analyses of the stone surfaces were executed. A hydrological and hydrogeological study was completed to determine the best way to dispose of rainwater, and a survey of the biological growth on the soils and surfaces of the stone was conducted. A shelter was deemed to be the most efficient method of attempting environmental control. An open, lightweight structure was chosen with the intention of preserving aesthetic value and overall site context (Cassar et al. 2018).

The construction of the Tarxien shelter has eliminated collapses from flooding and alleviated many of the major environmental problems that were prior concerns (Valantinavicius et al. 2020). The design of the shelter along with the establishment of an efficient guttering system have mitigated the most pressing water and insolation issues. No flooding or ponding have occurred since the shelter was erected. The effects of solar radiation on stone surfaces, and fluctuations in temperature and humidity have been dramatically reduced. Higher plants have also been eliminated and addressed by the decrease in light and lack of moisture. Another benefit provided by the Tarxien shelter is the increase in visitor comfort and improved legibility of the site (Cassar et al. 2018).

Despite the numerous improvements accomplished through the implementation of the shelter, the need for humidity and temperature fluctuations to be monitored remains. Rain-related issues will continue to be assessed via observation and photographic documentation. The degree of the reduction of biological growth, thanks to the decreased water supply and shade from the shelter, will continue to be recorded through biological surveys. The measurement of wind parameters will also be maintained (Valantinavicius et al. 2020). A weather station will continue to be utilized to assist with several aspects of the environmental monitoring of the site. While there are still ongoing challenges to monitor and mediate, the microclimate has become much more stable as a result of the construction of the shelter, which has provided necessary protection against weathering for the site (Cassar et al. 2018).

The Mitraeum – Great Britain

The London Mithraeum, a 3$^{rd}$ century Roman temple of Mithras that was discovered and excavated in the 1950s, is now located within Bloomberg's European headquarters. Soon after the site's initial discovery, it was dismantled, moved approximately 100 meters away from its original position, reconstructed, and opened to the public in 1962. Bloomberg later purchased the site in 2010. As a result of the conditions for redevelopment, they were then responsible for recording the 1962 reconstruction, dismantling it, and reconstructing the temple again in as close to the original location as possible (Jackson 2016).

The 1962 reconstruction was a result of poor planning with little regard for the site's original context. A large portion of architectural detail was omitted, and hard cement mortar was used to supplement salvaged material that had been stolen following the excavation of the site. The reconstruction was oriented incorrectly, and it was raised above ground, contra the original temple's partly subterranean placement (Jackson 2016).

Bloomberg's reconstruction efforts involved a series of problem-solving methods. The structure could not be moved in one piece without causing adjacent streets to collapse on the underground tunnels. Dismantling the 1962 reconstruction without destroying the Roman brick and masonry was a challenge, but this was eventually accomplished using diamond-tipped chainsaws. Nearly all of the original material was salvaged undamaged, however the amount of stone and brick was not sufficient to build a complete reconstruction. Replica bricks were manufactured and marked so that they could be easily identified. The site of the original location of the Mithraeum was investigated by archaeologists and the remains of the eastern third of the temple foundations were found *in situ*. These remains could not be moved for the reconstruction, and they could not be displayed due to the waterlogged ground. The resulting solution was that the *in situ* remains were preserved and the new reconstruction was moved approximately 12 meters to the west, so that the ground plan of the structure could be observed by visitors (Jackson 2016).

Herculaneum – Italy

Herculaneum, on the Bay of Naples in southern Italy, is an ancient Roman town that was destroyed by the eruption of Mt. Vesuvius. Excavations of the town initially started in the 18$^{th}$ century, but the majority of the remains as they can be seen today were unearthed in the 20$^{th}$ century under archaeologist Amedeo Maiuri. Maiuri orchestrated a number of conservation measures for the site, with varying degrees of success. Many of the shelters he constructed have deteriorated and/or collapsed, largely because of insufficient water drainage (Pesaresi and Massari 2018). In more recent years, the Herculaneum Conservation Project has been working towards achieving a higher level of preservation (Thompson 2006).

Several roof types, each with their own set of limitations, have been utilized to protect various portions of the site, including flat roofs, tiled roofs, transparent or semi-transparent roofs, temporary roofs in multilayered corrugated metal sheets, and experimental temporary roofs. Flat roofs, the most common type and the most high-maintenance, have a shallow pitch that drains rainwater very poorly. Tiled roofs also present issues with water drainage and are not considered to be efficient. Transparent or semi-transparent roofs provide aesthetic appeal but are not durable and do not allow for micro-environmental control (Figure 6). Temporary metal sheet roofs are only intended to last up to ten years. The experimental temporary roofs that have been used at the site, however, have proved to be efficient, low-maintenance, low cost, and can last up to twenty years (Thompson 2006; Pesaresi and Massari 2018).

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Funding was an issue because it had been allocated for new excavations rather than conservation and maintenance, which contributed to the level of decay in the exposed portions of the site. A comprehensive plan was developed to address negative impact concerns, mainly to improve water drainage, roofing, and site access, as well as to stabilize high escarpments. Repairs, upgrades, and replacements have been made across the site and all structures have been stabilized (Thompson 2006). The ancient sewer system has also been reactivated, which has created an efficient water disposal system for newly installed roofs (Pesaresi and Massari 2018). Current conservation measures include routine monitoring, cleaning, photography, the installation of pigeon nets, and plant growth management. (Thompson 2006). The conservation efforts at Herculaneum show that a structured plan can ensure the survival of an archaeological site.

Ephesus Terrace Houses – Turkey

The Terrace Houses at Ephesus in Turkey are located along the Aegean coast. Ephesus was a harbor city that was originally settled during the Neolithic period. The Roman era terrace houses date to the first century BC and were excavated in the early 1950s (Terrace House 1) and late 1960s (Terrace House 2) by the Australian Archaeological Institute. Once Terrace House 2 was uncovered, plans were made to construct a protective shelter over it based on the ground plans of the rooms, with a goal of recreating the original aesthetic. Unfortunately, the amount of original architecture was not sufficient to accurately construct a roof over the remains. Reinforced concrete was utilized, which is not reversible without causing archaeological damage. Other issues included water infiltration and speculative decision-making, which eventually caused construction of the shelter to be terminated in 1986. Excavations proceeded more quickly than conservation, which left many structures at risk and exposed (Bellibas 2018; Ladstätter et al. 2016).

Friedrich Krinzinger successfully led another attempt to create a Terrace House shelter at the site in 1995. Modern technologies were used to develop a far lighter construction than the original roofing system. The main goal of the structure was to provide protection from climatic factors, while blending in with the surrounding area. The resulting shelter was made using a membrane and steel, which continues to require minimal maintenance on an annual basis (Figure 7). The design did not take accessibility to wildlife into account, however, which led to a pigeon problem. Luckily, a family of owls resides at the site periodically, which deters the pigeons (Bellibas 2018; Ladstätter et al. 2016).

Walkways for visitors were installed once the shelter was finished, which further reduces site impacts. These walkways provide access for visitors to view almost every room, while simultaneously safeguarding the site. Overall, the constructed shelter over Terrace House 2 at Ephesus provides adequate protection for the site and allows for conservation to be performed year-round, which helps preserve the integrity of the remains (Bellibas 2018; Ladstätter et al. 2016).

Figure 6. Example of a transparent roof over a room with frescoes at Herculaneum.

Figure 7. The shelter over Terrace House 2 at Ephesus (from Belibas).

# ARCHAEOLOGICAL PROTECTIVE MEASURES

Jinsha – China

Jinsha, located in Chengdu within the Sichuan Province, is one of the earliest national archaeological parks in China and represents the Shu culture (dating to 1000 BCE). Excavations began in 2001 and were continued by the Chengdu Institute of Archaeology in 2002. Archaeological remains lie within a modern urban area, and some (including the sanctuary) are now on display in an on-site museum hall, which was built in 2007. A glass curtain wall and roof cover the remains, which prevents the penetration of ultraviolet light. Archaeological excavation grids, as well as many organic and inorganic artifacts, have been left in place. Conservation concerns at the site include the hot and humid environment, rain, and the unstable environment, which influences the growth of moss and invertebrate activity (Bai and Zhou 2012).

The design of the protective enclosure around the site has not fully succeeded in mitigating against these environmental impacts. The transparent cover still allows sunshine through, while the roof panels allow access for birds and rain. The outdoor climate continues to impact the conditions indoors. Air-conditioning has failed to stabilize the site environment. As a result, the organic artifacts on display are quickly deteriorating. Despite conservation efforts, moss and cracks have developed within the site (Bai and Zhou 2012).

Biocide, in the form of germall, was used to remove moss from the surface of the site. However, the biocide requires repeated use to be effective and the potential for chemical reactions with the artifacts remain unknown. The lack of preventative conservation at Jinsha is the leading cause of the site's deterioration. Costly methods have become necessary to remedy this oversight, which could have been prevented. The design of an archaeological site's shelter is crucial to combat the potential damage of the micro-environment. Public interest and communication with conservators also play a large role in the protection of archaeological remains (Bai and Zhou 2012).

Sir Bani Yas Island Christian Monastic Complex – United Arab Emirates

The Christian Monastic complex on Sir Bani Yas Island in Abu Dhabi, United Arab Emirates was originally excavated by the Abu Dhabi Islands Archaeological Survey between 1993 and 1996. A community of thirty to forty monks of the Church of the East, or the Nestorian Church, are believed to have settled the island in approximately 600 A.D. The site consists of a large monastery complex that contains a church in the center of a courtyard. Before the site was discovered, large holes were dug through the remains to plant trees and the church walls were levelled to a largely uniform height as a result of bulldozing the area. Portions of the walls and plaster flooring are missing due to the previous mechanical clearing. After the initial unearthing of the site, it was reburied until a long-term shelter could be constructed. Certain areas of the church that were deeply excavated were buried in order to make it level and increase the site's legibility for visitors. Excavations resumed in 2009 and the site was opened to the public again in 2010 (Goodburn-Brown et al. 2012).

Initial environmental concerns at the site consisted of rainfall, humidity/drying, wind/windblown sand, plant roots and growth, and erosion. In the spring and winter, torrential rain can fall, which causes erosion. Humidity in Abu Dhabi fluctuates drastically. Heavy dew has drenched surfaces on the site, and then quickly dried with the rising sun. Windblown sand erodes the exposed archaeology and plant root growth has caused spalling of stone and plaster. Site condition concerns include extensive cracking, loose mortar, vulnerable undercuts, and spalling. Solutions to these issues consisted of installing fencing, a temporary shelter structure, stabilization of the plaster walls, partial reburial of the site, irrigation removal, tree removal, wall capping, and monitoring. Missing sections of the church walls were replaced with dry stones to create containment walls. Large vegetation and irrigation in close proximity to the site were removed (Goodburn-Brown et al. 2012).

In 2019, the site was opened to the public with an open-air exhibition, visitor walkways, and display panels. The shelter structure is simple, lightweight, and open-sided with steel pillars set into 1-meter-deep concrete blocks. Tan fabric that is waterproof underneath is stretched over a gabled roof. The staff at the island casually monitor the site. Intensive monitoring and maintenance are performed biannually by the archaeological and conservation team. Reed fencing has been positioned around the original courtyard perimeter in order to protect the site against wind erosion. The fencing has provided satisfactory protection, but it must be regularly maintained. Additionally, cement blocks have been placed around the site to monitor the effects of wind and windblown sand erosion. Plant removal will continue to take place at the site (Goodburn-Brown et al. 2012).

The shelter structure has largely protected the site from rain, but condensation on the metal beams and dripping along the edges has been observed. This will be mitigated by wrapping the beams with hemp rope to absorb any moisture that accumulates. Birds were initially a concern, but the roof fabric's slight flapping deters birds from settling in the eaves. Future improvements under consideration are the installation of gutters and water drainage, better ventilation to prevent heat and condensation, and the construction of a more permanent structure to provide more robust protection. Routine monitoring of the site and conservation efforts will continue in order to maintain the integrity of the archaeological remains (Goodburn-Brown et al. 2012).

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## Summary

The archaeological site at the Lumpkin's Slave Jail Site/Devil's Half Acre is rich and complex and offers unique opportunities to interpret the history of the domestic slave trade in Richmond during the nineteenth century and the redemption afforded during the empowerment of formerly enslaved peoples during the Reconstruction. To be interpreted permanently, however, the City will need to overcome a number of physical and historic preservation constraints and management challenges associated with excavation and conservation of an important archaeological resource and site of remembrance.

The physical constraints include the expansive character of the Lumpkin's Jail site itself; it is large, deep, and we do not yet know its full horizontal or vertical boundaries. The archaeological site also is hemmed in by a variety of constraints: I-95, city utilities, other archaeological sites and areas of archaeological sensitivity, and historically significant buildings and structures. Future excavation and permanent exposure of the site for interpretation will need to thread the needle, so to speak, to further sample the site, plan for protective engineering features, and create a space that can be interpreted appropriately and sympathetically.

The full scope of any historic preservation constraints on the development of the site and the planning of the proposed museum at this location is not known at this time. In part this is due to uncertainty over whether the project will eventually need to comply with Section 106 of the National Historic Preservation Act. Section 106 is triggered by federal funding or federal regulatory involvement. Although any such triggers have not yet arisen, they might in the future. The project likely will be subject to local historic preservation review, but that process will not start until a design is more fully evolved. A key issue for understanding potential historic preservation constraints is related to any existing agreements between the City and the federal agencies that provided grants for acquisition of the Main Street Station and Trainshed and Seaboard Building properties. These agreements were not made available to the project team for review. Hence, we are not aware of any explicit covenants that those agreements might contain that would limit the design of the proposed museum.

Future excavations of the site will pose management challenges for the City and their archaeologists. These include the planning and management needs associated with conducting deep excavations safely. The need to manage groundwater infiltration is well understood and will require short-term engineering solutions as well. The long-term *in situ* interpretation of the site presents a range of other challenges, including the need to shelter the resource effectively, the need to keep groundwater completely outside of the footprint of the archaeological footprint, the need to provide a carefully managed environment to limit physical degradation of the remains, and the need to make the site's remains visible to the public in an appropriate and respectful manner. Fortunately, archaeologists, preservationists, and engineers have worked together for decades to develop appropriate and sympathetic techniques to make archaeological sites accessible to the public. Any issues posed by these management challenges can be addressed through effective planning and design.

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# FINAL RECOMMENDATIONS

# FINAL RECOMMENDATIONS

This Site Feasibility Study is intended to establish the amount of space and volume that could be constructed at the LSJS/DHA site within the existing site constraints and discuss any modifications that could or might be made to accommodate a final design that meets the program established during the earlier Concept Design phase completed in 2019. As a result of this study, the SmithGroup team has several recommendations that are based on the information received from the City of Richmond and the team's analysis of the same. A new survey of the site and surrounds incorporating the known site constraints, offered a finer grain of detail that allowed the team the ability to better understand the minimum on-site footprint for a future museum that could be placed at the site and provide as accurate as possible placement on the site. This survey included the following:

- Mapping of the at grade conditions and topo at 1'-0" elevation intervals.
- Mapping of the underground utilities
- Inclusion of Main Street Station, the Train Shed, the location of the future high-speed line tracks/platform/elevators/stair towers, and the Seaboard Building
- Overlay of the 100-year and 500-year floodplains
- Overlay of the FEMA identified Floodway
- Mapping of the required setbacks for the various utilities and structures
- Establishing an area for VDOT's servicing of the cribbing supporting I-95

From this site survey starting point, the team further studied the approximate location of the archaeology at the Lumpkin's Slave Jail/Devil's Half Acre (LSJS/DHA) project site to determine any potential conflicts with existing infrastructure. The additional soil borings and ground water monitoring done by Schnabel Engineering provided critical information to evaluate possible solutions for the highwater table as well as mitigations for flooding and the floodway.

Based upon the study evaluation and analyses, we recommend the following be considered for the next phase:

STRUCTURE

Geotechnical Investigation and Analysis- As seen in the preliminary findings of this study and the Schnabel geotechnical report, further studies and recommendations are required based on the final chosen design. The main required recommendations are listed below once the project is further developed:

- Final recommendations for building foundations and site retaining walls
- Final recommendations for permanent support excavation/slurry wall with permanent tiebacks to include required global stability analysis for temporary and permanent conditions
- Final recommendations related to constructing within a floodway once building size is determined
- Sub slab/foundation drainage system requirements, which will require special requirements at the proposed exposed archaeology within a museum. A further analysis of the cutoff wall design should be investigated with the various City of Richmond agencies having jurisdiction to determine quantity and proper location of tiebacks.
- Further investigation to better profile of the rock layer capable of having the deep foundations achieve adequate support and bearing. It will also be important to understand the depths to which the cutoff walls will need to extend to limit seepage into the site.
- Perform additional testing to determine Soil Site Class. Per Schnabel Preliminary Geotechnical Report dated June 16, 2021, a Soil Site Class C may be attainable by utilizing geophysical methods to collect of shear wave velocity data.

Hydraulic Analysis-- As seen in the preliminary findings of this study, further studies and recommendations are required based on the final chosen design. The main required recommendations are listed below once the project is further developed:

- Determine Design Flood Elevation-Currently this cannot be determined until a final building design has been determined. According to the Kimberly-Horn report, the base flood water surface elevation (NAVD 88) for the sections where the museum building will be located (sections D and E for Shockoe Creek) are between 25.26' to 25.58' (with floodway).
- Determine flood loading. This will be determined based on final building size and is also contingent on which stormwater option described in the Stormwater Analysis narrative is chosen.
- Define flood conditions for the museum and other flood requirements- This will be determined based on final building size and is also contingent on which stormwater option described in the Stormwater Analysis narrative is chosen.

# FINAL RECOMMENDATIONS

STRUCTURE (cont.)

Excavation/Archaeology/Conservation of Ruins-The following design items will be determined in future phases based on the final chosen design and future investigations:

- Once full excavation is undertaken, it will be necessary to assess the condition of the historically important retaining walls to assure structural stability
- Based upon the observed and yet to be observed fluctuations in the water table, determine what impact this will have on the foundations of the building and the preservation of the archaeology
- It should be determined whether a secondary interior cavity and liner wall are required inside the slurry wall to maintain a humidity-controlled museum environment to protect the archaeology. If it is deemed the best solution, an interior cavity and liner wall would facilitate waterproofing of the lower level.
- Determination of allowable loading over existing utilities, particularly the 27' wide combination sewer. This needs to be determined to understand construction related loading conditions.

CIVIL

- Based upon the architectural massing studies that follow, this study has made observations and recommendations consistent with the information provided by the CoR. Once the building design is finally established, an analysis will be made on any impact to the flood plain/floodway.
- The integration of FEMA required site and building requirements for construction in the floodway/ floodplain will be developed with the design team during the actual design phase of the project once a decision is made on the path forward.
- Once the extent and depth of the archaeology is determined, the entry floor and lower floor level for the archaeology will be established to determine excavation depths and how connections to the various utilities will be made.
- Final stormwater management design including all City of Richmond DPU stormwater management component requirements for the project site will be developed in the actual design and docu mentation phases of the project.

ARCHAEOLOGY

The following recommendations apply to the management of constraints and physical challenges associated with the archaeological site at the Lumpkin's Slave Jail Site/Devil's Half Acre:

- Conduct a round of additional archaeological excavation as soon as feasible to:
- Sample the presumed boundaries of the Lumpkin's Slave Jail site sufficiently to determine the full extent of Robert Lumpkin's compound. This will help determine the extent of the site that is acces sible for full excavation interpretation and support how these future excavations relate to existing utilities.
- Collect additional archaeological data on the depth and complexity of features, especially on the site's lower terrace.
- Additional archaeological excavations of the site, beyond those proposed here, will be necessary, if the city chooses to move forward with permanent in situ interpretation of the archaeological site. A program of careful planning that incorporates extensive public outreach and public education efforts will be required before any future excavations proceed.
- The area around the Lumpkin's Slave Jail archaeological site is archaeologically sensitive. Additional archaeological survey is appropriate for any areas outside of the footprint of the Lumpkin's Slave Jail archaeological site that will be impacted by the proposed museum's design. This survey should be conducted as soon as a possible museum design is accepted, so that the city understands these other archaeological constraints.
- The historic preservation constraints on development of the site are not yet known to the design team. These issues need to be researched and communication and planning sessions completed with state and other stakeholders so that historic preservation can be folded into planning.
- The community's interest in the history and archaeology of the site was well established during the outreach for Richmond Speaks and during the concept design phase of this project. The public has heard virtually nothing from the city about this project in three years. The city and the public would be well served to renew the previous engagement activities.
- We have demonstrated that the archaeological site will need to be managed carefully during both short-term excavations and most specifically if it is to be interpreted as an exposed excavation. Fortunately, the techniques for archaeological site protection are well understood and improving. Any archaeological excavation efforts should include extensive planning to assure the protection of the site and the excavators. Best practice techniques should be identified and employed during the excavations. In addition, any future permanent exposure of the archaeological site must be proceeded by the preparation of an archaeological conservation plan that is based upon the use of best international principles of planning, implementation, and monitoring.

# FINAL RECOMMENDATIONS

ARCHITECTURE

The Case Studies section of this feasibility study covers several projects that were constructed on difficult sites. For two of these projects, the National Museum of African American History and Cul ture and the DC Water Headquarters, the SmithGroup was intimately involved with their design and construction. With our consultants' similar experience, we have the knowledge to design for the varying flood and groundwater conditions at the Lumpkin's Slave Jail/Devil's half Acre site. Several areas to be studied further to mitigate the issues at the site will include the following:

- The foundation system and slurry wall with inner foundation wall as discussed in the structural section will provide the necessary barrier structure that will protect the archaeology as the same sys tem did at the National Museum of the African American Museum of History and Culture.
- Capturing the storm water on the site with various methods such as extensive green roofs, bio-retention ponds, cisterns, pervious paving, and landscaping features to slow, retain, treat, and provide infiltration to provide a more naturalized setting that yields far less run-off than the extensive pavement that exists on the site currently.
- The below grade archaeology will be protected by a cut-off slurry wall and an inner wall that has been waterproofed such that the water table can be held back and only seepage into the excavated site will occur which can be removed by an under-drainage system to dual sump pumps on back-up emergency generators.
- The first floor will be located 1' (one foot) above the 100-year floodplain. The final design will intend to minimize the final below grade footprint to minimize disturbance to the area while still allow- ing for the visitor experience requested during the community engagement process.
- Emergency generators will have adequate capacity fuel source storage for extended operation.
- All utility penetrations will be sealed to maintain integrity of the structure.
- Flood barrier walls will be implemented along with barrier gates at all entrance/exit locations in the event of a flood event to protect the integrity of the building enclosure.
- Based upon the summaries and recommendations from the team's structural, civil, and archaeology consultants, the architectural design team developed three options for blocking.
- Develop a process with the City of Richmond regarding the visitor access to the archaeological asset below grade.

**NEXT STEPS**

- Working from the blocking and stacking options developed in this study, determine with the city the ideal building footprint and massing for the site based upon the physical site constraints and restrictions, and the community-driven desire to uncover the archaeology, history, and the lasting impact of the slave trade.
- Develop the archaeological investigation and implementation plan.
- Conduct the initial archaeological site investigations through excavation at the presumed corners of the archaeology to determine the actual extent and accurate location for GPS recordation of the archaeology as well as record depths of the foundations for the various levels.
- Develop the agreed upon building footprint and massing to a concept level similar in detail and development to the level of the original concept presented in 2019.
- Understand the results from the Schnabel monitoring of the water table for infiltration as well as subsequent geotechnical recommendations for the further development of the foundation system.
- Work with the CoR's DPU and DPW staff to create strategies to protect existing utilities and infrastructure and/or determine where utility relocations can benefit the new construction without com- promising any integrity of the existing utility infrastructure.
- Present the revised concept to the Mayor, City Council, the Shockoe Alliance, the community that spent many hours working on developing the original concept, and other interested parties to gath- er further information to include in the further development of the design
- Provide a cost estimate for probable total project cost based upon the chosen direction.
- Provide a financial, business and operations plans, and an overall project budget for the future sustainability of the museum.

