

CHOREOGRAPHING SEDIMENT

Sparrow's Point, Baltimore, MD

David Michael Bayer

Thesis submitted to the faculty of
the Virginia Polytechnic Institute and
State University
in partial fulfillment
of the requirements for the degree of
Master of Landscape Architecture
In
Landscape Architecture

Nathan Heavers
Committee Chair

Susan Piedmont-Palladino

Laurel McSherry

6 May, 2015
Alexandria, Virginia

Keywords: Landscape Infrastructure, Dredge, Remediation

ABSTRACT

CHOREOGRAPHING SEDIMENT

DAVID MICHAEL BAYER

In 2016 the Panama Canal expansion is set to open, allowing a new class of ships to call on east coast ports. The dredging involved in deepening navigation channels to ensure safe passage of these vessels will place an increased amount of pressure on containment facilities up and down the coast. With limited disposal space, and increasing volumes, many ports have begun to rethink the treatment of this excess material. This thesis explores the prospect of dredge material being more than engineered fill. It suggests that dredge processing can become the basis for a new form of productive recreational landscape, one that can engage the public in a conversation of the spatial and material operations that sustain our lives. It works blur and dissolve the boundaries that have been erected between working landscapes and the public realm, and seeks to create a landscape that establishes a new sense of place prepared to mark the future of the new working urban waterfront; one where industrial operations generate new ecological substrates, and where productive frameworks become recreation networks.

ACKNOWLEDGEMENTS

To my tremendously supportive committee. Nathan Heavers, Susan Piedmont-Palladino, and Laurel McSherry. This thesis is testament to their dedication and support in guiding me through the last three years.

To my freinds and fellow classmates, especially Brian Green, Marykate Weaver, and Chris Ard. Your support has helped me thrive through this process, I could not have done this without you.

To my patient and loving girlfriend Leah. You have been so wonderful through all of this.

And to my family. For all of the love and support they have given me throughout my education, and for always believing in me and giving me the freedom to pursue my dreams.

TABLE OF CONTENTS

Abstract	iv
Acknowledgements	v
Introduction	2
Case Studies	
Westergasfabriek	5
Duisburg Nord	7
Gasworks Park	9
Erie Pier	11
Siting the Project	14
Dredging Baltimore Harbor	16
Sparrow's Point	21
Material Systems	
Beneficial Reuse of Dredge	25
Industrial Site Reclamation	31
Design	
Mining Sparrow's Point	37
Dredge as Material System	51
Dredge as Product	55
Dredge as Monument	60
Conclusions	69
Bibliography	73
List of Images	74
Image Sources	75



Sectional View of Maersk Triple E Class under construction

INTRODUCTION

In our current global economic system, ports represent a critical point of exchange in the transportation of goods and services. To ensure the safe passage of vessels entering and exiting ports, it is often necessary to continually excavate sediment deposits from designated shipping channels to maintain an appropriate depth. This excavated sediment, also known as dredge, is removed from the channel and placed in another location. Historically, dredge material has been used to construct new land, and manipulate shorelines to suite a desired land use. More recent practices, however, involve dredged material being deposited in designated open water dumping areas or specified containment facilities, and in some instances, when toxicity levels are low, it is utilized in operations such as beach nourishment or habitat restoration. As infrastructural and technological advances allow larger ships to enter our ports, the requirement of deeper channels and more extensive dredging operations will place a greater demand on areas to dispose of dredge material. Considering this necessity of dredging operations, and the abundance of material it produces, the question becomes: can dredge, as a material system and functional operation of ports, be used as more than fill?

In 2016, the Panama Canal is expected to open a new series of locks and channels, allowing the passage of a new class of Super Post-Panamax ships between the Pacific ocean and the Gulf of Mexico. The expansion of the canal involves the the movement of more than 173 million cubic yards of earth, a volume ten times that of the Big Dig in Boston and more than the construction of the entire Suez Canal. [10] This immense infrastructural expansion is causing many ports along the

Gulf coast and east coast of the US to prepare for larger ships calling on their terminals. As stated previously, these ships will require deeper channels and larger air drafts, meaning that any port vying for their business is expanding dredging operations and updating facilities in order to handle these higher volumes. The Port of Baltimore is one of these ports.