# MASSING STUDIES

# MASSING STUDY INTRODUCTION

The Lumpkin's jail site has the capacity to hold and support the 100,000 gsf, community generated museum program by right. The massing studies presented in this section are blocking and stacking diagrams generated by the conceptual museum program. A future architectural study would consider hybrid combinations of some of the unique features inherent in each option. However, the massing diagrams provided here are simply feasibility diagrams designed to test the capacity of the site to physically hold the desired program.

For purposes of this study the base flood elevation was established as elevation (31.24'). The "with floodway" flood elevation (31.24') was used instead of the regulatory flood elevation (30.73') since it is more conservative. The below-grade program in all schemes would be built as a "bathtub" equipped with slurry walls and under slab sub drainage to provide protection from flooding and environmental damage. Furthermore, all schemes would be equipped with intensive green roofs, floodwalls, and barrier gates to the extent necessary. Approximately 45' feet of clear space is maintained between the north end of the Seaboard Building and the massing studies.

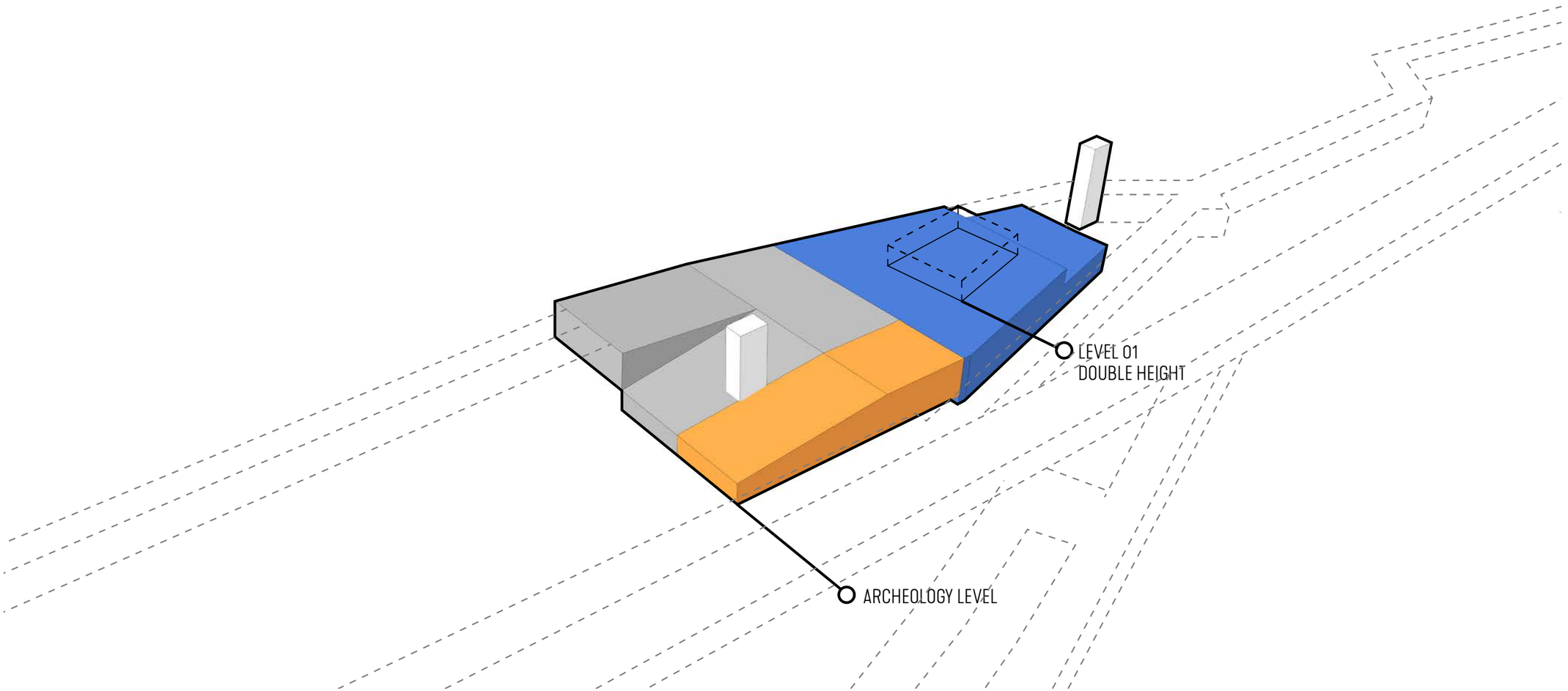
Each massing study also includes the premise that the archeology will be re-excavated, encapsulated by the building, and part of a visitor experience. This experience was the most crucial listed by the public during the 2017-2018 concept engagement studies. To interpret and acknowledge the remains as evidence, this will require coordination with and variances from certain flood way guidelines similar in nature to those examples by NMAAHC and the 911 Museum.

**Option 1**
This scheme elevates the above-grade program or Level 2 of the museum to elevation (55.24') at 24 feet above the floodway elevation (31.24'). By doing this the largest mass of the above-grade program is elevated a full story above grade on piers. Additionally, Level 1 or the ground floor entrance is made accessible by way of a plinth elevated to Elevation (40.24') at 9 feet above the floodway elevation of (31.24'). The elevated plinth mitigates the need for floodwalls, but a barrier gate would be required at the loading dock entrance. The ground floor program is minimized to a small footprint to account for vertical circulation and service functions. The below grade functions would allow for the archaeology of the Lumpkin's jail site to be fully exposed with space for interpretation and minimal support space for loading and processing. The overall height of the building from the floodway elevation to the roof elevation is 84 feet.

**Option 2**
In this scheme Level 1 or the ground floor elevation is located at elevation (32.24') at 1 foot above the floodway elevation of (31.24'). The premise of this scheme is to keep the building compact while affording a central full height atrium as an architectural feature. The atrium would allow for interpretive opportunities and views looking down into the archaeology throughout the building. The below grade functions would allow for the archaeology of the Lumpkin's jail site to be fully exposed with space for interpretation and minimal support space for loading and processing. The overall height of the building from the floodway elevation to the roof elevation is 80 feet.

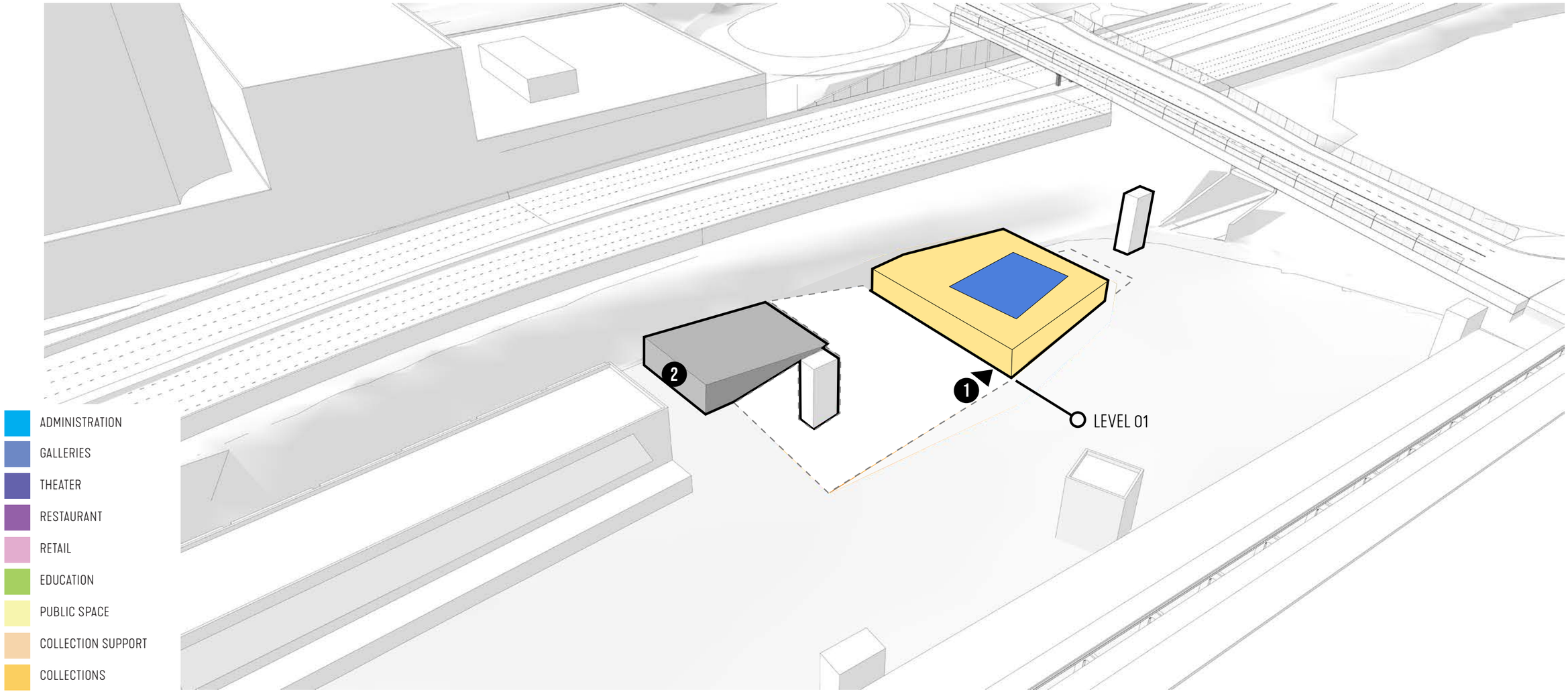
**Option 3**
In this scheme Level 1 or the ground floor elevation is located at elevation (32.24') at 1 foot above the floodway elevation of (31.24'). This scheme features a sloped green roof that positions the tallest mass of the building northward away from Main Street Station. The intent of the design is to minimize the overall architectural profile of the building and limit the visual impact on the site. The below grade functions would allow for the archaeology of the Lumpkin's jail site to be fully exposed with space for interpretation and minimal support space for loading and processing. The overall height of the building from the floodway elevation to the highest roof elevation is 80 feet.

# MASSING STUDY
## OPTION 01: LEVEL B1 (BELOW GRADE)

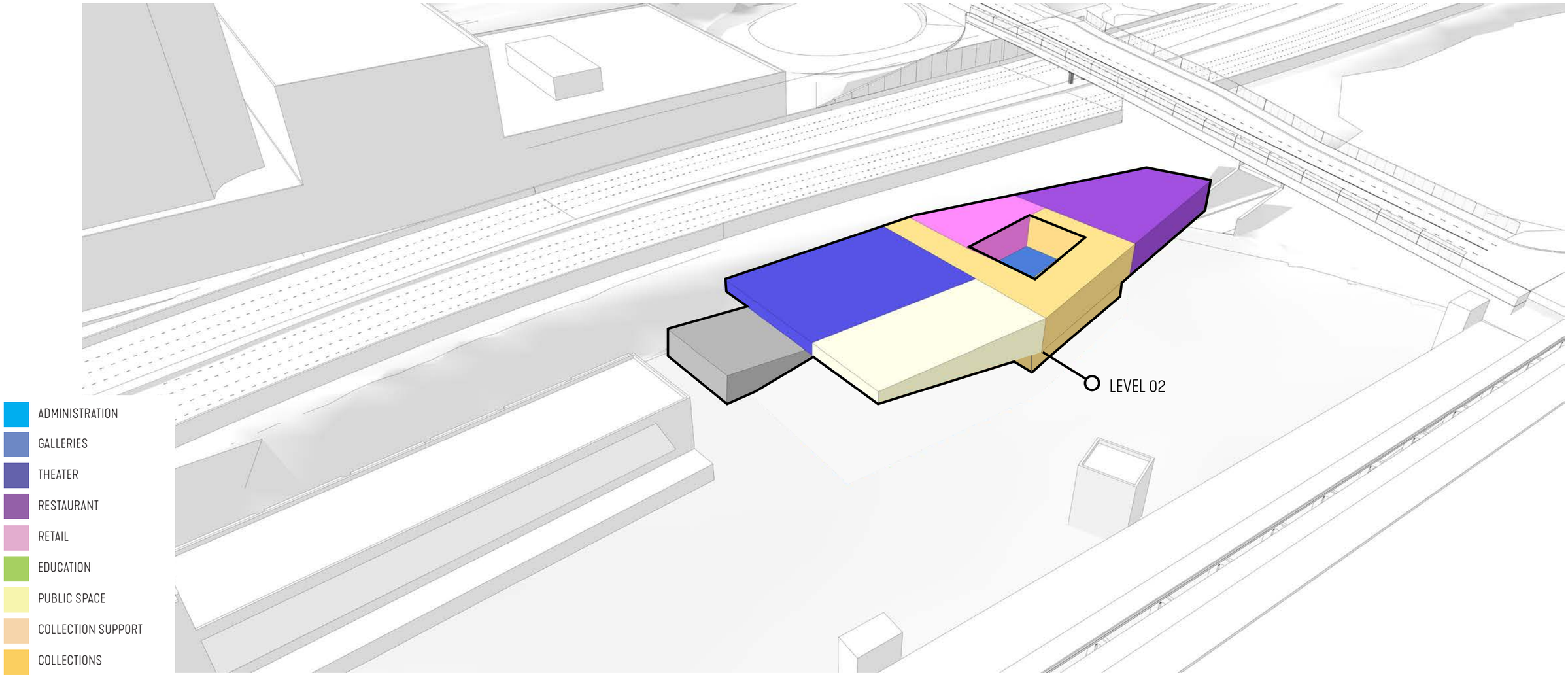



- ADMINISTRATION
- GALLERIES
- THEATER
- RESTAURANT
- RETAIL
- EDUCATION
- PUBLIC SPACE
- COLLECTION SUPPORT
- COLLECTIONS
- SUPPORT
- VERTICAL CIRCULATION

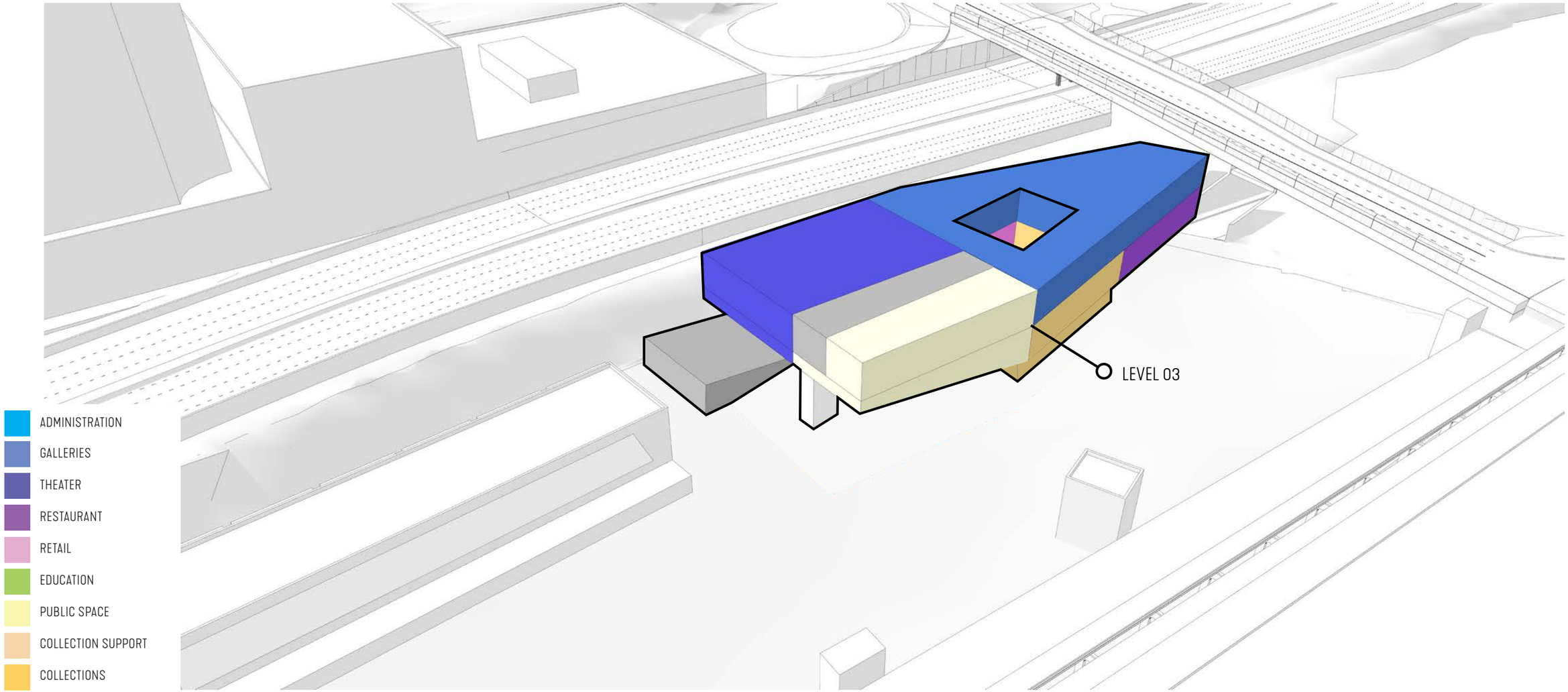
# MASSING STUDY
## OPTION 01: LEVEL 01



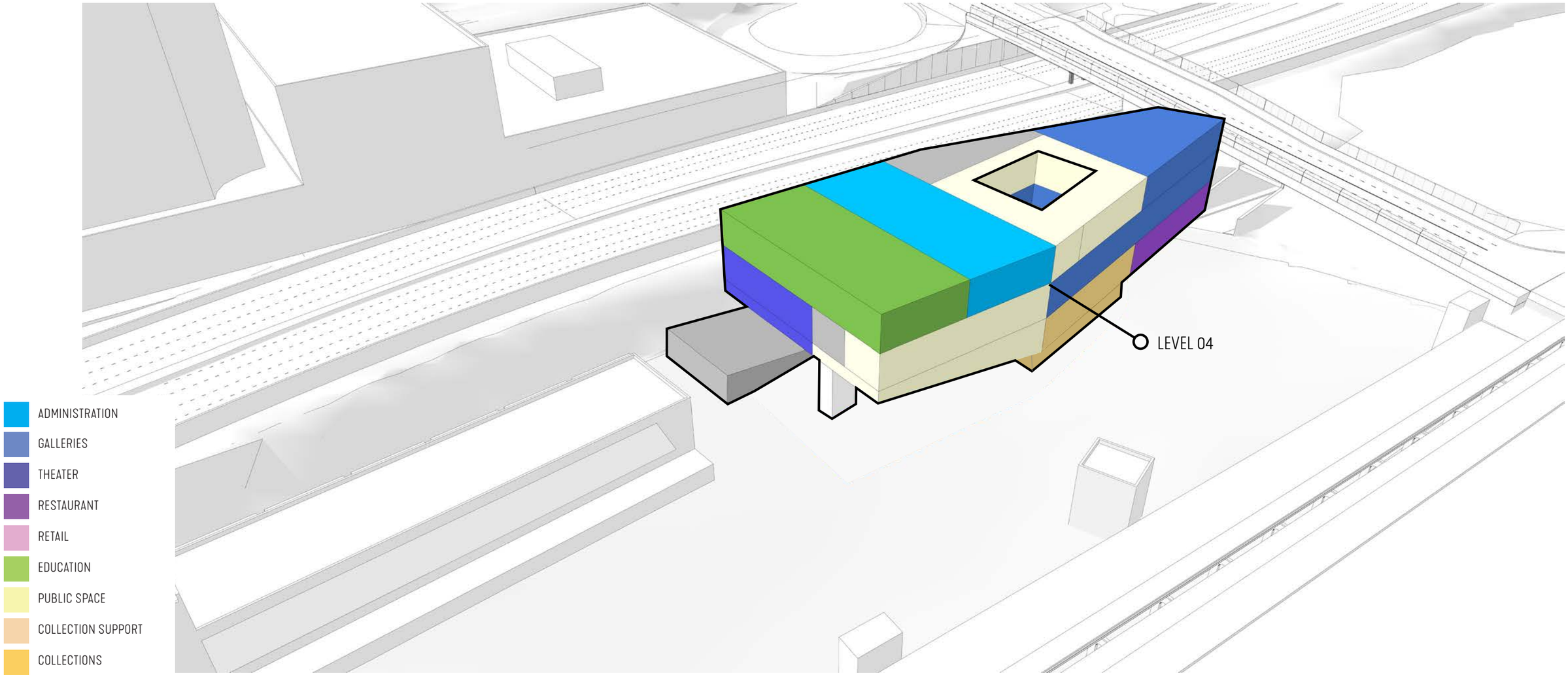
# MASSING STUDY
## OPTION 01: LEVEL 02



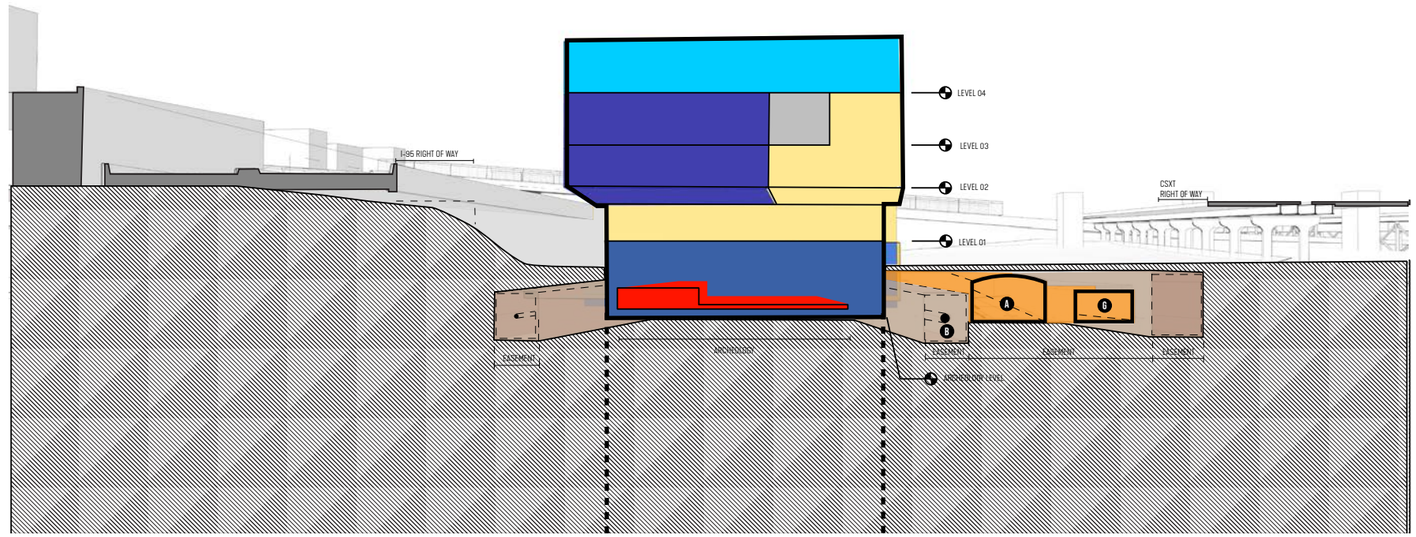
# MASSING STUDY
## OPTION 01: LEVEL 03



# MASSING STUDY
## OPTION 01: LEVEL 04



# MASSING STUDY
## OPTION 01: TRANSVERSE 3D SITE SECTION




- ADMINISTRATION
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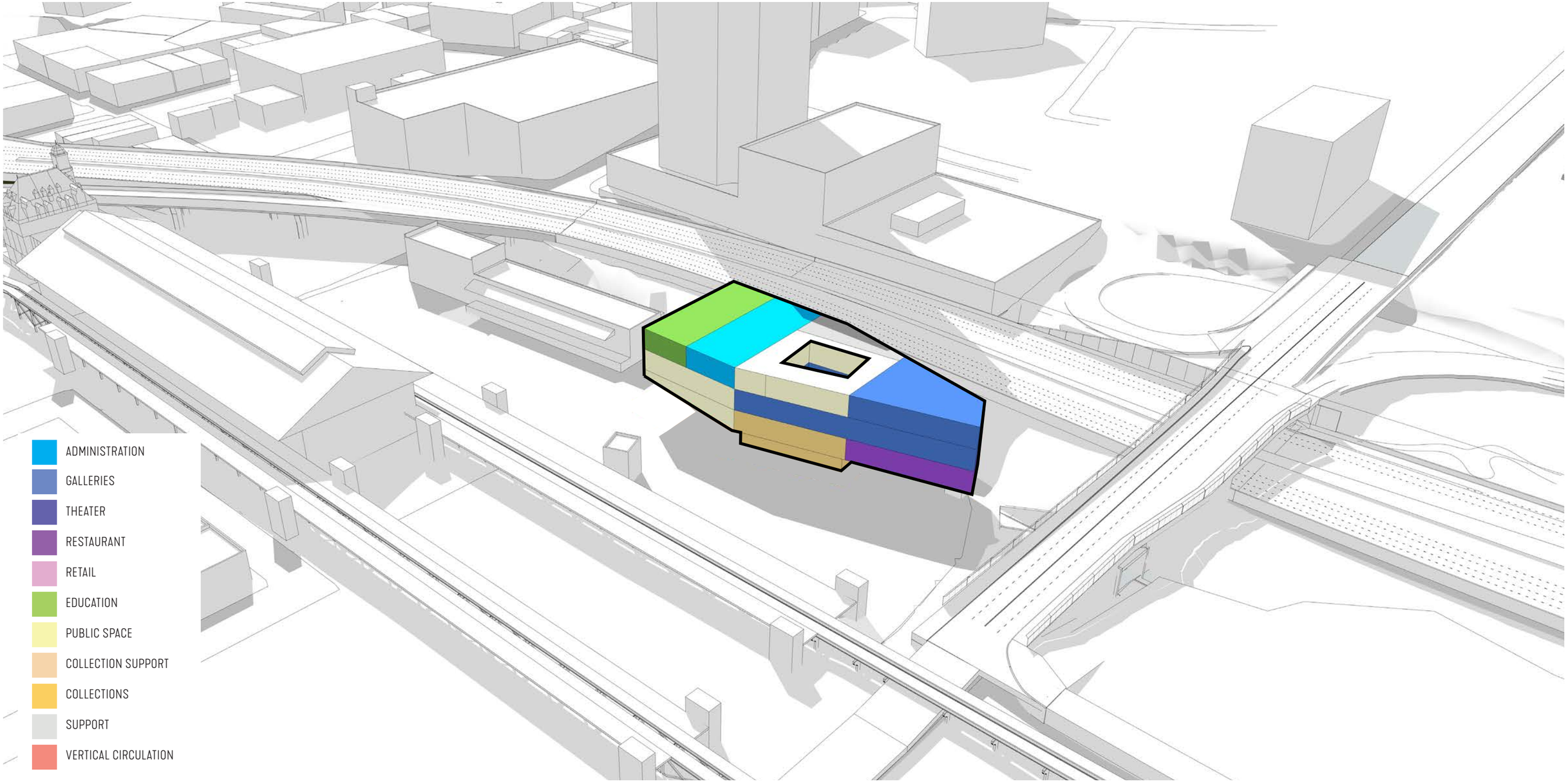
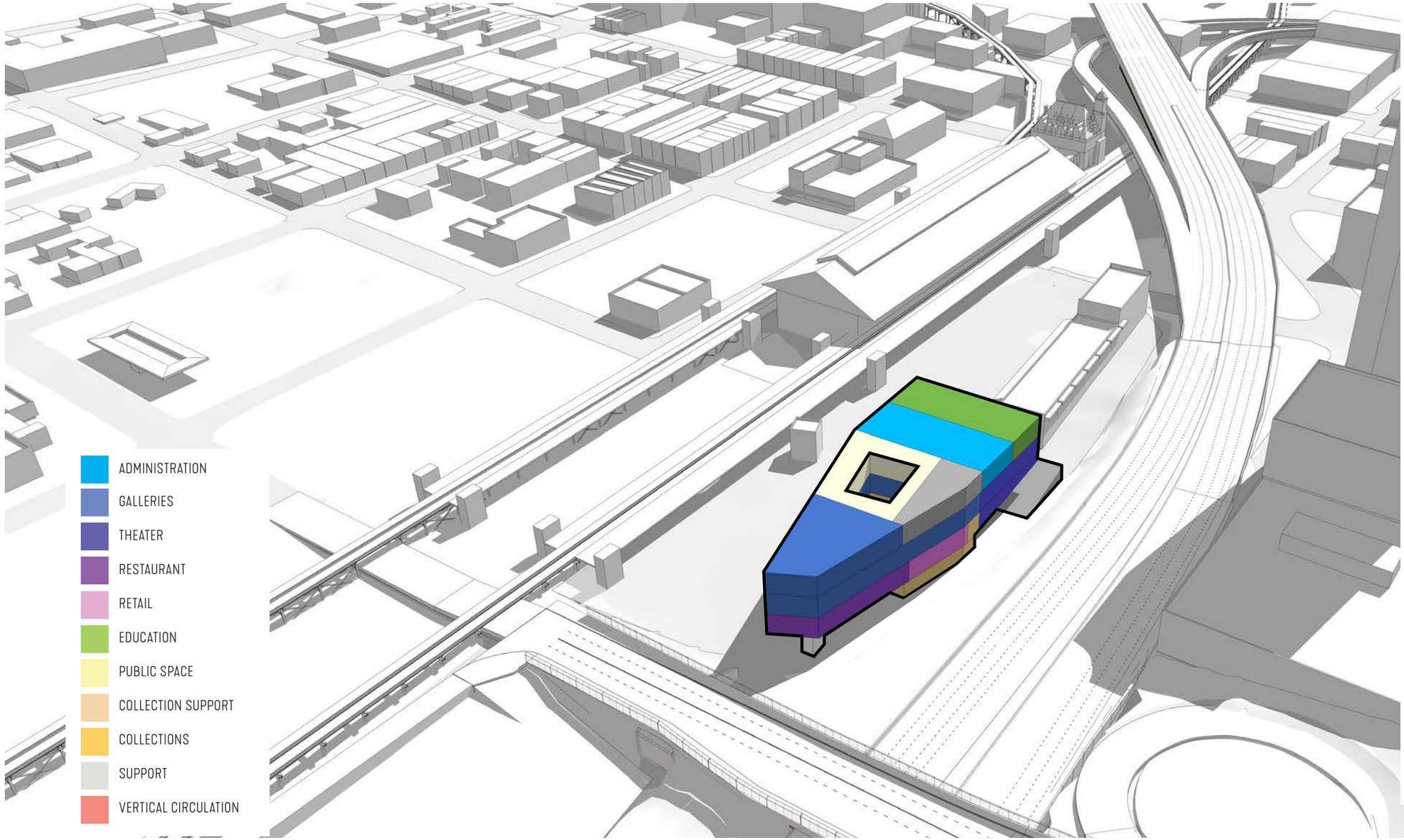
← SEE STRUCTURAL DRAWINGS FOR FURTHER REFERENCE →

# MASSING STUDY
## OPTION 01: 3D PERSPECTIVE FACING NORTH



# MASSING STUDY
## OPTION 01: 3D PERSPECTIVE FACING SOUTH



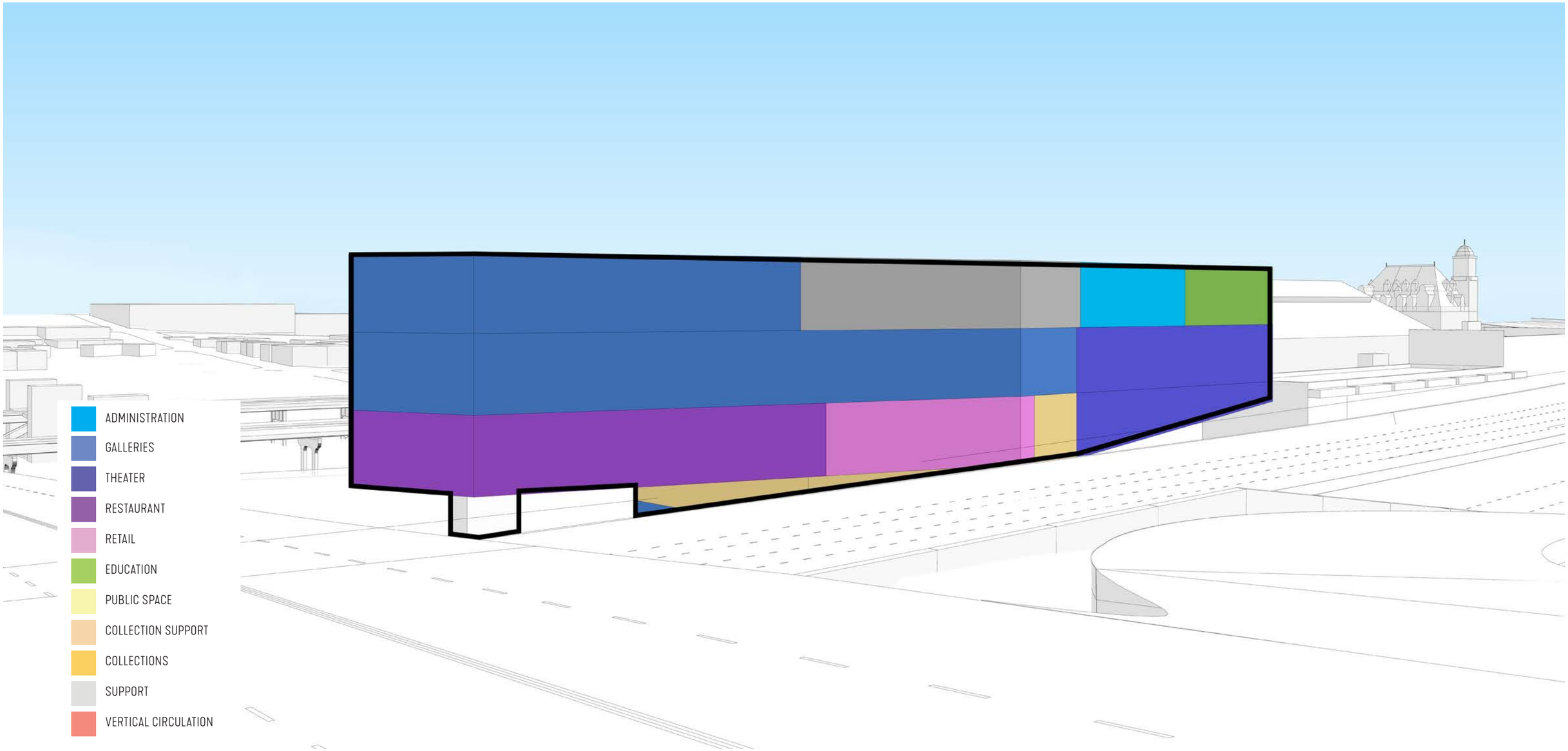

**PROS:**

1. THE PRIMARY MASS OF THIS BUILDING (2ND FLOOR AND ABOVE) IS ELEVATED A FULL STORY ABOVE THE 100 YEAR FLOOR PLAIN .
2. ELEVATING THE BUILDING ABOVE OBSTRUCTIONS ALLOWS FOR LARGE AND EFFICIENT FLOOR PLATES.
3. THE OPEN SPACE BELOW THE ELEVATED BUILDING AFFORDS A DIRECT OPPURTUNITY TO EXPAND AND THOROUGHLY INTEGRATE THE SITE INTO THE BUILDING.
4. AFFORDS OPPURTUNITIES FOR AN INTERPETIVE LOOK OUT POINT TO OVERLOOK RELATED SITES THROUGHOUT SHOCKOE BOTTOM.

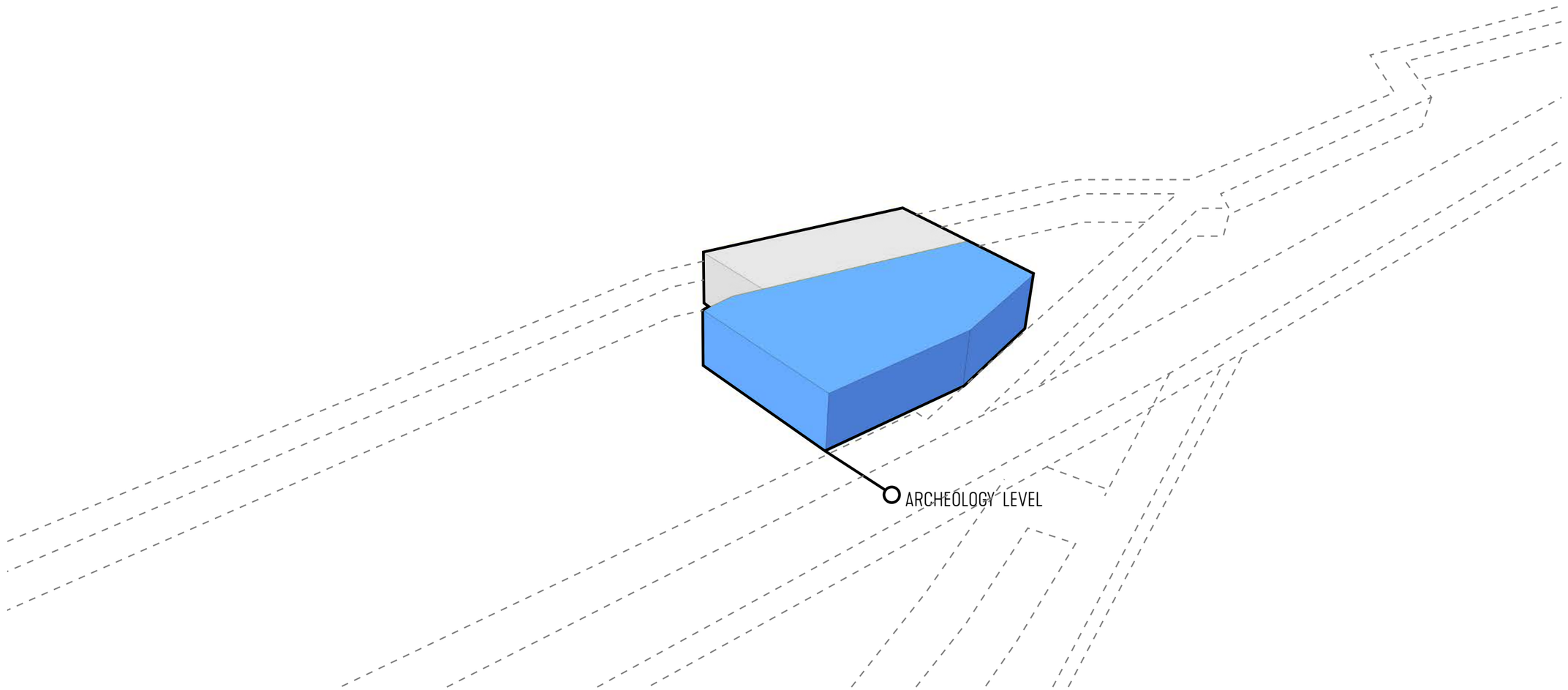
**CONS:**

1. ELEVATING THE MASS OF THE BUILDING HAS A GREATER IMPACT ON THE VIEW SHEDS TO AND FROM THE TRAIN SHED.
2. ELEVATING THE MASS OF THE BUILDING 1 STORY ABOVE THE100 YEAR FLOOD PLAIN CREATES AN EXPERIENTIAL DISCONNECT. BETWEEN THE ARCHAEOLOGY AND THE PRIMARY BUILDING FUNCTIONS ELEVATED ABOVE. HOWEVER, THIS COULD BE AN OPPURTUNITY TO DIFFERENTIATE THE INTERPETIVE EXPERIENCE AROUND THE ARCHAEOLOGY FROM THE MAIN MUSEUM MAKING THE ARCHAEOLOGY A SELF CONTAINED EXPERIENCE NOT REQUIRING ACCESS TO THE MAIN MUSEUM.

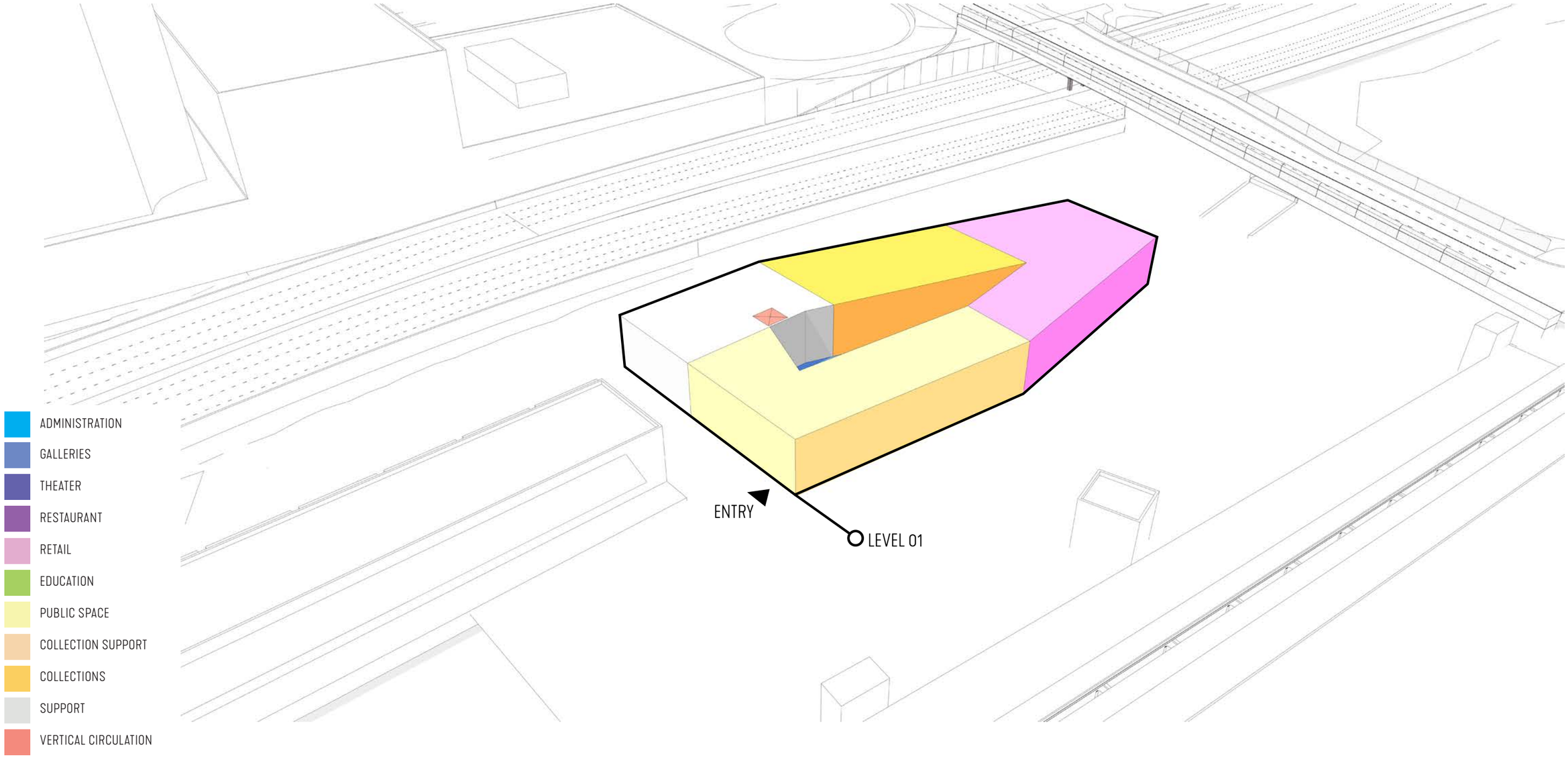
# MASSING STUDY
## OPTION 01: 3D PERSPECTIVE VIEW SHED



# MASSING STUDY
## OPTION 02: LEVEL B1 (BELOW GRADE)



# MASSING STUDY
OPTION 02: LEVEL 01



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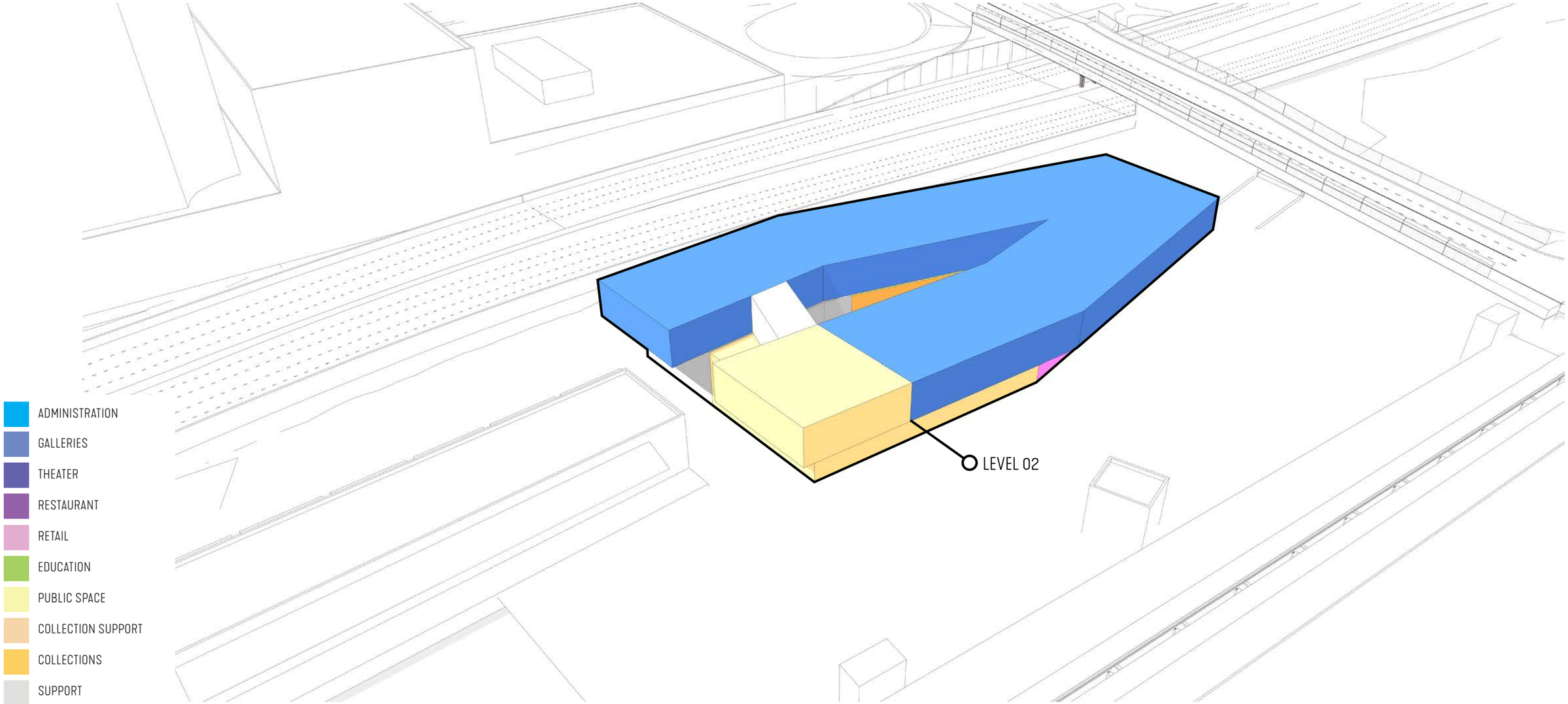
## OPTION 02: LEVEL 02




- ADMINISTRATION
- GALLERIES
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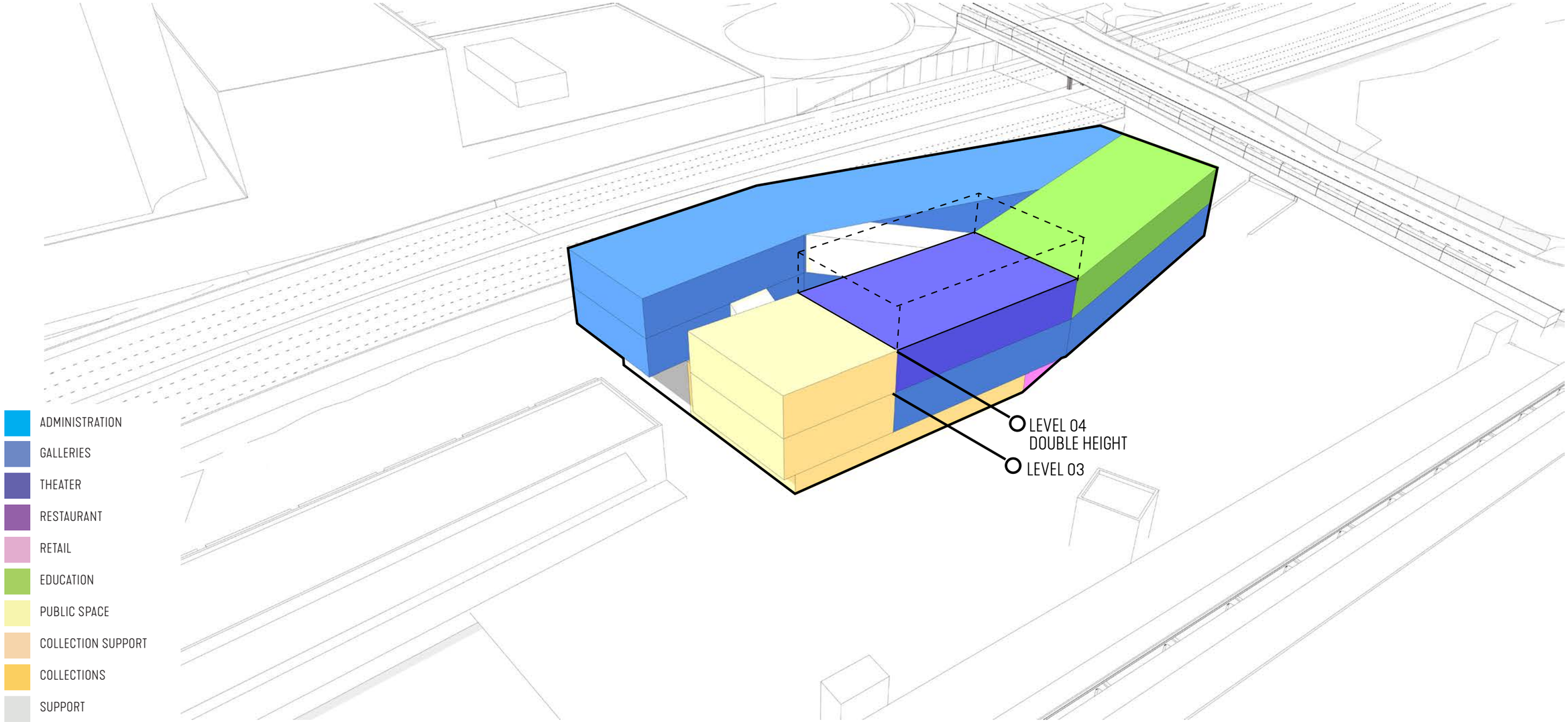
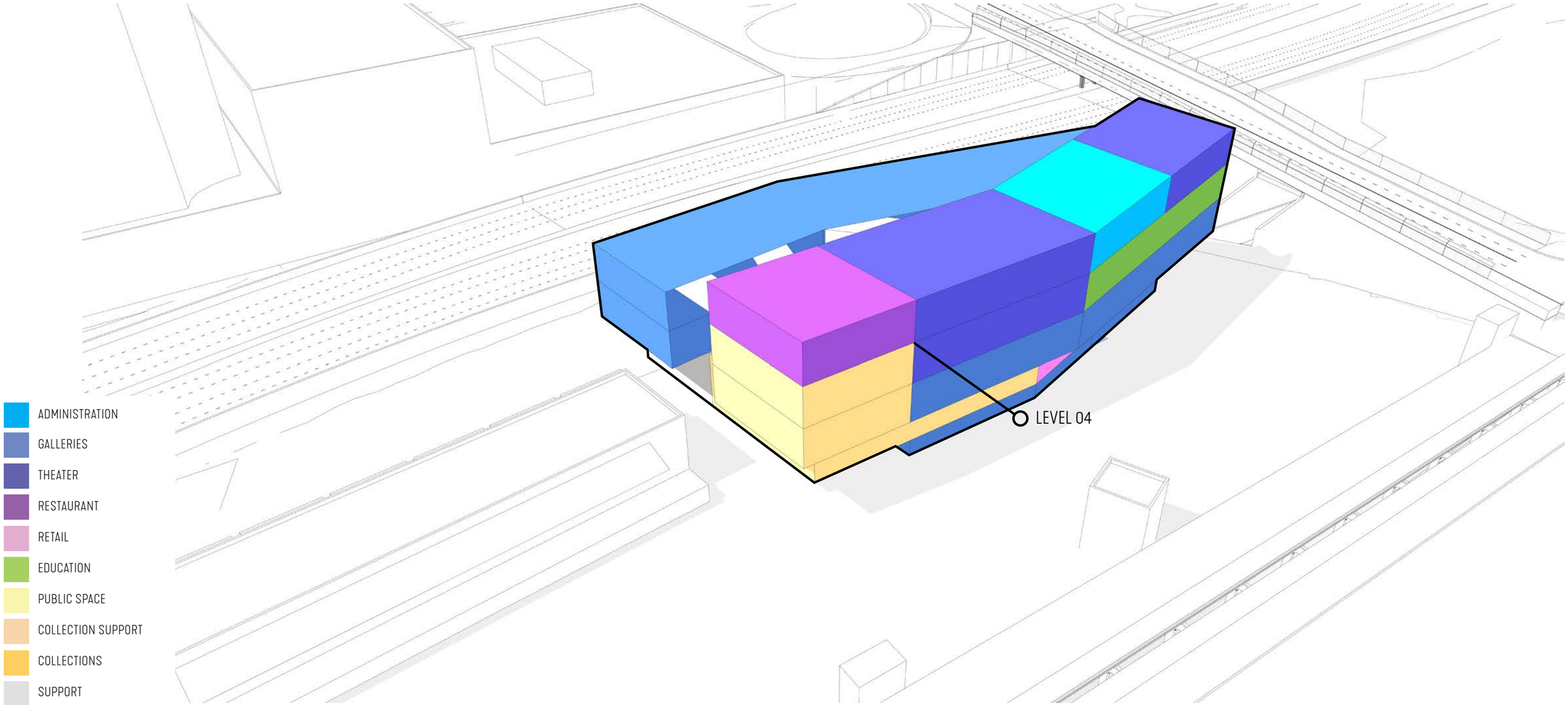
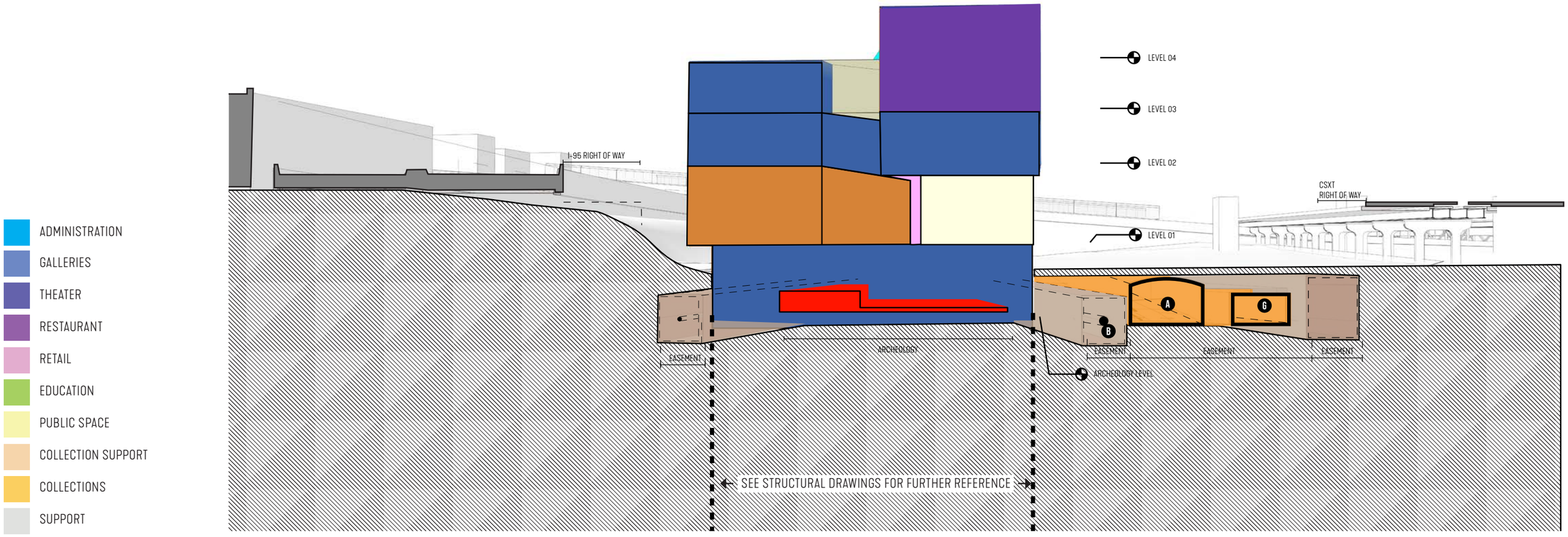
# MASSING STUDY
## OPTION 02: LEVEL 03



# MASSING STUDY
## OPTION 02: LEVEL 04



# MASSING STUDY
## OPTION 02: TRANSVERSE 3D SITE SECTION

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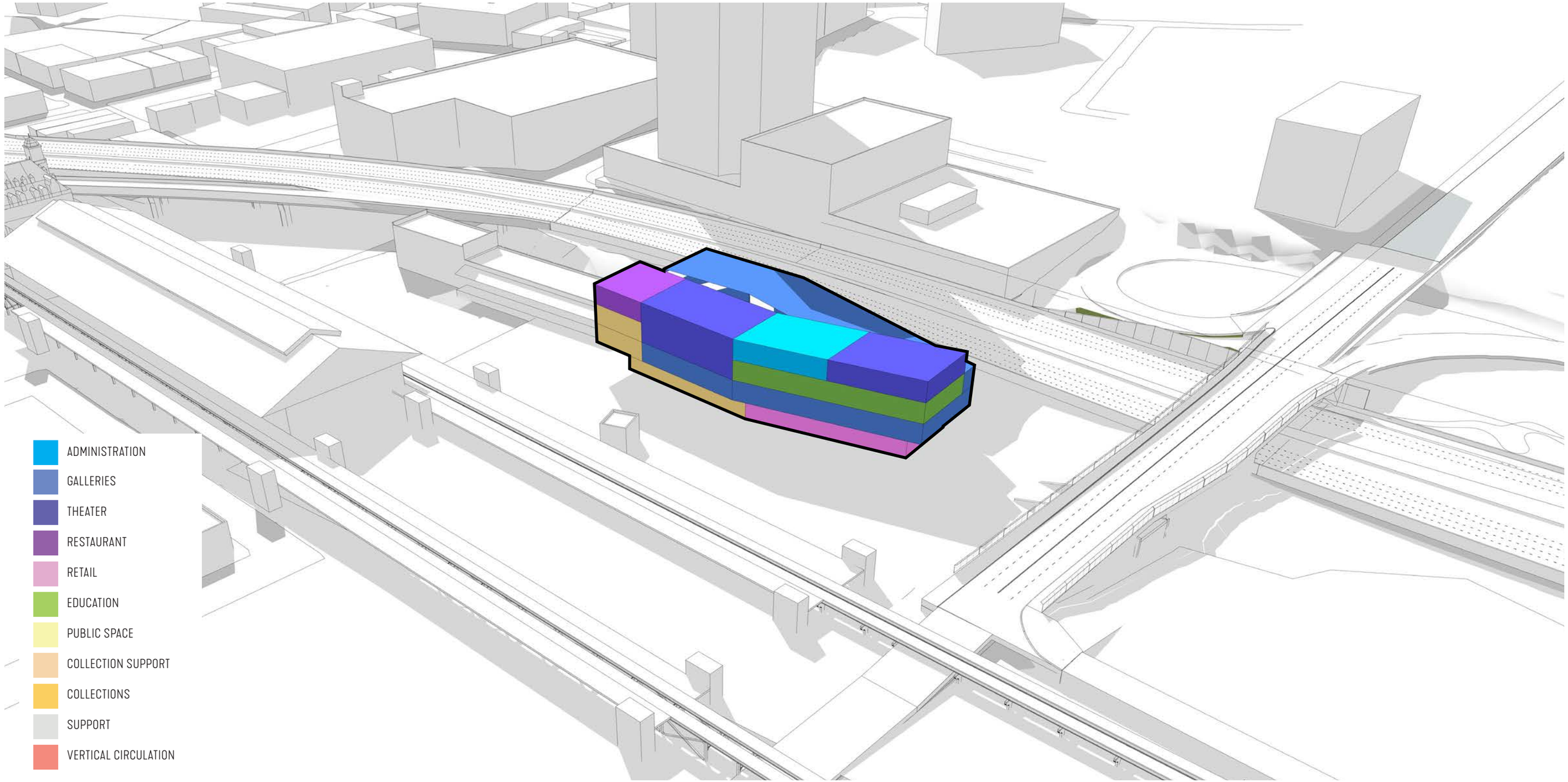
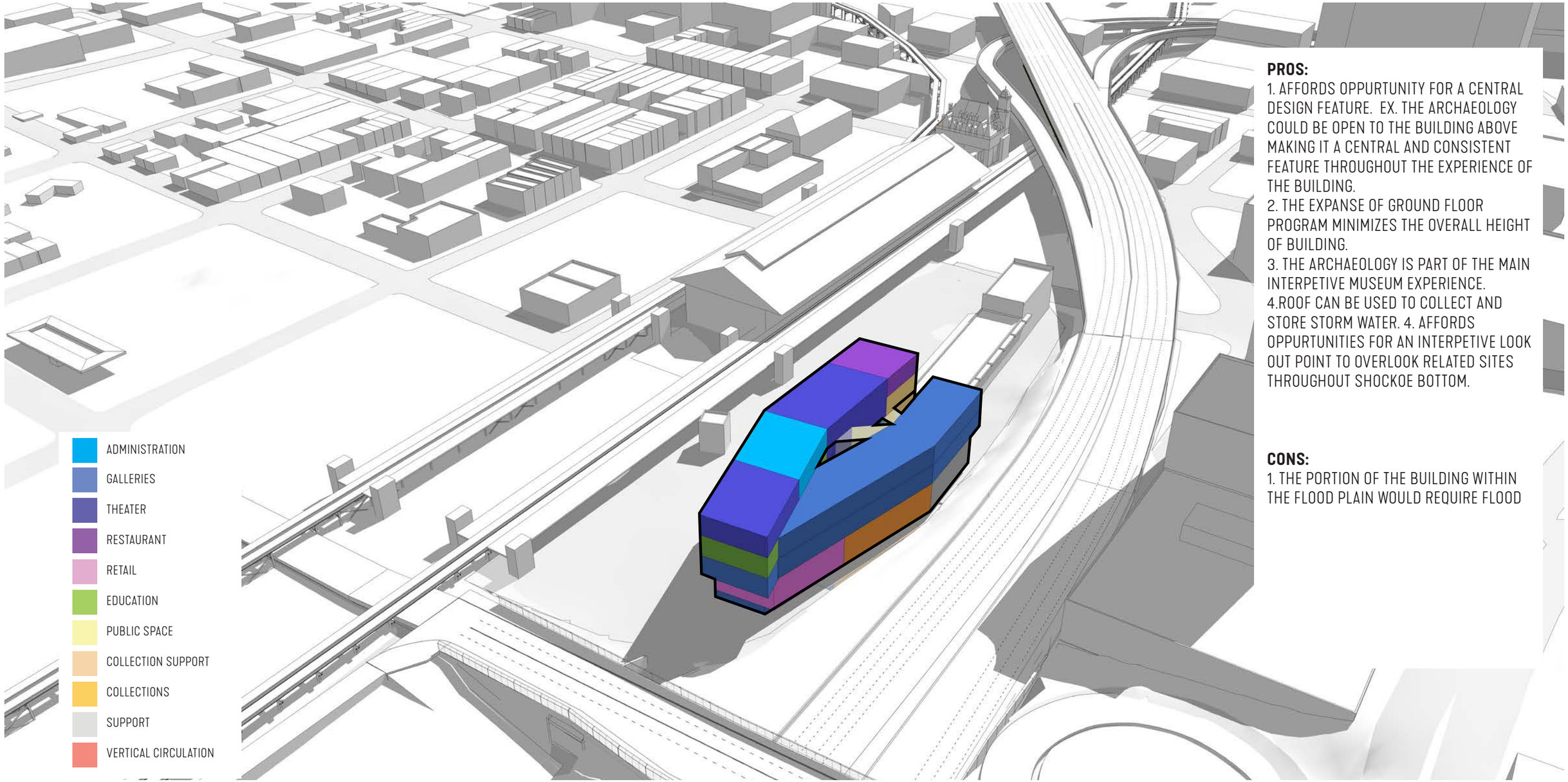
# MASSING STUDY
## OPTION 02: 3D PERSPECTIVE FACING NORTH



# MASSING STUDY
## OPTION 02: 3D PERSPECTIVE FACING SOUTH



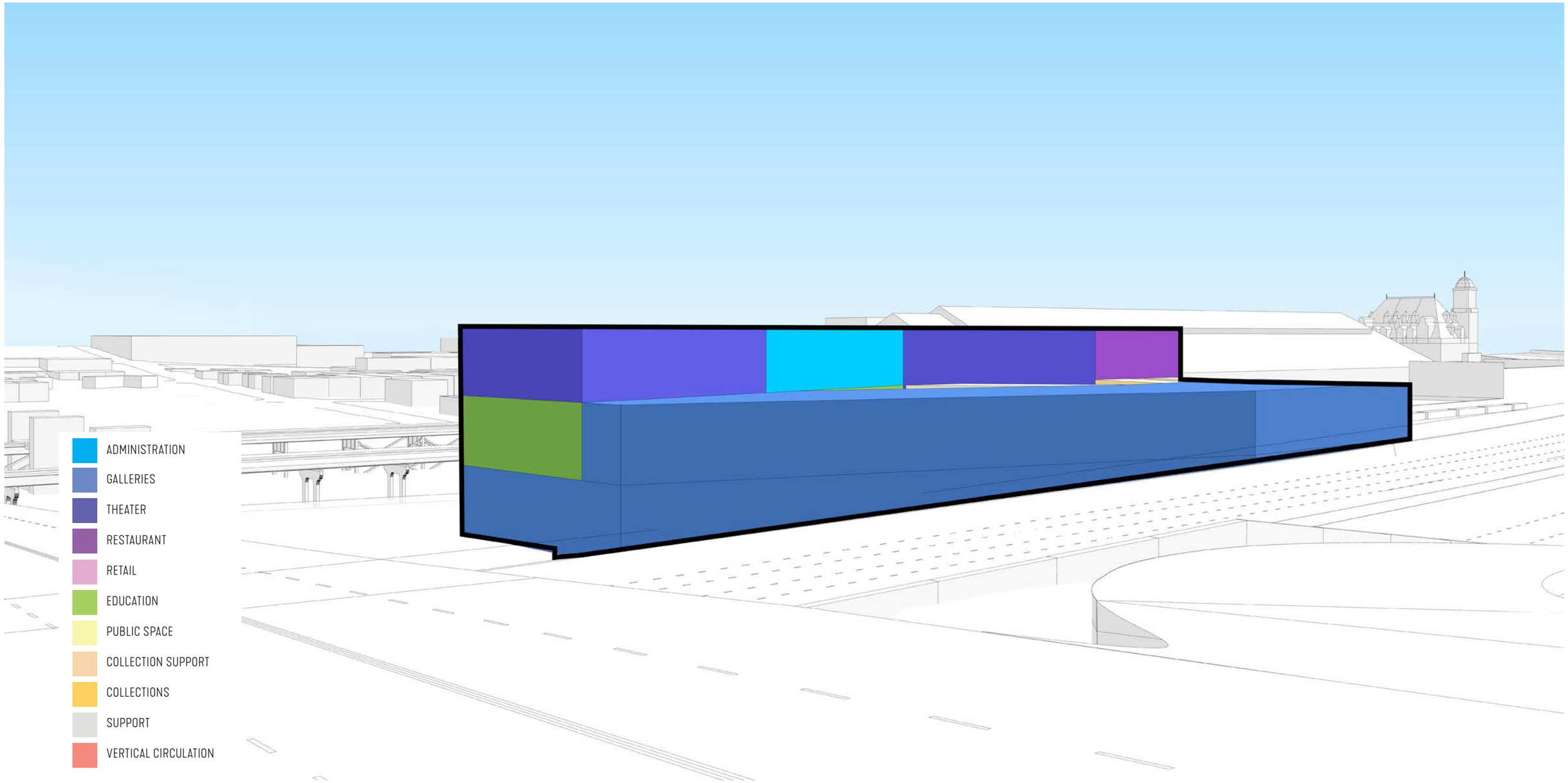

**PROS:**

1. AFFORDS OPPURTUNITY FOR A CENTRAL DESIGN FEATURE. EX. THE ARCHAEOLOGY COULD BE OPEN TO THE BUILDING ABOVE MAKING IT A CENTRAL AND CONSISTENT FEATURE THROUGHOUT THE EXPERIENCE OF THE BUILDING.
2. THE EXPANSE OF GROUND FLOOR PROGRAM MINIMIZES THE OVERALL HEIGHT OF BUILDING.
3. THE ARCHAEOLOGY IS PART OF THE MAIN INTERPETIVE MUSEUM EXPERIENCE.
4.ROOF CAN BE USED TO COLLECT AND STORE STORM WATER. 4. AFFORDS OPPURTUNITIES FOR AN INTERPETIVE LOOK OUT POINT TO OVERLOOK RELATED SITES THROUGHOUT SHOCKOE BOTTOM.

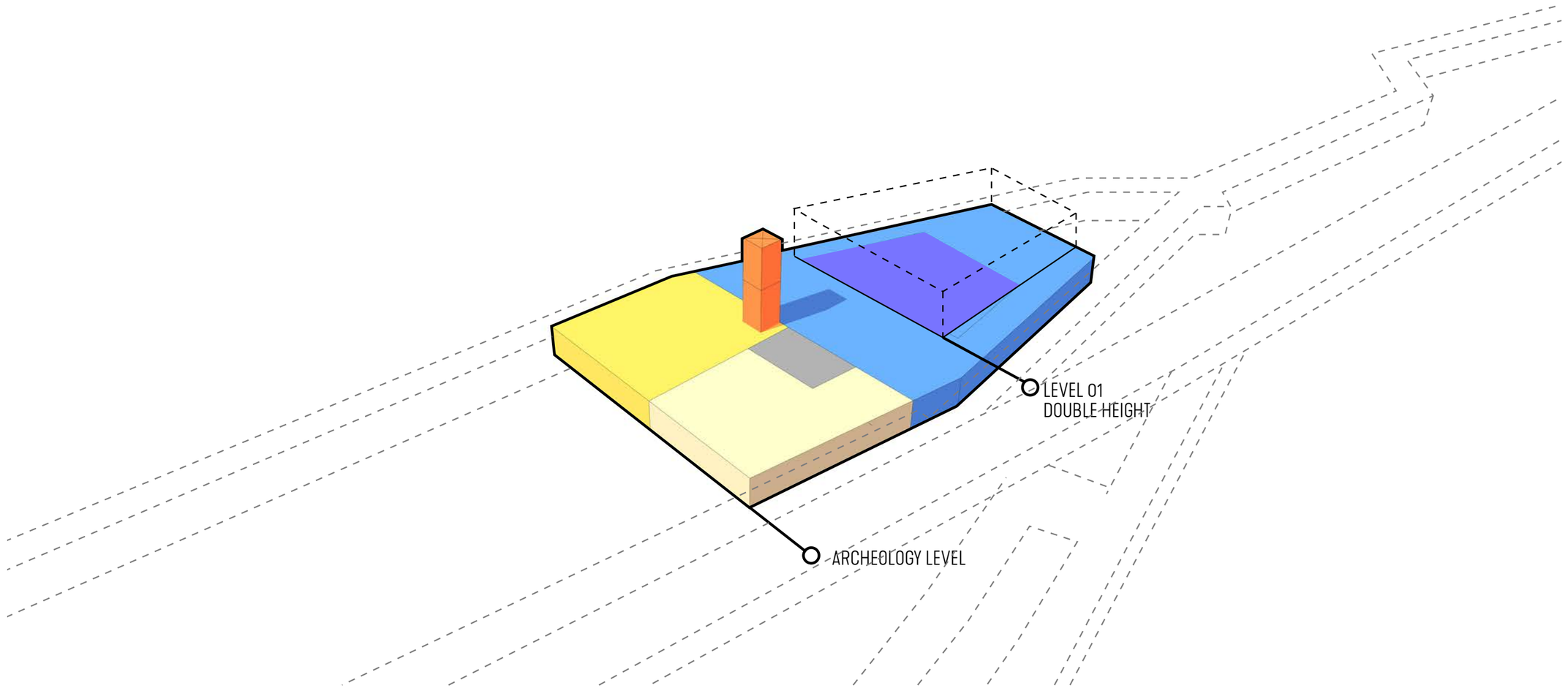
**CONS:**

1. THE PORTION OF THE BUILDING WITHIN THE FLOOD PLAIN WOULD REQUIRE FLOOD

# MASSING STUDY
## OPTION 02: 3D PERSPECTIVE VIEW SHED

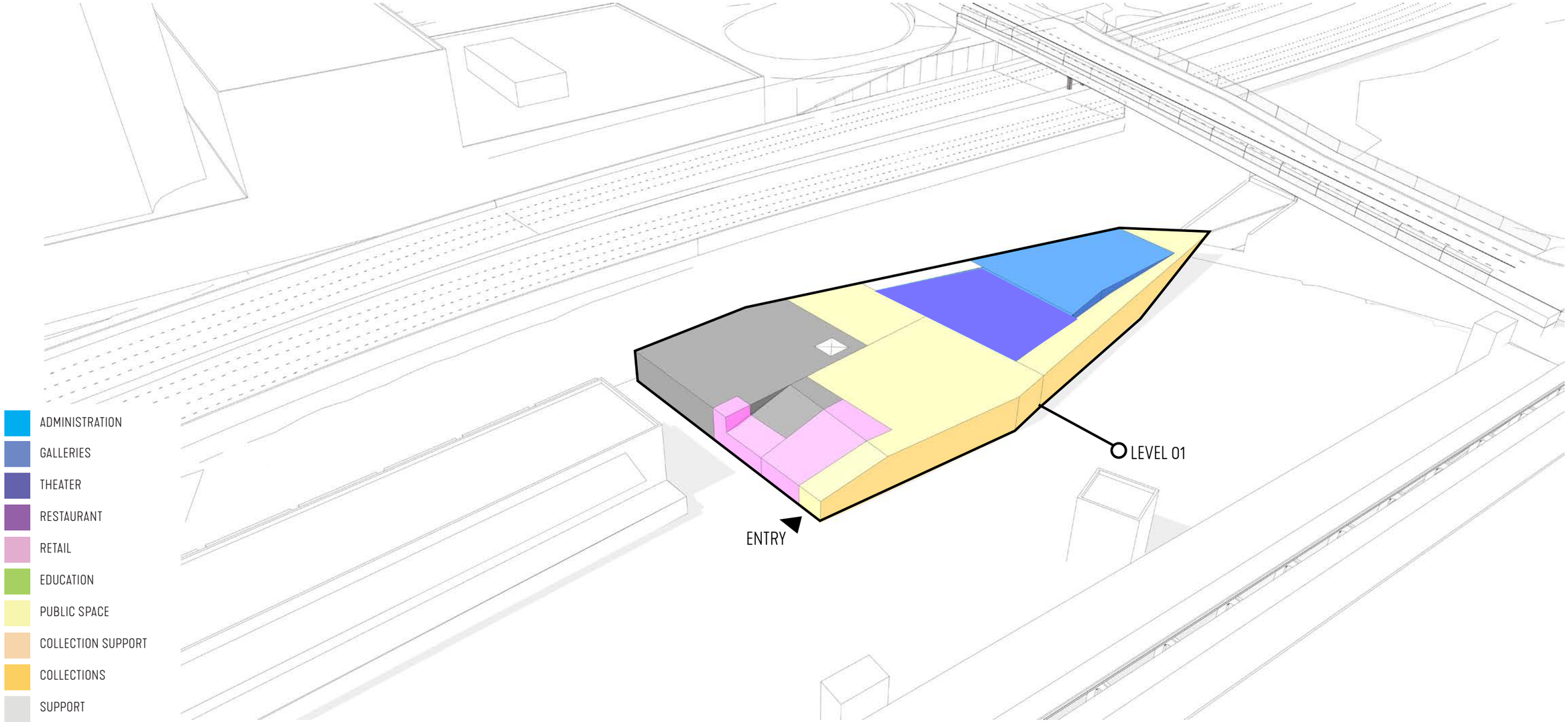


# MASSING STUDY
## OPTION 03: LEVEL B1 (BELOW GRADE)

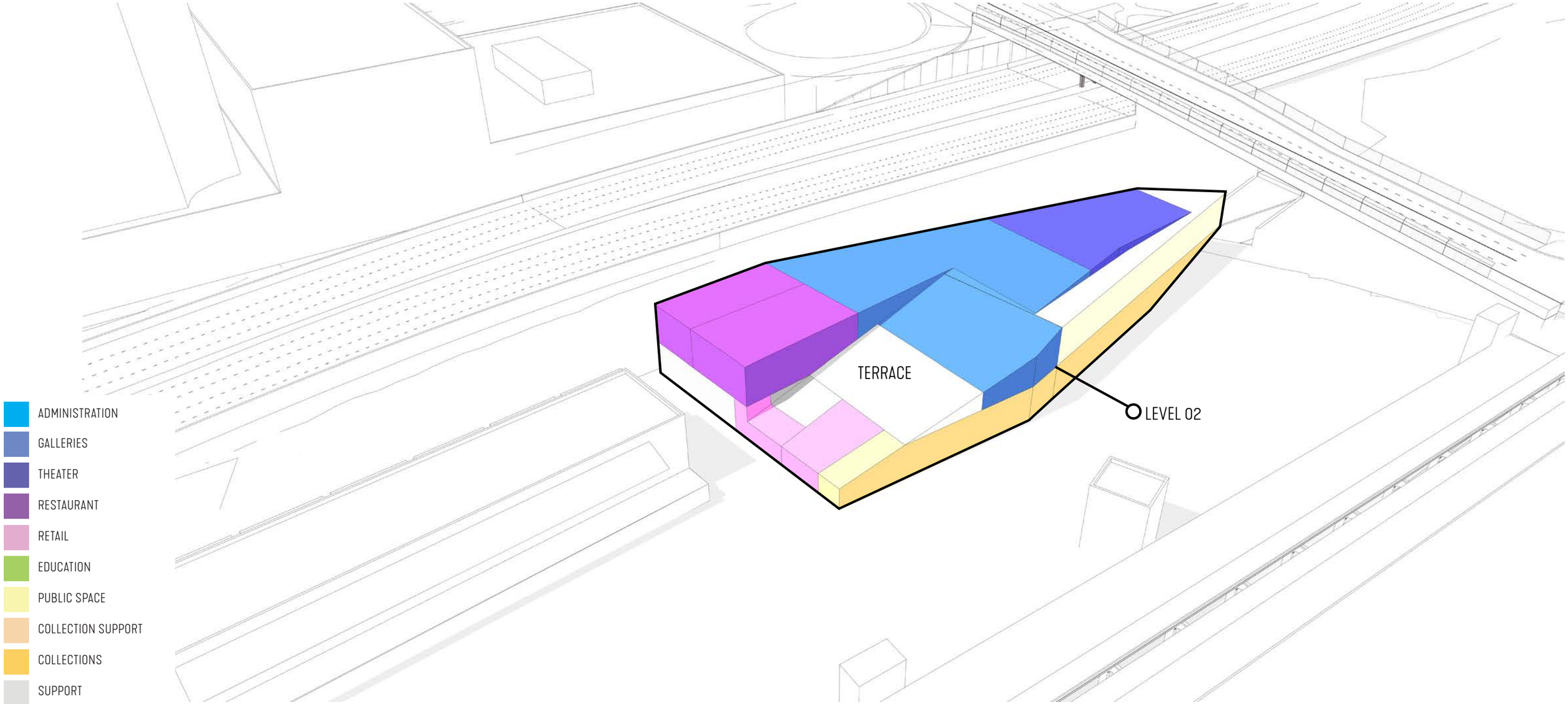



- ADMINISTRATION
- GALLERIES
- THEATER
- RESTAURANT
- RETAIL
- EDUCATION
- PUBLIC SPACE
- COLLECTION SUPPORT
- COLLECTIONS
- SUPPORT
- VERTICAL CIRCULATION

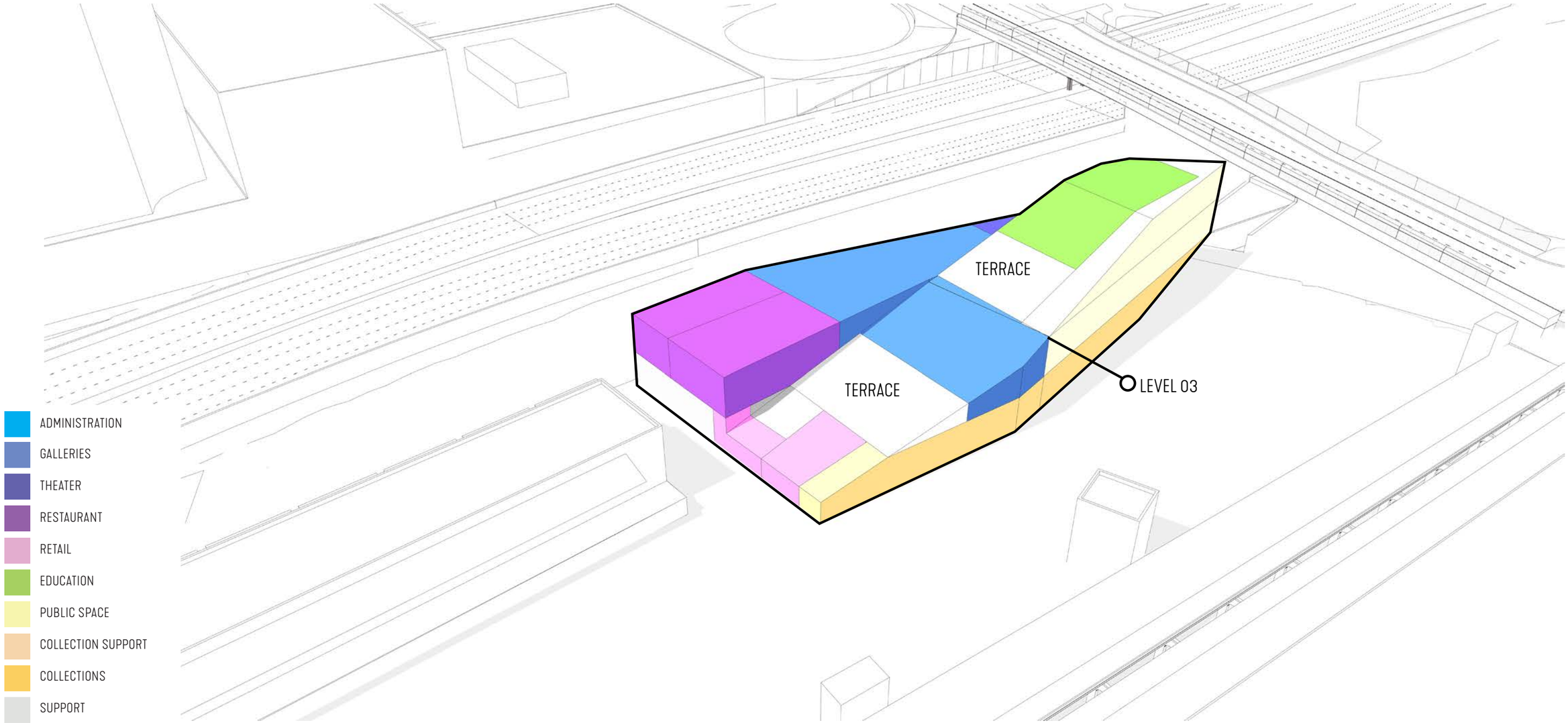
# MASSING STUDY
## OPTION 03: LEVEL 01



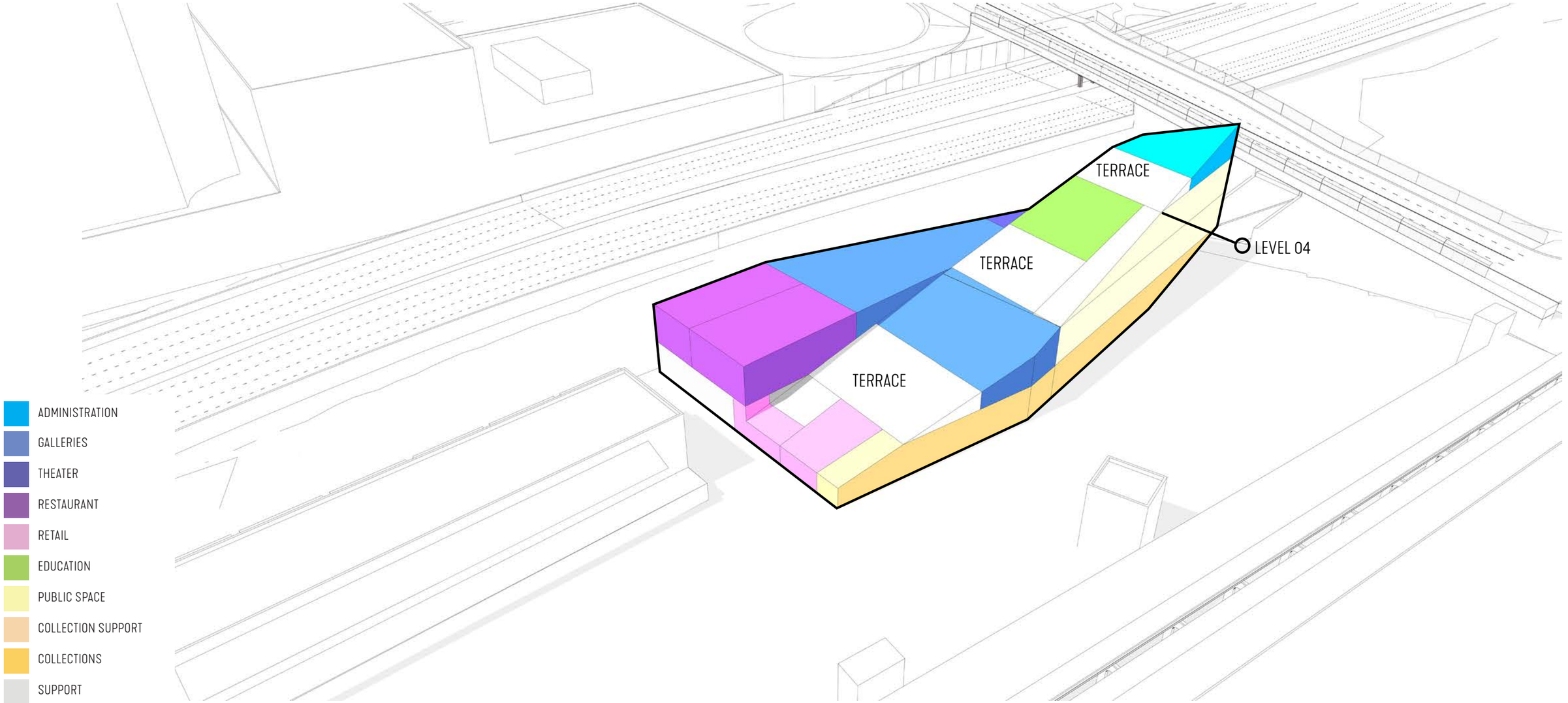
# MASSING STUDY
## OPTION 03: LEVEL 02



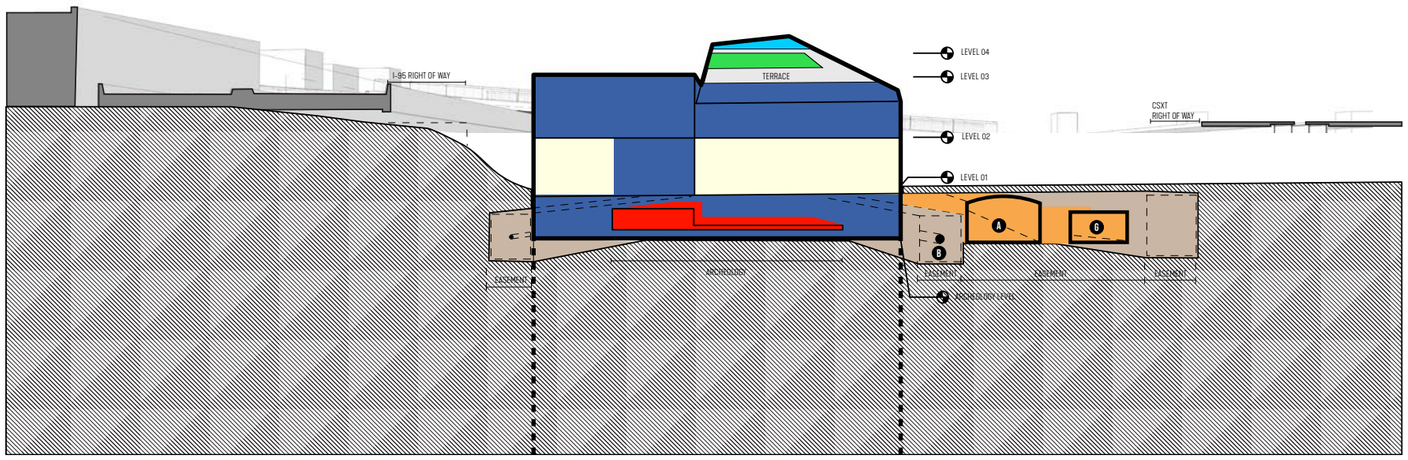
# MASSING STUDY
## OPTION 03: LEVEL 03



# MASSING STUDY
## OPTION 03: LEVEL 04



# MASSING STUDY
## OPTION 03: TRANSVERSE 3D SITE SECTION




- ADMINISTRATION
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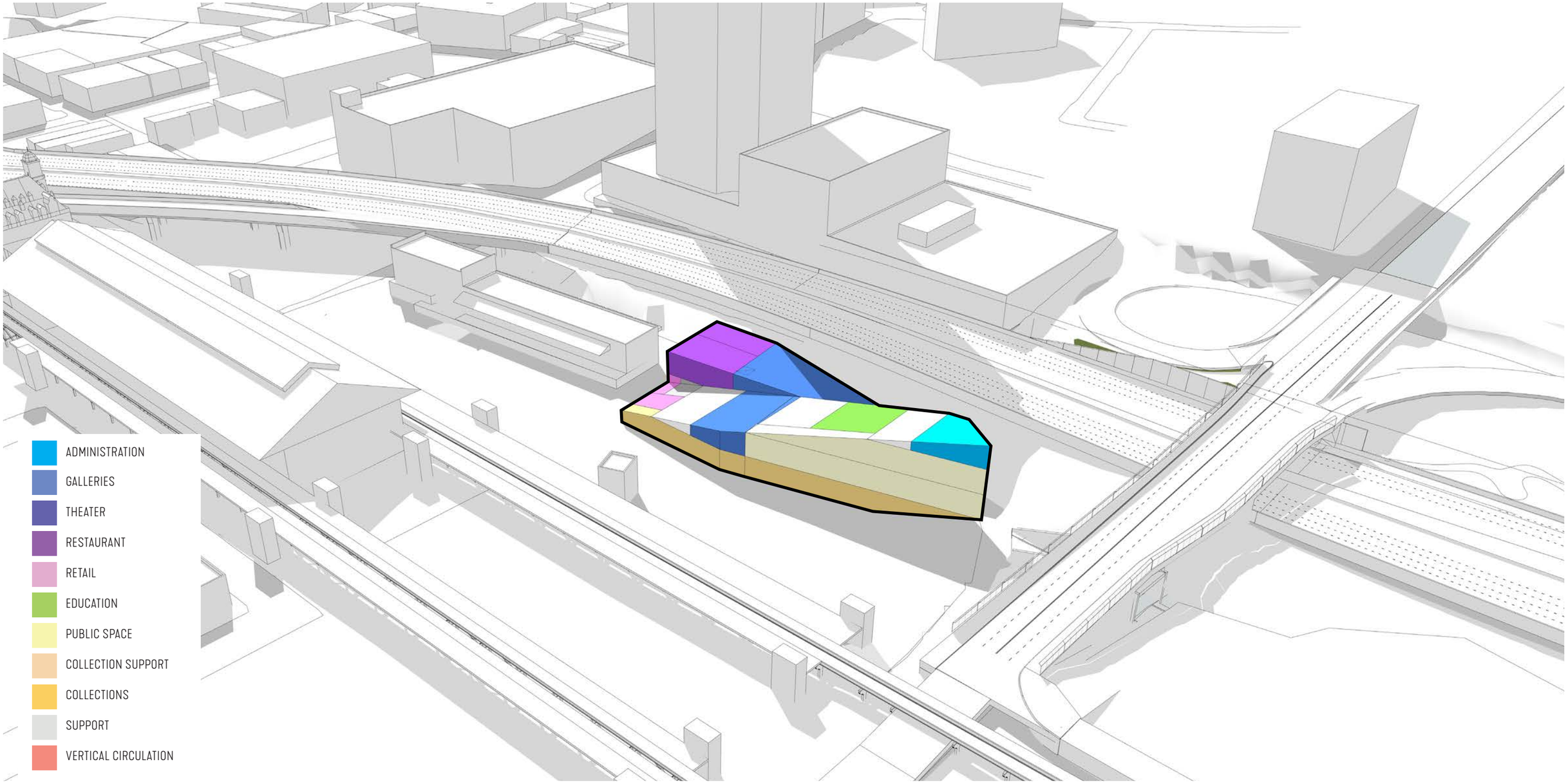
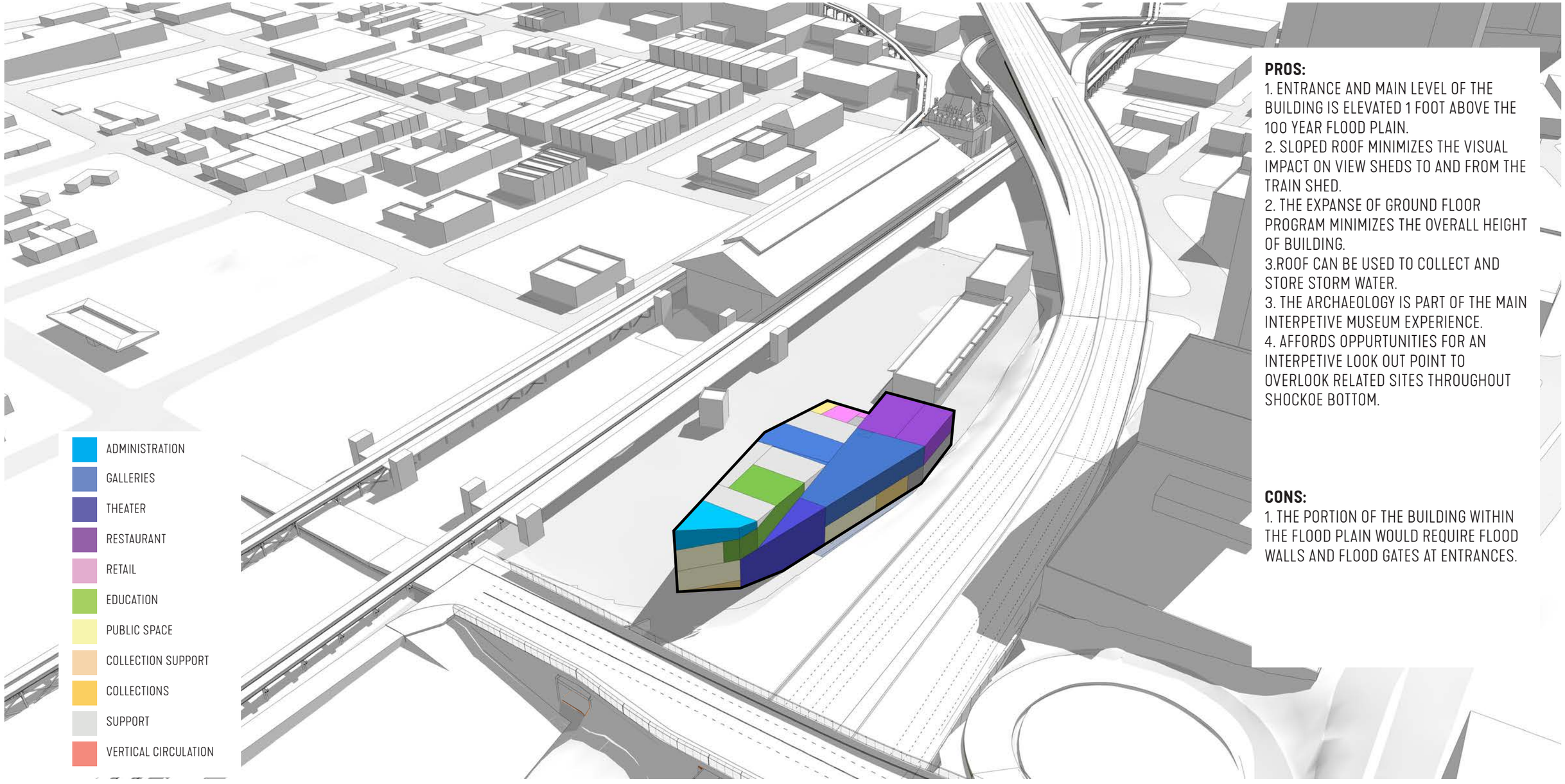
← SEE STRUCTURAL DRAWINGS FOR FURTHER REFERENCE →

# MASSING STUDY
## OPTION 03: 3D PERSPECTIVE FACING NORTH



# MASSING STUDY
## OPTION 03: 3D PERSPECTIVE FACING SOUTH



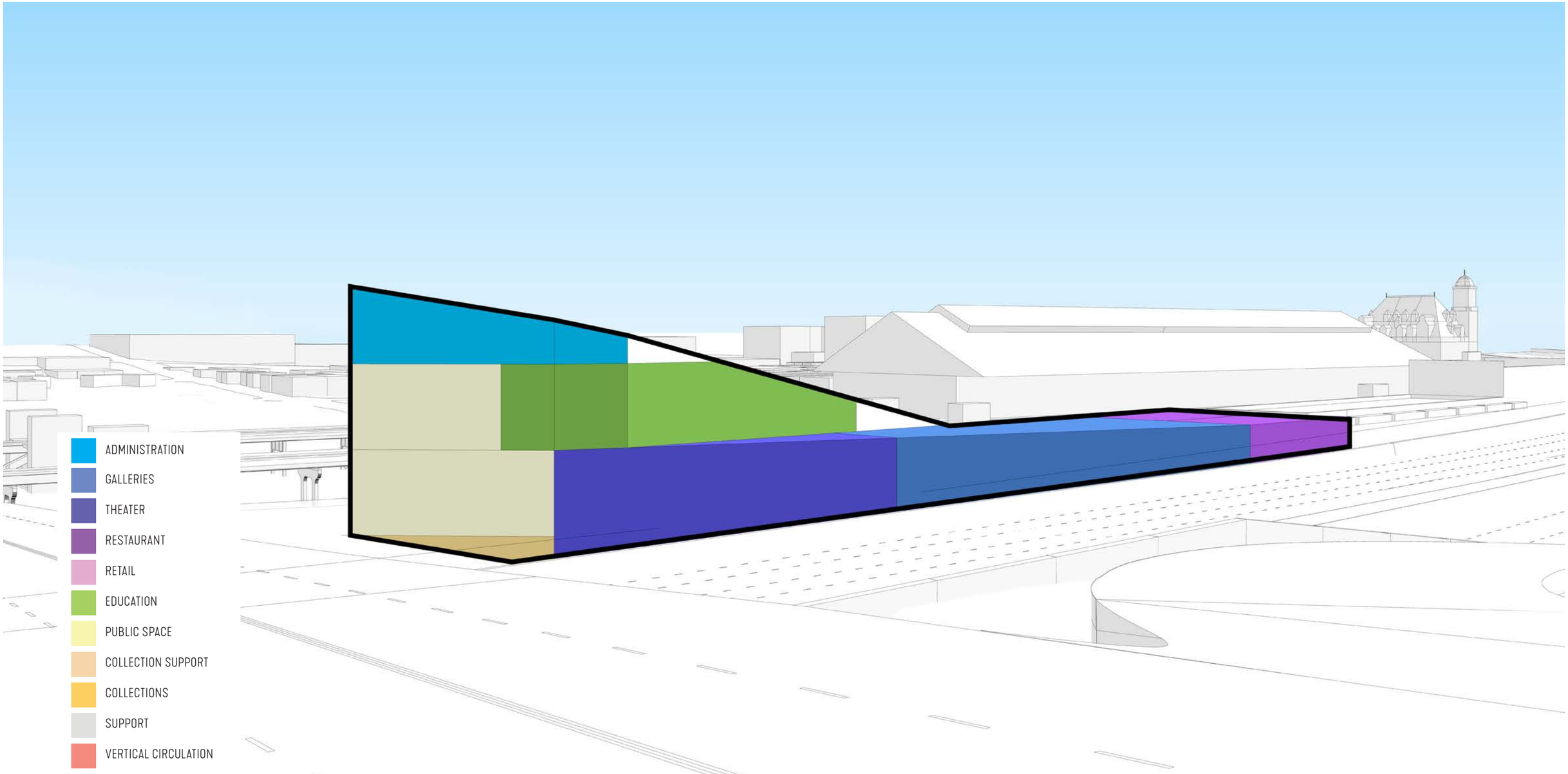

**PROS:**

1. ENTRANCE AND MAIN LEVEL OF THE BUILDING IS ELEVATED 1 FOOT ABOVE THE 100 YEAR FLOOD PLAIN.
2. SLOPED ROOF MINIMIZES THE VISUAL IMPACT ON VIEW SHEDS TO AND FROM THE TRAIN SHED.
2. THE EXPANSE OF GROUND FLOOR PROGRAM MINIMIZES THE OVERALL HEIGHT OF BUILDING.
3.ROOF CAN BE USED TO COLLECT AND STORE STORM WATER.
3. THE ARCHAEOLOGY IS PART OF THE MAIN INTERPETIVE MUSEUM EXPERIENCE.
4. AFFORDS OPPURTUNITIES FOR AN INTERPETIVE LOOK OUT POINT TO OVERLOOK RELATED SITES THROUGHOUT SHOCKOE BOTTOM.

**CONS:**

1. THE PORTION OF THE BUILDING WITHIN THE FLOOD PLAIN WOULD REQUIRE FLOOD WALLS AND FLOOD GATES AT ENTRANCES.

# MASSING STUDY
## OPTION 03: 3D PERSPECTIVE VIEW SHED



# COST ESTIMATE

# COST ESTIMATE

**COST ESTIMATE AND ANALYSIS**

On these pages, you will find an outline of rough-order-of-magnitude (ROM) costs for a project to mitigate constraints, provide protection for the archaeology, and build a structure that is comprised of the interpretive program vetted by the public in 2018.

**Cost estimate assumes a building including the excavated archaeology of approximately 97,000 gsf.**

This site feasibility study made certain assumptions regarding the encapsulation of the archaeological assets and the building program as an example of the financial impact of a project of this importance. Future work and refined costing will require further archaeological investigation and building/infrastructure design prior to defining a more detailed understanding of all the costs involved. In this analysis, a range of typical industry standards has been provided to allow for decision making during this process.

Below are descriptions for the work covered in the summary cost table:

- **Museum:** This section includes all construction work associated with the building except for archaeological and flood mitigation measures. This includes, structure, enclosure, mechanical and electrical services and installations, all contractor indirect costs (general conditions, overhead, profit), construction and design contingency specific to the building. This also includes the excavation below ground.
- **Infrastructure:** This includes the heavy construction infrastructure required to provide a below ground sealed environment for the archaeology including slurry walls, utility relocation, new utility services, retention basin and other flood mitigation measures.
- **Exhibit MEP:** This extends the building mechanical and electrical systems beyond the base build to provide a dedicated secondary system for the exhibits and interpretive spaces.
- **Exterior:** This section provides allowances for hard and soft landscaping including final grading of the topsoil.
- **Escalation:** All pricing is based upon current day pricing. This allowance is an estimated addition to account for price rises at the time of bid for the project – for this project Q2 2024. This date was selected as a target to provide a realistic escalation number.
- **Total Construction:** Provides the costs for the building complete except for the exhibitions. Exhibition costs provided can be a range dependent upon the detail and level of digital components or casework provided. Industry standard ranges have been included in this report.
- **Total Exhibits:** Provides allowance for the supply and installation of all exhibits (excluding artifacts) along with design fees associated with this specific work. Artifacts and object installation would be a component of a specific project budget determined once gallery, exhibit, or interpretive design is complete.
- **Other:** This includes fees for all other team member fees (architect, civil, engineers, etc.), planning fees, all surveys, presentations and models, and design team expenses. An allowance for FFE and a client contingency @ 10% across all costs make up the bulk of these figures. Those listed and calculated in this report are to give the City a rough-order-of magnitude scale of additional costs to the overall project that are outside of site and building construction costs to assist in an understanding of a complete financial project cost outline. These costs may change up or down due to specific scope requirements or design requirements for the project.

**FIGURE 1: TOTAL PROJECT COST RANGE PER CATEGORY**

| High level Summary - Project Cost Range | Low | High | |
|---|---|---|---|
| Museum, building, archeology | $65,700,000 | $80,200,000 | 36% |
| Infrastructure, flood mitigation, slurry walls, tie backs | $9,100,000 | $11,200,000 | 5% |
| Exhibit MEP | $7,000,000 | $8,600,000 | 4% |
| Exterior; landscaping, site work | $4,200,000 | $5,200,000 | 2% |
| Escalation; midpoint of constr. Q2 2024 | $10,000,000 | $12,300,000 | 5% |
| **Construction Costs** | **$96,000,000** | **$117,500,000** | **52%** |
| Exhibits; including exhibit design fees | $25,500,000 | $31,200,000 | 14% |
| Other; AV, IT, FFE, Fees | $62,600,000 | $76,300,000 | 34% |
| Total | $184,100,000 | $225,000,000 | 100% |

**FIGURE 2: TOTAL PROJECT COST OUTLINE: MID-RANGE EXAMPLE ESTIMATE**

| Mid-range Example | | Sub Total | $/sf | Cumulative Total | Cumulative $/sf |
|---|---|---|---|---|---|
| Construction cost | | | | | |
| Museum | | $72,952,870 | $753.29 | | |
| Infrastructure | | $10,142,132 | $104.72 | | |
| Exhibit Infrastructure @ $150/sf of exhibit area | | $7,812,000 | $80.66 | | |
| Exterior | | $4,711,568 | $48.65 | | |
| Escalation | 11.66% | $11,153,782 | $115.17 | | |
| Total Construction | | $106,772,352 | $1,102.50 | $106,772,352 | $1,102.50 |
| Exhibits | | | | | |
| Exhibit, 30,000sf x $800 | | $24,000,000 | $247.82 | | |
| Exhibition designer | 18.00% | $4,320,000 | $44.61 | | |
| Total Exhibits | | $28,320,000 | $292.42 | $135,092,352 | $1,394.92 |
| Architect | 6.00% | $6,406,341 | $66.15 | | |
| Project Manager (Owners Representative) | | excl | | | |
| Estimator | 0.40% | $427,089 | $4.41 | | |
| Structural Engineer | 1.00% | $1,067,724 | $11.02 | | |
| Civil | 1.00% | $1,067,724 | $11.02 | | |
| Building Services Engineer (MEP/FP) | 2.00% | $2,135,447 | $22.05 | | |
| Acoustics | 0.50% | $533,862 | $5.51 | | |
| Other specialists yet to be identified | 1.00% | $1,067,724 | $11.02 | | |
| Legal Fees | 2.00% | $2,135,447 | $22.05 | | |
| Tax Consultancy | 0.10% | $106,772 | $1.10 | | |
| Planning Consultant | 0.30% | $320,317 | $3.31 | | |
| Planning Fees | 0.50% | $533,862 | $5.51 | | |
| Building Regulation Fees / Approved Inspect | 0.30% | $320,317 | $3.31 | | |
| Topographical survey | 0.30% | $320,317 | $3.31 | | |
| Geotechnical survey | 0.30% | $320,317 | $3.31 | | |
| Acoustic survey | 0.50% | $533,862 | $5.51 | | |
| Other surveys | 1.00% | $1,067,724 | $11.02 | | |
| Expenses in relation to Professional Fees | 0.25% | $266,931 | $2.76 | | |
| Presentations and models | 0.60% | $640,634 | $6.61 | | |
| Total Fees | | $19,272,409 | $199.00 | $154,364,761 | $1,593.92 |
| FFE / AV / IT / Security @ $50/sf | | $4,842,300 | $50.00 | | |
| Client Contingency | 10.00% | $15,920,706 | $164.39 | | |
| Total Other | | $40,035,416 | $413.39 | $194,400,177 | $2,007.31 |
| TOTAL | | $194,400,177 | $2,007.31 | | |

# COST ESTIMATE

**FIGURE 3: TOTAL PROJECT COST OUTLINE: SUMMARY MATRIX OF MID-RANGE CONSTRUCTION COSTS**

SUMMARY MATRIX

| | | Museum 96,845 SF | | Infrastructure | | Exterior | | Overall Totals | |
|---|---|---|---|---|---|---|---|---|---|
| Element | | Subtotal | Cost/SF | Subtotal | Cost/SF | Subtotal | Cost/SF | Subtotal | Cost/SF |
| A) Shell (1-5) | | $26,039,275 | $268.87 | $2,928,426 | $30.24 | | | $28,967,701 | $299.11 |
| 1 Foundations | | $2,679,135 | $27.66 | $1,770,771 | $18.28 | | | $4,449,906 | $45.95 |
| 2 Vertical Structure | | $6,438,404 | $66.48 | | | | | $6,438,404 | $66.48 |
| 3 Floor & Roof Structures | | $6,385,268 | $65.93 | $148,376 | $1.53 | | | $6,533,643 | $67.46 |
| 4 Exterior Cladding | | $7,514,334 | $77.59 | $770,000 | $7.95 | | | $8,284,334 | $85.54 |
| 5 Roofing and Waterproofing | | $3,022,134 | $31.21 | $239,280 | $2.47 | | | $3,261,414 | $33.68 |
| B) Interiors (6-7) | | $7,425,764 | $76.68 | | | | | $7,425,764 | $76.68 |
| 6 Interior Partitions, Doors and Glazing | | $1,481,916 | $15.30 | | | | | $1,481,916 | $15.30 |
| 7 Floor, Wall and Ceiling Finishes | | $5,943,847 | $61.37 | | | | | $5,943,847 | $61.37 |
| C) Equipment and Vertical Transportation (8-9) | | $5,068,996 | $52.34 | | | | | $5,068,996 | $52.34 |
| 8 Function Equipment and Specialties | | $2,157,995 | $22.28 | | | | | $2,157,995 | $22.28 |
| 9 Stairs and Vertical Transportation | | $2,911,002 | $30.06 | | | | | $2,911,002 | $30.06 |
| D) Mechanical and Electrical (10-13) | | $17,945,269 | $185.30 | | | | | $17,945,269 | $185.30 |
| 10 Plumbing Systems | | $1,360,563 | $14.05 | | | | | $1,360,563 | $14.05 |
| 11 Heating, Ventilation and Air Conditioning | | $8,231,825 | $85.00 | | | | | $8,231,825 | $85.00 |
| 12 Electrical Lighting, Power and Communications | | $7,965,501 | $82.25 | | | | | $7,965,501 | $82.25 |
| 13 Fire Protection Systems | | $387,380 | $4.00 | | | | | $387,380 | $4.00 |
| E) Site Construction (14-16) | | | | $4,923,500.00 | $50.84 | $3,647,643 | $37.66 | $8,571,143.49 | $88.50 |
| 14 Site Preparation and Demolition | | | | | | | | | |
| 15 Site Paving, Structures & Landscaping | | | | $2,850,000 | $29.43 | $3,647,643.49 | $37.66 | $6,497,643 | $67.09 |
| 16 Utilities on Site | | | | $2,073,500 | $21.41 | | | | |
| Subtotal Cost | | $56,479,304 | $583.19 | $7,851,926 | $81.08 | $3,647,643 | $37.66 | $67,978,874 | $701.93 |
| General Conditions | 8.0% | $4,518,344 | $46.65 | $628,154 | $6.49 | $291,811 | $3.01 | $5,438,310 | $56.15 |
| General Requirements | 3.0% | $1,829,929 | $18.90 | $254,402 | $2.63 | $118,184 | $1.22 | $2,202,516 | $22.74 |
| Bonds & Insurance | 1.5% | $942,414 | $9.73 | $131,017 | $1.35 | $60,865 | $0.63 | $1,134,295 | $11.71 |
| Contractor's Fee | 4.0% | $2,550,800 | $26.34 | $354,620 | $3.66 | $164,740 | $1.70 | $3,070,160 | $31.70 |
| Design Contingency | 10.0% | $6,632,079 | $68.48 | $922,012 | $9.52 | $428,324 | $4.42 | $7,982,415 | $82.42 |
| Total Estimated Construction Cost | | $72,952,870 | $753.29 | $10,142,132 | $104.72 | $4,711,568 | $48.65 | $87,806,570 | $906.66 |

Prepared by CUMMING

# APPENDIX

# APPENDIX

Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

REPORT DATE: 9/3/2021

| DOCUMENTS AT PROJECT START (Pre-2021) | |
|---|---|
| 1 | **Archaeology** |
| | Main Street Station Site Plan (2000)<br>Loving's and City Parcels (2006)<br>JRIA Phase I report (2006)<br>JRIA Phase III Report (2010)<br>CD of field and artifact photos<br>JRIA-Matt Laird PPTs and presentations<br>2008 Geotech coring data<br>2008 shoring design (not implemented)<br>Main Street Station ESA (2008)<br>Soil and Groundwater Sampling Report (2009)<br>Intermediate Plan (Landscaping and Interpretation) (2009)<br>National Slavery Museum Shockoe Heritage Landscape Plan (2010?)<br>RSTC Charette Agenda (2011)<br>Richmond Community Visioning<br>BAM Architects 3D renderings<br>Lumpkin's Jail Complex and Museum (2013)<br>National Slavery Museum Master Plan (2014)<br>Richmond Speaks Final Report (2016)<br>June 2, 2016 letter from NPS (NRHP and NHL Office) to Richmond City Council RE: Site importance<br>Shockoe Bottom Memorial Park Community Proposal (June 2016)<br>November 2, 2016 letter from FTA To Jeannie Welliver RE: NEPA and Section 106 |
| 2 | **Historic Preservation and Site History** |
| | Main Street Station Site Plan (2000)<br>Loving's and City Parcels (2006)<br>JRIA Phase I report (2006)<br>JRIA Phase III Report (2010)<br>CD of field and artifact photos<br>Matt Laird PPTs and presentations<br>2008 Geotech coring data<br>2008 shoring design (not implemented)<br>Main Street Station ESA (2008)<br>Soil and Groundwater Sampling Report (2009)<br>Intermediate Plan (Landscaping and Interpretation) (2009)<br>National Slavery Museum Shockoe Heritage Landscape Plan (2010?)<br>RSTC Charette Agenda (2011)<br>Richmond Community Visioning (date?)<br>Burt Pinnock 3D renderings (2013?)<br>Lumpkin's Jail Complex and Museum (2013)<br>National Slavery Museum Master Plan (2014)<br>Richmond Speaks Final Report (2016)<br>June 2, 2016 letter from NPS (NRHP and NHL Office) to Richmond City Council RE: Site importance<br>Shockoe Bottom Memorial Park Community Proposal (June 2016, all updates through 2018, 2019)<br>November 2, 2016 letter from FTA To Jeannie Welliver RE: NEPA and Section 106<br>Dutton Report |

A: Architecture
C: Civil
S: Structural
A-HP: Archaeology, Historic Preservation
L/Z: Local Zoning

1

# APPENDIX

Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

REPORT DATE: 9/3/2021

| DOCUMENTS AT PROJECT START (Pre-2021) | |
|---|---|
| 3 | **Site Information - Written and Verbal (Site Information Meetings Task 1: Pre-Design)** |
| | FIRM Maps (obtained 2018) City Water Utility Map - pdf date 9/26/2017 (City Streetlight Utility Map - pdf date 9/26/2017; City Sewer Utility Map - pdf date 9/26/2017; City Gas Utility Map - pdf date 9/26/2017).<br>10 sheet drawing set "Shockoe Bottom Drainage Improvements..." - set dated 02/2009.<br>10 sheets from "Route 4 and Sewer in Shockoe Creek..." - sheets dated 1923<br>6 sheets from "Richmond Local Flood Protection Interior Drainage..." - sheets dated 1990<br>Sheet 2136 from "Shockoe Creek Project - Arch Sewer 27'-0" x 15'-1-1/2" - sheet dated 1923<br>9 sheets from "Plan & Profile of Proposed Richmond Petersburg Turnpike" - sheets dated 1956<br>Draft Floodway Study<br>MSS Platform Study (2009 SMBW)<br>Richmond GIS Utility Maps (via city website)<br>MSS Site Drawings (2000 Harry Weese Associates)<br>Shockoe Creek Sewer Drawings (1923)<br>Infrastructure As-Builts (1993 Army Corp of Engineers)<br>Multi-modal Master Plan for MSS (2014 SMBW)<br>Setbacks given (all verbal from meeting(s)):<br>o Maintain 50' setback from centerline of future highspeed rail platform<br>o Requested 50' setback from edge of 27'dia culvert<br>o Requested 30' vertical clearance above culvert<br>o 20' ROW at I-95 cribbing<br>o Smaller box sewers can be rerouted<br>o Meeting Minutes dated Nov 2017: Site Information Meeting at Richmond Public Library<br>Broad Street Bridge Replacement Study CSX – received August 6, 2020 |
| 4 | **Shockoe Related Proposals and Studies** |
| | 9 Acre Memorial Park Plan dated 2016 and all updates<br>Shockoe Bottom Economic Impact 2019 – VCU/Preservation Virginia – received August 6, 2020<br>Shockoe Small Area Plan DRAFT 07/09/2020 – received August 6, 2020 |

A: Architecture
C: Civil
S: Structural
A-HP: Archaeology, Historic Preservation
L/Z: Local Zoning

# APPENDIX

Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

REPORT DATE: 9/3/2021

| | DOCUMENTS RECEIVED BY CITY OF RICHMOND (COR) | Date of Request | Secondary Request | Additional Request | Received Y | Received N | Date of Response | Priority | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **Documentation Requested by Project Team at project start (reference SOW)** | | | | | | | | |
| 1.1 | Complete survey, including all utilities and inverts, on the site area from Main Street Station to the Burial Ground and from the centerline of the tracks approaching Main Street Station to the edge of I-95, including topography (1'min) and physical limits | Included in Original SOW October 2020 ("SOW") | Prioritized List Email date 01/29/2021 | | X | | 2/11/2021 | 1st | Shape files contained within zip file. Complete topographic survey data is not available from City. Contract amended to include new topographic survey - PO received and contract updated on 04/29/2021. Survey completed on 05/19-20/2021 |
| 1.2 | I-95 Drawings, & ROW/Easements | SOW | 01/29/2021 | 2/11/2021 | | * | 2/11/2021 3/19/2021 | 1st | On 2/11/21 City sent civil drawings and renderings to VDOT for review and comment (Note: An I95 ROW drawing was received 02/11 however the drawing, a scan of an aged file is illegible and requires more information from VDOT) City to follow up with VDOT for more information. Response 03/19/2021 from City that VDOT did not have further information. Minimal ROW information and easement mentioned in MSS deed received on 03/24/2021. See Comments Section for updates. *Recommendations and thoughts received. Conflicting information to be resolved. |
| 1.3 | Topographic Survey with contours at 1' minimum, including tops and inverts of storm and sanitary sewer pipes | SOW | 01/29/2021 | | | * | | 1st | GIS data available only at start of project. Topographic Survey not in original scope, added to contract on 04/29/2021. * Topo Survey conducted 05/19-20/2021 |
| 1.4 | Site area geo-technical report including infiltration tests | SOW | 01/29/2021 | | X | * | 3/8/2021 | 1st | DPU did not have Geotechnical reports for the area prior to beginning of thisproject. 2008 geotech and environmental testing reports to support excavation activities received on 03/08/2021. Request for location and information from project team on 03/15/2021. Information and location of proposed borings delivered to City by project team on 03/15/2021. Follow Up requested by Schnabel on 03/29/2021. Project team set up call on 03/29/2021 in response. Call to coordiante with project team/Schnabel 03/30/2021. Separate Geotechnical boring tests are required and will be procured by the City. *Geotech performed and delivered to project team on 6/16/2021 |
| 1.5 | City sewer main records - plans / profiles | SOW | 01/29/2021 | | X | | | 1st | Shape files contained within zip file. 1993 Army corps of engineer drawings on file. |
| 1.6 | Layout of future highspeed rail and platform locations and plans | SOW | 01/29/2021 | | X | | 2/4/2021 | 2nd | Microstation Files and link listed below |
| 1.7 | Current studies related to the High-Speed Rail project | SOW | 01/29/2021 | | X | | 2/4/2021 | 2nd | (all of the current reports and studies for high speed rail are available on the website -- https://www.dc2rvarail.com/ ) |
| 1.8 | Broad Street ROW or Easements, Tunnel Information under Broad Street | SOW | 01/29/2021 | | X | | | | Broad St Tunnel Drawing Received, no ROW information on drawings. City does not have ROW or easement drawings for Broad from either DPW or VDOT. On 2/11 City sent civil drawings and renderings to VDOT for review and comment |
| 1.9 | Proposed / upcoming City of Richmond projects information / plans regarding any adjacent parcels or structures: improvements to Main Street Station Plan and surrounding area including but not limited to the additional utilities adjacent parcels,traffic patterns, etc | SOW | 01/29/2021 | | | * | 2/4/2021 3/24/2021 | 2nd | Information regarding high speed rail received (see above). MSS deed dated 08/30/2000 received on 03/24/2021. *No other documentation received unless referenced below. |
| 1.9a | Proposed / upcoming City of Richmond projects information / plans regarding any adjacent parcels or structures: improvements to Broad Street, possible tunnel, utilities, ROWs, adjacent parcels, storm water impacts, traffic patterns, etc | SOW | 01/29/2021 | | X | | 2/5/2021 | 2nd | City provided Information regarding tunnel modifications project for the area under Broad Street that connects LSJS/DHA to African Burial Ground. No ROW information at Broad Street directed to project team. |
| 1.9b | Proposed / upcoming City of Richmond projects information / plans regarding any adjacent parcels or structures: improvements to or modifications and requirements for the Seaboard Building including utilities, ROWs, adjacent parcels, traffic patterns, access, etc | SOW | 01/29/2021 | | | X | | 2nd | No Future planning information for the Seaboard Building provided to the project team (reference document only Shockoe Small Area Plan). Response 02/22/2021 directs Dironna Clarke and Jeannie Welliver to provide extensive documentation. Information not received upon additional request. |
| 1.10 | Written information or diagrams that outline the required view sheds of MSS that must be maintained. | SOW | 01/29/2021 | | | X | | 1st | 2/11 sent drawings to VDHR requesting an informal review. Viewsheds described verbally as recommendations, no documentation received from City of Richmond or VDHR regarding constraints or requirements. |

A: Architecture
C: Civil
S: Structural
A-HP: Archaeology, Historic Preservation

# APPENDIX

## Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1.11 | Complete information pertaining to the Seaboard building, its use, program, right of ways, parcel information and boundaries, diagrams, access, including MOAs, documentation, etc. that define restrictions. Information should include future plans for the program and use of the Seaboard Building, potential timelines, future renovations/refurbishments, entries, updated assessments. | SOW | 01/29/2021 | 7/15/2021 | | X | 2/22/2021<br>7/15/2021 | 2nd | 02/22/2021 response frrom CoR that only Broad Street had future projects - no other adjacent parcels had additional information. Additional request made as per SOW. No information received frrom the City regarding future easements, restrictions, right of ways, program, parking, entries, exits, etc. for this existing structure. No boundary information between buildable area for LSJS/DHA site and Seaboard Building documented. City has defined the building as undetermined use and intended to support the functions of multi-modal/high speed transportation at MSS. CoR did not believe a meeting to understand use or access, adjacency restrictions related to the Seaboard building was necessary. Reference Email 7/15/2021. Shockoe Small Area Plan and Alliance Information conflicts and demonstrates that certain restrictions should be acknowledged, but remain unresolved at the final printing of this report. |
| 1.12 | 2006 and 2008 archaeological excavation field notes (from JRIA) | SOW | 01/29/2021 | | X | | | 2nd | 2008 Notes received , 2006 notes received 04/26/2021 and 04/27/2021 |
| 1.13 | Additional Environmental Site Assessments (completed to date) | SOW | 01/29/2021 | | | X | | 1st | None available |
| 1.14 | Additional soil and groundwater studies (completed to date) | SOW | 01/29/2021 | | | X | | 1st | None Available |
| 1.15 | Exact description, or property boundary for the project site and extent of the actual project site related to the actual buildable area for the museum. | SOW | 01/29/2021 | | | X | | 1st | City did not define during the project duration |
| 1.16 | Complete survey, including all utilities and inverts, on the site area from Main Street Station to the Burial Ground and from the centerline of the tracks approaching Main Street Station to the edge of I-95 | SOW | 01/29/2021 | | | * | | | Duplicate (See above)*Topographic study performed by project team 05/19-20/2021 |
| 1.17 | Historic consultation files with VDHR (related to Main Street Station, the Seaboard Building, and the acquisition of the properties utilizing federal grants or other federal monies | SOW | 01/29/2021 | | | * | 3/15/2021 | 3rd | On 02/11/2021 City sent drawings to VDHR requesting an informal review. Informal Review received 03/15/2021 *No files on record transferred to project team related to VDHR and acquisition or restrictions on property. |
| 1.18 | Call Reports for coordination with VDHR or attendance during information gathering calls for understanding of the City and State perspectives. | SOW | 01/29/2021 | | | * | | 3rd | VDHR meetings during Task 1 Pre-Design were planned, but not held due to hold placed on project by the City of Richmond. * VDHR Informal review as listed above. |
| 1.19 | All agreement documents related to the Main Street Station, the Seaboard Building, and the acquisition of the properties utilizing federal grants or other federal monies. | SOW | 01/29/2021 | | | X | | 3rd | Extensive documentation – can be handled in a discussion with Dironna Clarke and Jeannie Welliver. Deeds for MSS, no information regarding other adjacent structures that may impact access to site. |
| 1.20 | Historic consultation files with VDHR (related to the archaeological site) | SOW | 01/29/2021 | | | X | | 3rd | *No files on record transferred to project team related to VDHR and restrictions relted to the archaeology |
| 1.21 | Completed "Floodplain and Floodway Analysis" prepared by Kimley – Horn and Associates, Inc. (including flood plain, and storm water analysis data) | SOW | 01/29/2021 | | X | | 2/2/2021 | 1st | File received from CoR DPU, Uploaded to Teams |
| 1.22 | Small Area Plan (to understand how proposed uses effect watershed stormwater management calculations. | SOW | 01/29/2021 | | X | | 4/2/2021 | 2nd | Download draft report from website link from CoR. Link contains comments from alliance members, pdf's do not include this information. https://richmond.konveio.com/shockoe-small-area-plan-draft-document |
| 1.23 | Final Rose Fellowship and ULI report record deliverable | SOW | 01/29/2021 | | X | | 2/5/2021 | 3rd | Final Reports and presentations received. No direction from the City regarding outcomes of the report |
| 1.24 | Any additional studies related to the area: economic development, City projects, MSS, etc. | SOW | 01/29/2021 | | | X | | 3rd | From CoR: "Will provide if needed, not relevant to site analysis" |
| 1.25 | Coordination and Reports for Historic 2006 and 2008 excavations: Include information transfers between archaeological, structural, geotech, and civil to address dewatering | SOW | 01/29/2021 | | | X | | | No specific information received related to this data aside from separate geotechnical reports, etc. Although a Site feasibility study was referenced in the original RFP and it was stated that the City would not require one from the contracted party since one had already been performed, this information was not made available to the project team. Any information related to the coordination of the protection and recommendations made during the initial investigations would be beneficial to include in the report. |

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# APPENDIX

Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

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| 2 | Documentation Requested by Project Team/Delivered by City Staff during the project (reference emails) | | | | | | | | Meetings with City Staff 04/13/2021 and 05/06/2021 - Site Info Draft 06/25/2021 |
|---|---|---|---|---|---|---|---|---|---|
| 2.1 | LSJS/DHA Easement Requirements for Box, Arch, West Interceptors | Kick-Off Mtg | 1/29/2021 | | X | | 4/14/2021 | | Sent from Susan Hamilton, DPU |
| 2.2 | East Broad Streetscape contract drawings | 2nd Mtg | 5/6/2021 | | X | | 5/6/2021 | | Sent from Thomas Westbrook, DPW |
| 2.3 | Deed info for 1555 E Broad Street | 2nd Mtg | 5/6/2021 | | | | 5/6/2021 | | Sent from Thomas Westbrook, DPW |
| 2.4 | Deed info for LSJS/DHA property | 2nd Mtg | 5/6/2021 | | X | | 5/6/2021 | | Sent from Thomas Westbrook, DPW |
| 2.5 | Purchase of MSS, Ordinances, plans | SOW | 1/29/2021 | | X | | 5/11/2021 | | Received from K. Chen, Note that additional information would be delivered to project team regarding limits around Seaboard building later the same week. |
| 2.6 | Broad Street Gateway Phase II Plans | SOW | | | X | | 5/11/2021 | | |
| 2.7 | Preliminary Boring Results from Schnabel Engineering (Geotech) | SOW | 1/29/2021 | | X | | 6/7/2021 | | Received preliminary boring results to obtain questions and comments on 06/07/2021. Final report due 06/16/2021 |
| 2.8 | Shockoe Watershed Analysis (City and Greeley Hansen) | Site Info Doc | | | | | 6/21/2021 | | |
| 2.9 | Gas Main, Arch Sewer and Gatehouse Information | Site Info Doc | 6/25/2021 | | X | | 7/7/2021 | | |
| 2.10 | Water Resources Document | Site Info Doc | 6/25/2021 | | X | | 7/7/2021 | | |
| 2.11 | VDOT "Thoughts About Lumpkins Jail" Document | Site Info Doc | 6/25/2021 | | X | | 7/13/2021 | | Received first round of feedback frrom VDOT on 7/13, raw survey datat shared by project team to VDOT 7/14/2021 |
| 2.12 | Project Team Questions / Answers regarding Geotechnical data | Site Info Doc | 6/25/2021 | | | | 6/29/2021 | | Info requested by project team, answered by geotech |
| 2.13 | FIRM Mapping of 100 and 500 year flood limit in Shockoe | Site Info Doc | | | | | 8/2/2021 | | Email received on date shown |
| 2.14 | Additional Comments from the Water Management Team | Site Info Doc | | | | | 8/3/2021 | | Email received on date shown |
| 3 | Documentation Received/Feedback to/Comments On Final Draft Document | | | | | | | | Draft Document Delivered via Teams Link 08/13/2021 and updated 08/23/2021 |
| 3.1 | Comments frrom Richmond Gas Works | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/24/2021 | | Email received on date shown - Comments on next tab |
| 3.2 | Comments frrom Sanitary and Stomrwater Engineering Group | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/24/2021 | | Email received on date shown - Comments on next tab |
| 3.3 | Water Resrouce Comments and WRD Review Checklist | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/25/2021 | | Email received on date shown - Comments on next tab |
| 3.4 | Additional Water Resource Comments 1 | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/27/2021 | | Email received on date shown - Comments on next tab |
| 3.5 | General VDOT Comments | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/31/2021 | | Email received on date shown - Comments on next tab |
| 3.6 | Additional Water Resource Comments 2 | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/31/2021 | | Email received on date shown - Comments on next tab |
| 3.7 | Additional VDOT Comments | Final Draft Review | DRAFT 8/16/2021 | | X | | 8/31/2021 | | Email received on date shown - Comments on next tab |
| 3.8 | DED (K Chen) Requested 2018 Visitor Experience Plan | | | | | | | | VEP was part of Volume 2 of the 2019 deliverable along with the Statement of Purpose (SOP). K Chen email 08/24/2021 confirmed receipt |
| 3.9 | | | | | | | | | |
| 3.10 | | | | | | | | | |

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Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

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| | COMMENTS ON DRAFT REPORT 08/16/2021<br>RECEIVED BY CITY OF RICHMOND (COR) | Date of Receipt | Reference in Report | CoR Dept | Additional Reference | Discipline | PROJECT TEAM RESPONSE<br>A-Architecture, C-Civil, S-Structural, AHP-Archaeology/HP | |
|---|---|---|---|---|---|---|---|---|
| **1** | **Sanitary Sewer and Stormwater Engineering Response** | | | | | | | |
| 1.1 | There is an overall question about the building footprint as it relates to the 27'x15' arch sewer. Sheet 16 shows a buildable area that does not overlap the arch and sheets 49 and 50 show a roof area that does not overlap it either. However, sheet 22 shows a cantilevered "envelope by right" over the arch. In addition, significant discussion is highlighted in the case studies starting on page 26 regarding other structures that have been built directly over and/or on top of large sewer lines/structures. Also, the massing study profile options on sheets 116, 124, and 132 show alternatives, some of which overhang the arch to some degree. We are concerned about any proposals that would overlap the arch due to the need to have large equipment out there in the event of a needed repair. | 8/24/2021 | Page 16, 26, 116, 124, 132 | DPU | | A | Project team requested and needs additional information from the City regarding the easements and rights of way/constraints on the site, especially around and over any areas requiring mitigation or protection. Heights should be defined by the city for incorporation into the study report. The final study has been updated to include information received via these comments, and verbally relted to overhead clearances. Future design phases will need to comply with City constraints. | |
| 1.2 | On sheets 40 and 41, the paragraph on Site Constraints discusses the arch sewer. Regarding the work being done on the arch, it is not currently being reinforced to handle additional load – it is having spot repairs conducted on the internal surfaces to correct defects. The exact depth of cover over the arch is unknown but is estimated to be as little as 4 to 5 feet. It is also at least 100 years old. The loading capability of the arch and the ground geology around it is unknown. What it has previously handled normal traffic, its ability to handle large construction vehicles is dubious at best. If the concern here is construction traffic, then it is possible that some kind of "bridging" structure may need to be installed over the arch. Before any work is undertaken, geotechnical borings should be taken in the vicinity of the arch, taking care not to damage the line. It is our understanding that some work in this area may have been done. If so, we would request a copy of the report to have the impact on the arch further assessed. | 8/24/2021 | Page 40-41 | DPU | | A,S,C | Geotechnical data performed under separate City contract 06/16/2021 and should be distributed to City staff by City project PM. If further information is required, or additional borings necessary, this should be an extended City contract. Prior to design, if there are additional borings or loading studies to be performed, they should take place before Task 2: Schematic Design to inform details of final building construction. | |
| 1.3 | Sheet 39 shows tiebacks into rock for the slurry walls. Care needs to be taken that these tiebacks do not negatively impact the arch sewer. We need the Schnabel report showing the depths and extent of the rock to be used for tie-backs of the slurry wall and foundation loading. | 8/24/2021 | Page 39 | DPU | | S | Geotechnical report was performed under a separate City contract. City project PM can distribute information to City staff for departmental analysis and review. For the slurry walls, tie backs are not anticipated to extend to rock and is depicted as extending in the soil behind the slurry wall in the Figure in the Structural Narrative. The slurry wall extends down and sockets into rock to serve as a cutoff wall for water into the site. This report is a site feasibility report and the level of detail required to respond will occur in the Construction phase. If a CM is engaged earlier than the CA phase, details related to this may be developed earlier as this is a delegated design by a speciality contractor. | |
| 1.4 | Museum support pile installation locations and methods need to be provided. Pile installations should not impact existing infrastructure, especially the arch, with vibrations during installation or load transfer. | 8/24/2021 | Page # | DPU | | A,S | Pile selection is determined by the Geotechnical engineer in coordination with the Design team. It is anticipated that this will occur in the Task 2 - Design Phases. It is anticipated that a drilled pile solution will be utilized to limit vibration. Vibration and movement monitoring is anticiated and the criteria and areas of monitoring will need to determiend by the City in consultation with the Design/Construction Team. | |
| 1.5 | Discharge location and piping system plans for the underslab drainage system need to be provided. | 8/24/2021 | Page # | DPU | | C | This report is a site feasibility report. This comment and the level of detail required to respond will occur in the Task 2 phase of the project design. | |
| 1.6 | The existence, size, and connectivity of all lines shown for connection to sanitary and storm lines need to be field researched and verified and needs be done prior to submission of plans for approval. | 8/24/2021 | Page # | DPU | | C | For consideration when building enters the design documentation phase and building design is established. Building design is not a part of this scope of work. This Site Information Report is Phase IA. Documentation is Task 2: Schematic Design, Design Development, and Construction Documents. | |
| 1.7 | Preliminary Stormwater Plans – Option 1<br>This plan shows discharge of an 18" overflow pipe into a smaller stormwater main (12" on this plan and 15" on GIS), which is not allowed. Plans should be made to upgrade this line assuming this concept is approved. An 8' wide, rip rap overflow swale is shown discharging to the 10'x8' West Interceptor. The connection type will need to be coordinated with DPU standards as a swale cannot discharge into a closed structure. Changes to contours where soil is added or removed will need to be reviewed for impacts to infrastructure. | 8/24/2021 | Preliminary Stormwater Plans – Option 1 | DPU |  | C | Civil plans have been modified to show the sand filter (and overflow pipe) have been removed. The sand filter has been replaced with a permeable surface. The grate over the large sewer is referred to as a closed structure, however, it is an open grate. (See image) The overflow will drain directly into the large grates as shown. In addition, a concrete overflow structure has been added to the proposed detention basin to reduc potential overflow to the rip-rap swale (and thus to the open grate). Changes to the countours will be reviewed for impacts to infrastructure. | |

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Interim Phase IA: Site Feasibility Study

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| 1.8 | Preliminary Stormwater Plan – Option 2<br>A percolation report will be required to ensure that a permeable concrete drive is viable on the western side of the building. Two 90o directional changes on the 36" PRC could cause surcharging in the manholes. The line angle needs to be increased. A MH will be required at the location where the existing 36" pipe and the proposed relocated 36" pipe meet. An 8' wide, rip rap overflow swale is shown discharging to the 10'x8' West Interceptor. The connection type will need to be coordinated with DPU standards as a swale cannot discharge into a closed structure. The 18" overflow pipe on the southern side of the building is shown connecting to the existing 18x24" pipe. A MH will be required for this connection and the direction of flow determined for the ultimate discharge point. Changes to contours where soil is added or removed will need to be reviewed for impacts to existing infrastructure. | 8/24/2021 | Preliminary Stormwater Plan – Option 2 | DPU |  | C | There is a geotechnical report for this site, however, a percolation test was not included. GU agrees and understands a percolation test will be required, and it can be completed in Task 2 as part of a separate contract with a Geotechnical engineer through the CIty. GU proposes to push the upstream connection of the 36" pipe as far back towards the Broad Street tunnel as possible and then smooth out the bends of the storm drains as much as possible in prder to prevent sharp bends/turns in the new storm drain. The updated Option 2 plans reflects this relocation and plans have been adjusted to propose a new 24" storm drain. GU agrees a manhole will be required and proposed one be installed at the site of the relocated 36-inch drainpipe. Proposed manholes are now shown on the updated Option 2 plans and, as mentioned, the proposed storm drain is now 24". As mentioned in Option 1 (see image) the grate over the large sewer, referred to as a closed structure, is an open structure. The proposed rip-rap swale is to discharge runoff to this location. In addition, a concrete overflow structure has been added to the proposed detention basi to reduc potential overflow to the rip-rap swale (and, thus, to the open gate). Please provide additional clarification regarding connection to an existing 18"x24" pipe (it is unclear where a pipe this size is located - we only see the 18" pipe). Prior connection to the existing 18" pipe has been removed as plan revision has eliminated the underground sand filter and replaced it with the permeable concrete drive. The 6" overflow pipe beneath the permeable concrete now connects to the existing 18" pipe. Changes to the countours will be reviewed further for impacts to existing infrastructure. | |
| 1.9 | Proposed sanitary sewer and roof drain connections will need to be determined. Civil drawings will be reviewed when building design is established and discharge locations are proposed. | 8/24/2021 | Page # | DPU | | C | For consideration when building enters the design documentation phase and building design is established. Building design is not a part of this scope of work. This Site Information Report is Phase IA. Documentation is Task 2: Schematic Design, Design Development, and Construction Documents. | |
| 1.10 | | | | | | | | |

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| **2** | **Water Resource Comments: Surani Olsen (DPU)** | | | | | | | |
| 2.1 | All new constructions within any floodplain district shall conform to the applicable sections of the Virginia Uniform Statewide Building Code, and the followings shall be submitted with the permit application: A) The elevation of the 100-year flood (show the Base Flood Elevations (BFE) around and at the site), the floodplain limit, and the floodway limit on all submitted plans that match with the limits shown on the effective FEMA map. B) The elevation (in relation to the mean sea level) of the lowest floor (including the basement) of all new and substantially improved structures. Provide the finished floor elevations of each level/floor according to NAVD 1988. The lowest floor of proposed buildings including basement, shall be elevated to no lower than one foot above the base flood elevation. A registered professional engineer or architect shall certify that the standards of this subsection are satisfied. C) Submit a plan to show that the building materials at and below the BFEs have to be flood-resistant material and the elevation to which a nonresidential structure is to be floodproofed in accordance with Federal Emergency Management Agency requirements. Provide the floodproofing certificate per FEMA requirements. You can check your BFE on FEMA FIRM map attached. | 8/25/2021 | Page # *COR included additional resources, checklists, and information, documents map image in email as reference* | DPU | WRD Plan Review Checklist included in response with additional City drawing and documentation. Hydrology requirements pdf and How to develop a no rise certification pdf also included for reference | C | A) GU agrees the elevation of the 100 year flood, floodplain limit, and floodway need to be determind and shown on all submitted plans; this will be completed once we enter Task 2 (design and development). It is not feasible in the current phase, Task 1A, to submit elevation of the 100 year flood, floodplain limit,and floodway. B) GU understands and agrees that the elevation of the lowest floor (including the basement) of all new improved structures will be required and that will happen in schematic design phase, Task 2. | |
| 2.2 | The electrical power lines, transformers, electrical panels, electrical equipment, HVAC (heating, ventilation, plumbing, air conditioning) unit, and other service equipment shall be designed to prevent water from entering or accumulating within the components during flooding at and shall be located at a minimum 1ft above the BFE. Provide plan view and side views to show any service equipment that will be installed in this project and their elevations that match with the data on the elevation certificate. A registered professional engineer or architect shall certify that the standards of this subsection are satisfied on the plans. | 8/25/2021 | Page # | DPU |  | A,C | For consideration when building enters the design documentation phase and building design is established. Building design is not a part of this scope of work. This Site Information Report is Phase IA. Documentation is Task 2: Schematic Design, Design Development, and Construction Documents. | |
| 2.3 | Fully enclosed areas below the lowest floor shall be used solely for parking of vehicles, building access or storage and can not be used for other purposes. It shall have permanent openings designed to allow the entry and exit of floodwaters in accordance with specifications as set forth at 44 CFR § 60.3(c)(5). Provide the flood openings design certification per FEMA requirements. | 8/25/2021 | Page # | DPU | | A,C | GU understands the exit of floodwaters must be in accordance with specifications as set forth in 44 CFR 60.3(c) (50). GU will coordinate with the architect to address this in Task 2. | |
| 2.4 | Require to submit a proposed construction elevation certificate and a finished-construction elevation certificate that are certified by a professional engineer or a professional surveyor. | 8/25/2021 | Page # | DPU | | C | GU acknowledges that a proposed construction elevation certificate and a finished construction elevation certificate are required. This will take place in Task 2. | |
| 2.5 | **As part of the hydrology and hydraulic analysis to prove that there will be no effects from the development on the floodway and floodplain, below comments are required to be addressed in the draft feasibility study:** | 8/25/2021 | Page # | DPU | | C | Greening Urban has addressed all comments below as they relate to the civil plans for the feasibility study. | |

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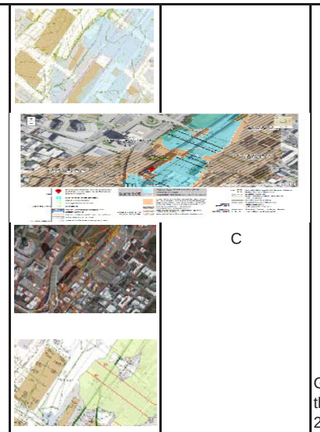
| 2.6 | Floodplain limit does not match with effective FEMA FIRM (attached and shown below), revise to match the effective FEMA FIRM as required by the City Code, State and federal regulations, and FEMA requirements. Show the BFE lines based on the existing condition/effective FIRM. **REVISED COMMENT 08/27/2021**: As directed by FEMA, you are required to use the floodplain limit, floodway limit, and BFEs from proposed FIRM by FEMA as copied below in the hydrology and hydraulic studies for the no rise certification and other required design and civil plans. Show the floodplain limit, the floodway limit and the BFEs on all plans based on FEMA preliminary maps below as the existing conditions prior to the development. And show the floodplain limit, floodway limit, and the BFEs on proposed plans after the development based on the hydrology and hydraulic studies and modeling result. In addition to the hydrology and hydraulic modeling file and report, you are required to submit cut and fill calculations for the whole proposed development to prove that the fill won't exceed the cut. All the other previous comments are still valid and required to be addressed. **REVISED COMMENT 08/31/2021:** The State, FEMA, and the City require that more stringent or more conservative BFEs, floodplain limits, and floodway limits ( more stringent data between the data from the effective FEMA map and the proposed FEMA map )to be used in the design of the proposed development, and storm sewer system at any proposed development in the floodplain and/or floodway and in the hydrology and hydraulic calculations/analysis/modeling for no rise certification . The floodplain limit and the floodway limit are more stringent in the proposed map but the BFEs are more stringent in the effective FIRM so they should be used in the hydrology and hydraulic analysis/calculations/modeling for the proposed development. The effective FIRM and the effective BFEs are copied below. Please find also the guidance on what documents and/or files and/or data are required for the hydrology and hydraulic analysis for no rise certification. | 8/25/2021<br>8/27/2021<br>8/31/2021 | Page #<br>*COR included additional resources, checklists, and information, documents map image in email as reference thumbnails included on this sheet as reference only* | DPU |  | C | GU ackowledges that more conservative/stringent values are to be used in the analysis that will be performed in the design phase of the project (Task 2). More conservative values have been provided in the May 2020 "Floodplain and Floodway Analysis (Draft)" by Kimberly-Horn for the City of Richmond. |
| 2.7 | As part of the hydrology analysis: require to submit the detailed drainage area delineation map with the drainage area sizes and C or CN number, time of concentration paths, arrows to show flow directions, and detail Tc calculations until each outfall (can be a City's inlet or gutter) from each drainage area. Clearly define all subdrainage areas and drainage divide lines. Provide all run off calculations, all run off model files, and all run off model reports to show how all numbers (for various storm run off) presented in the Civil Report are obtained. The formulas used in each calculation shall be provided as well as the project is required to use formulas acceptable by DEQ. The drainage area map shall show all the BMP locations. | 8/25/2021 | Page # | DPU | | C | Drainage area delineation map had been provided in Options 1 and 2 of the civl report showing BMP locations. Arrows to show flow direction can be added. CN numbers had previously been used in calculations but had not been included in the initial report. Time of concentration paths and Tc calculations had not been performed. Additional calculations can be performed and can be included as an appendix or appendices to the report if required. |
| 2.8 | Submit the complete existing and proposed hydrology computations, all storm drain hydraulic computations, and demonstrate that the 10 year design flow is less than each pipe capacity. All hydraulic calculations shall be submitted on standard VDOT forms. Provide the minimum required cover for the BMPs, storm drainage structures and pipes. Submit storm drainage computations to support all storm drainage outfalls. | 8/25/2021 | Page # | DPU | | | Please provide clarification regarding "hydrology computations". GU is able to compute the storm drain hydraulic computations (HGL calculations) to fit VDOT standards. |
| 2.9 | Submit the complete hydrologic and hydraulic study/analysis/run off model reports with the no rise certification showing the existing BFEs and the proposed BFEs at and around the property in the floodway. No rise certification shall be posted on the plan and is required to be signed and sealed by a Professional Engineer. | 8/25/2021 | Page # | DPU | | C | GU understands and agrees that the proposed BFEs will need to be determined and provided to the City, and this is projected to happen in Task 2 when the proposed building (footprint, flood openings, etc) is in the schematic design phase. GU is unable to sign/seal a no-rise certification at the current stage of the project; it would take place in Task 2. |
| 2.10 | Based on the proposed contours and overflow discharge location, the proposed development will drain into the MS4 system (all green lines/pipes and structures on below drawings are MS4), therefore, require to show compliance with the water quantity (flood protection and channel protection)and water quality requirements (nutrient credit requirement calculation spreadsheets) from the Virginia Stormwater Management Program regulation. Submit the impervious and pervious areas delineation map for each drainage area on the proposed developments and submit the water quality calculations and provide the information about how the project will comply with the nutrient credit requirement. | 8/25/2021 | Page # | DPU | | C | GU can create the seperate water quality spreadsheets based on the two options provided (which are based off the mass block design). These water quality values could vary based on the actual proposed deisgn of the building (particuarly given the size of the roof - and subsequent greenroof - from whatever buulding design is selected. Our greenroofs, in both options, are estimated at 30,000 square feet. Water quality will be impacted with reductions in green roof area for a site that is currently a parking lot). |

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| 2.11 | As mentioned before several times in the meeting, please note that underground(u/g) cistern, u/g detention system and u/g sand filter shall not be installed in a floodplain area as the water table is high in the floodplain area; therefore, should not be used for detention nor sand filter as flood water and ground water infiltration will cause these systems to fail or unable to function. The run off modeling for 10 year, 25 year and 100 year storms shall be provided to show how these systems can function during flooding. Provide the detail design calculations of all proposed BMPs (the retention basin, cistern, green roof, underground sand filter), detail lay out drawings and cross sections drawings of all BMPs with all dimensions data. In order to obtain water quality credits, all BMP design criteria shall comply with DEQ requirements. Show 2, 10, 100 year design storm elevations on each BMP profile and provide a run off model file and report to prove that the detention system works to detain 1 year, 10 year and 100 year storms. Submit all the required plans for stormwater management facility (detention system) in the Water Resources checklist. | 8/25/2021 | Page # | DPU | | C | Further clarification is needed. The comment above states that no underground BMPs can be installed in the floodplain while also requesting that we verify, with calculations, how well the underground BMPs work. The comment does not seem consistent in its request for design storm calculations (to the following storm storms are mentioned: 1, 2, 10, 25, and 100 year storms). In addition, plans that comply with the Water Resources Checklist are part of Task 2 Phase and Building/Site Design. |
| 2.12 | Submit the completed Water Resources checklist (attached) with all the civil plans required by the Erosion and Sediment Control checklist, Storm Drain System checklist, Stormwater Management Facility checklist, and Floodplain checklist to ensure that all other applicable Water Resources permit requirements can be met. | 8/25/2021 | Page # | DPU | | C | Greening Urban confirms receipt of the Water Resources checklist, ESC Checklist, Storm Drain checklist, Stormwater Management Facility checklist, and Floodplain checklist from the City of Richmond, however the checklists cannot be used during the current feasibility portion of the project (Task 1A), but can be used in the construction document phase (Task 2) of the project. |
| 2.13 | Submit a proposed drainage and grading layout drawing show all existing and proposed storm drainage structures (inlets and manholes) and pipes. Show all storm drainage profiles of existing and proposed drainage system until the outfalls with 10 year HGL lines to show that the capacity of the system can comply with the City Code and DEQ requirements. Submit all the civil plans required by the storm drainage checklist in the Water Resources checklist. Label the elevations of the contours. | 8/25/2021 | Page # | DPU | | C | GU has provided a drainage layout with drainage structures and pipes. Please refer to Option 1 and Option 2 layouts. |
| 2.14 | Provide the limit of proposed disturbed area in a scaled plan with north arrow that is sealed by a Professional Engineer or Architect. | 8/25/2021 | Page # | DPU | | A,C | GU is able to provide an existing conditions plan with the LOD for the project shown once we have reached Task 2 of the overall project schedule. We will need confirmation from the developer regarding extent of construction/modifications to the site. |
| 2.15 | Each plan submitted for the above comments shall be signed and sealed by a professional engineer and has a bar scale. | 8/25/2021 | Page # | DPU | | C | GU ackowledges the requirement that all plans require a professional engineer signature and/or stamp and a bar scale. This will be done once we move into the schematic drawing/constructuon document phase (Task2). |
| 2.16 | Permitting requirements: 1) Based on submitted drawings, a RSMP permit and a State permit with completed SWPPP documents and PPP plan will be required for the proposed project and you are required to obtain the approval prior to the building permit approval. 2) Since FEMA is revising the FIRM, the floodplain and floodway map and the details civil plans for this project have not been submitted, additional review comments will be provided after the detail civil plans are submitted and/or when the RSMP permit application and plans are submitted based on the effective FIRM map and the applicable regulatory requirements at the time of the RSMP permit application is submitted. A state permit application, SWPPP documents, and PPP plans are also required for this project to be submitted. Construction shall not be started before the RSMP permit and the State permit are approved. | 8/25/2021 | Page # | DPU | | C | 1) GU acknowledges and understand that four (4) seperate permits will be required prior to building permit approval. 2) GU acknowledges that additional comments are to be expected once the detailed civil plans are submitted based on the status of the FEMA FIRM map and all aplication regulatory requirements will need to be met. We understand that a state permit application will need to be provided along with SWPPP documents and PPP plans. |

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| 2.17 | I have a question for your consultant: will the archeology site be an open site or will it be located inside a building? Please note that area below the lowest floor shall only be used for storage, parking or building access with flood opening per my previous comments based on FEMA and the City Code requirements. If the site will be filled to achieve the allowable lowest floor design elevations, a FEMA approved LOMR-F (Letter of Map Revision based on fill) shall be submitted with the application as well, however, please note that when FEMA issues a new map in 2023, this LOMR will be superseded. | 8/27/2021 | Page # *COR included map image in email as reference thumbnails included on this sheet as reference only* | DPU |  | C,AHP | A/AHP: Part of the purpose of any future building will be to protect and interpret the archaeology on the site. In order to allow do so, access to the grade at archaeology is required. Reference the benchmarking examples of strategies utilized at NMAAHC (Washington DC) and the 911 Museum (NYC), both of which are in flood plains with high water tables. Public engagement during the 2017-2018 Task 1: Pre-Design Phase included receipt of public comment requiring physical access. Please also refer to the Archaeology report of this study for more information about protection measures for the archaeological asset. The details of access and protection measures will be a part of Task 2 design phases in conjunction with City review. Civil: GU acknowledges and understands FEMA regulations as it pertains to the the lowest floor shall be used for storage, parking or building access wth flood openings. GU to work in conjunction with archeology team during Task 2 to address this comment. |
| 2.18 | | | | | | | |

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| **3** | **VDOT Comments** | | | | | | |
| 3.1 | The floodplain labels do not appear to match on the pages shaded and pages just labeled. | 8/31/2021 | Page # | VDOT | | C | |
| 3.2 | The building footprint is very close to the retaining wall. Visually the retaining wall seems to be in functional condition now however in the future if something is needed to be done on it the working area will be very confined. A portion of the retaining wall is within the 100 year flood plain. During TS Gaston this whole area was under water and VDOT had to remove vehicles and debris off the wall after the water had receded. I believe that VDOT needs a maintenance easement that allows access for inspection and the possibility of future work.-- | 8/31/2021 | Page # | VDOT | | A,C,S | It is the recommendation of the project team that any major remedial work on the cribbing be accomplished before any museum site or building project construction starts. Current analysis provides a 20'-25' easement between the approximated location of the archaeology and the cribbing and assumes remedial work complete prior to building construction. 20-25ft easement was required and documented as part of the Task 1: Pre-Design Phase in 2017. Once the exact extent of the archaeology is determined through the next interim phase of archaeological excavation and boundary definition, we may be able to provide more information and determine with VDOT a suitable easement distance for the project pos-remediation of the current cribbing condition. |
| 3.3 | Any pile driving into bedrock so close to this retaining wall could cause soil to shift and voids to be created. Not only would this affect the retaining wall but could possibly affect I95 itself and the antiquated enclosed drainage system that we have in this area. | 8/31/2021 | Page # | VDOT | | A,S | Given the proximity of the I-95 embankment to the site, a condition assessment of the cribbing is recommended as noted Any repairs or reinforcement to the cribbing should occur prior to the commencement of this project. Pile selection is determined by the Geotechnical engineer in coordination with the Design team. It is anticipated that this will occur in the next Design Phase. It is anticipated that a drilled pile solution will be utilized to limit vibration. |
| 3.4 | Vibration monitoring and embankment monitoring will need to be addressed in the contract documents. Additionally, any tie-back system for the proposed slurry wall which extends below the existing I-95 embankment will need to be evaluated and ensure that any future modifications of the I-95 embankment will not create capacity issues or adversely affect those members. | 8/31/2021 | Page # | VDOT | | A,S | Vibration and movement monitoring is anticiated and the criteria and areas of monitoring will need to determiend by the City in consultation with the Design/Construction Team. Coordination with adjacent agencies like VDOT will be requried and noted. |
| 3.5 | | | | | | | |

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Lumpkin's Slave Jail Site / Devil's Half Acre

Interim Phase IA: Site Feasibility Study

REPORT DATE: 9/3/2021

| 4 | Planning and Economic Development Responses and Comments: Sharon Ebert/Kim Chen | | | | | | Reference Meeting Minutes of Page Turn of Final Draft 08/19/2021 | |
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| 4.1 | Can SG move the recommendations before the massing studies? | | | | | A | The project team has revised the final deliverable | |
| 4.2 | On the recommendations, can we be specific as to what we are recommending based upon the Feasibility Study | | | | | A | The project team has added clarity to the final deliverable | |
| 4.3 | State any unknown conditions that may impact the results | | | | | All | The project team is unsure of what the comment refers to, but we believe that we have responded to the conditions known to date and perscribed any examples of potential unknowns. One is the boundary of the archaeological asset, which we recommend as an immediate next step prior to building design and final placement. | |
| 4.4 | Moving the 36” line and any other utility relocations should be stated | | | | | A,C | This is shown in the Civil portion of the report. | |
| 4.5 | Where did the program come from as it contradicts recommendations being considered for other projects? | | | | | A | It was a direct outcome from the community meetings of 2017 and was covered in the Concept Study as well as in documentation and approved meeting sessions in 2017-2018. | |
| 4.6 | Why have all of these programmatic requirements at the museum? | | | | | A | The public, via workshops, interviews, small group sessions, and surveys requested a full program and a building that included activities beyond simply marking the Lumpkin's Jail Site. During the Concept workshops and expanded community meetings in 2017 and 2018, a dispersed museum was discussed. However the community felt that there should be a central place within the museum to cover all of these places, events, and needs for reconciliation. The public participants utilized the word "museum" to indicate the significance of the story and to have the City and State demonstrate the importance of the content. In addition, the public felt strongly, that this should be a new type of museum with activities and program beyond a typica museum, all housed in one central location. This program included areas ties directly to the extended study of the history of enslavement in America including but not limited to a geneology center, classrooms, interpretive spaces, spaces for community gatherings and performances, etc. It was also determined that pulling all of the programmatic wishes into a single facility would greatly reduce operational costs to the City. A financial and operations plan was to be an interim phase that followed the concept to validate the overal operational costs for the future facility. This service was proposed and submitted to the City, but not approved due to the need for a site study. In addition, this program was also vetted with City staff, City Council members, the Mayor, and State officials and presented numerous times and approved to form the program for the museum. The museum could still be a hub that tied in other sites of remembrance within Shockoe, Richmond and the nation. | |
| 4.7 | Please add property lines to the site | | | | | A | This has been included in the update to the report. | |
| 4.8 | Bob Steidel asked to show easements along I-95 and Broad Street. Kim will continue to enquire as to what easements are known along I-95 and ask Bob Steidel what he means by easements along Broad Street | | | | | All | No Information was received related to ROW or easements at Broad Street to include in this report. Additional information related to Broad Street may be included as an addendum if required. | |
| 4.9 | Regarding the easement along I-95, there was a recommendation that we provide a 50’ easement | | | | | All | Reference Recommendations - This conflicts with earlier information received in 2017. •During this meeting, it was agreed that this would be a negotiated item with VDOT, but that our recommendation should be to have any remedial cribbing work done before any building is constructed at the LSJS/.DHA site. | |
| 4.10 | On the diagram for the 100 tear and 500-year floodplains, what is shown as the 500-year floodplain is actually the floodway. Please confirm this | | | | | A,C | Floodway, and floodplain information has been updated in this version of the report. | |
| 4.11 | Add the high-pressure steam line to the site section. Will it also need to be relocated? If so, please state that. | | | | | C | For the setback to the north of the Seaboard Building, DPW needs to tell us what that should be, but the 45’ we show currently should be adequate for a drive lane and a row of parking. CoR to provide required setback from Seaboard Building to SG. | |

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| 4.12 | If there are any suspected overlaps of the archaeology into the setbacks for utilities, please state that, delete the 3D of the site that seems to show overlaps or show how they relate without overlapping | | | | | A/AHP | A/AHP: Archaeological investigations in 2006 and 2008 did not place or locate the archaeological asset boundaries. An additional archaeological investigation is required to determin placement and boundaries of the asset related to site utilities. There may be overlaps between the archaeology and the setbacks, but the specific amount of overlap is not certain because the exact location of the archaeological site and its boundaries is not known. The planned excavations of the archaeological site is intended to address this question. This should be done as an immediate next step following this report as an additional Task IA Interim Phase and prior to Task 2 Buildign design. |
| 4.13 | Show views of the massing studies for I-95 to better describe the viewshed for each. | | | | | A | We will indicate revised views in the final study |
| 4.14 | Any cantilevered area of the massing over the 27' arch sewer needs to have a 50' vertical clearance per latest from DPU | | | | | A | The project team has revised the final deliverable |
| 4.15 | Functions to be incorporated in the Seaboard Building have not been decided upon. There are no current plans to modify/renovate the Seaboard Building. There should be a drive aisle and one layer of parking to the west of the Seaboard Building | | | | | A/AHP | This study has been unable to assess any implications, restrictions, or impacts regarding activities, acces, use, or needs for the Seaboard Building since no information exists or has been shared with the project team. The degree that any changes to the Seaboard Building and the need for a drive aisle and parking needs to be clarified by the CIty so any potential constraints can be understood and incporated into future building planning. |
| 4.16 | The City will advise of any other changes or plans for the Seaboard Building, but no money has been allocated for improvements | | | | | A/AHP | This study has been unable to assess any implications, restrictions, or impacts regarding activities, acces, use, or needs for the Seaboard Building since no information exists or has been shared with the project team. The degree that any changes to the Seaboard Building needs to be clarified by the City so that these potential constraints can be understood and incorporated in the site planning and a comprehensive consideration of historic preservation issues. |
| 4.17 | In reviewing each section, structural, civil, archaeology, and architecture, summarize what techniques and/or features that can be utilized on the site whether above or below grade | | | | | All | Please see separate discipline sections. For archaeology, standard archaeological excavations, supported by large-scale earth moving and shoring, will be required. |
| 4.18 | Show grade elevations for working with the 100 year and 500-year floodplains | | | | | A,C | The grade elevations for the 100 year and 500 year floodplans are provided on the "Flood Study Cut Lines" document. |
| 4.19 | Indicate bedrock depth varies but is approx. 36' below grade and indicate water monitoring on diagrams | | | | | S | Reference to depth of rock has been included in the structural narrative. The narrative has been updated to reference the Figure in Schnabel's report that shows the location of the monitors. |
| 4.20 | Note that Virginia adopted the 2021 building code as the most recent, please note this in the structural section | | | | | A,C | The narrative has been updated to reference the 2021 building code and the applicable reference codes |
| 4.21 | Identify the capacity for retention and for detention if that is intended. Will this be a large open holding area? | | | | | C | The retention/detention capacities are now shown Appendix D (calculations). This will be a large, open holding area, but as this is the feasibility phase, it is open to modifications (whether it should be a dry open area or retain some water, as shown in our example of Appendix C). |
| 4.22 | Where does the overflow actually run and how is it handled? | | | | | C | Detention basin overflow, as shown on Option 1 and Option 2, is handled by both the overflowrip-rap swale, which drains to the existing, at grade, drainage grate. An additional overflow structure has been placed within the detention basin. The pervious concrete system has overflow pipes shown on the plans and the green roof will overflow to both an above-grade cistern and, in times of excess overflow, to roof drains. |
| 4.23 | Will the connection between the site and the burial ground be obstructed by the basin? | | | | | C | This is only diagrammatic there will be no obstructions between the burial ground the LSJS/DHA. |
| 4.24 | On the massing studies, show the height of each option relative to the Train Shed | | | | | A | The project team has revised the final blocking and stacking studies |
| 4.25 | Please make certain that costs to protect the archaeology are fully identified | | | | | A,COST | Please see the cost estimate for more information regarding break outs of specific aspects of the site and building work. |
| 4.26 | Final recommendations should be very specific | | | | | All | The project team has revised recommendations to facilitate an understanding of each aspect and discipline and have added a next steps section |

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