Currently, Baltimore Harbor and the Maryland Port Administration are undergoing a series of renovations and updates, that include expansion and increased maintenance dredging operations. Under the current dredge material management plan, approximately 5.24 million cubic yards of sediment is removed from the harbor channels annually, however, this volume will likely rise in the near future. At present, the MPA operates two dredge material containment facilities (DMCFs) at Masonville and Cox Creek, both of which are projected to reach capacity by 2023 at current operating volumes. [MPA website]

In order to reduce the need for contained placement facilities, the MPA has also been investigating beneficial reuses of dredge material since 2001. In a 2007 report titled "Innovative Reuse of Dredge Material", the MPA outlined the administrations findings on the possibilities for reuse. They included: construction aggregate, manufactured bricks and blocks, farmland enhancement, topsoil manufacturing, land creation, landfill capping, and general construction fill. Still, the MPA has been seeking sites for constructing a new DMCF. A proposal was made in 2011 to use a 300 acre portion of Sparrows Point, known as Coke Point, but no acquisition has been made yet.

In 2012, the Bethlehem Steel mill at Sparrows Point closed.

Located on the north shore of the Patapsco River and the eastern edge of harbor, the mill was one of the Baltimore's largest and most historic industrial sites. At its peak in 1957, the mill employed more than 30,000 people and produced more than 8 million tons of steel. It made the steel girders of the Golden Gate Bridge, the cables of the George Washington Bridge, as well as hundreds of ships during both world wars. Equally notable and pertinent to the study of landscape architecture, is that a sizable portion of the point's expanded landmass is built using the refuse of the steel making process. This 3,100 acre site is now a rusting reminder of the robust history of Baltimore's industrial legacy.

The simultaneous expansion of port facilities in the harbor, the need for DMCFs, the exploration of innovative reuses of dredge material, and the closure of a major industrial site provides a significant opportunity for redefining port operations to include the processing of dredge material in the harbor, realigning the industrial and cultural legacy of Baltimore and Sparrows point. The primary aim of this thesis is to ask whether dredge material processing can be a new industrial future of Sparrow's Point. In doing so, can it aid in the re-purposing, and re-habilitation of contaminated industrial sites? It suggests that there might be beneficial reuses of this material, in addition to its engineered containment and storage. Furthermore, the redesign of industrial landscapes might extend and evolve the working character of these sites, retaining industrial heritage through new activity. Finally, it questions current remediation practices that involve 'paving over' site histories, and proposes alternate modes of operation that expose history through site alterations.

CASE STUDIES

Westergasfabriek

2004

Amsterdam, Netherlands

Westergasfabriek is the former site of a nineteenth century gasworks in Amsterdam, Netherlands. The 28 acre site was designed by Kathryn Gustafson of Gustafson Porter (UK) and Gustafson Guthrie Nichol (USA).

A guiding principal for the park was to reflect changing attitudes toward the environment and landscape through contemporary form. The design team sought to contain any contamination onsite as in order to simply displace problem to another location. A particular challenge then became the management and disposal of contaminated soils and materials. Polluted material exceeded expectations prior to demolition, and in many cases, alterations to the demolition and remediation plan were necessary. Highly contaminated soils were excavated and contained on site, becoming the basis for new landforms. In their place, new soils were used to fill excavated voids in order to retain existing grades.



Westergasfabriek - "Natural" vegetation



Westergasfabriek - Earthen berm, canal and lawn



Duisburg Nord - Plaza space with remnant structures

CASE STUDIES

Duisburg Nord

1992-2002

Duisburg, Germany

The second case study exists on a much larger site. Duisburg Nord Landschaftspark, designed by German landscape architect Peter Latz, is part of a 568 acre master plan on the former site of steel mill and industrial park. The park was opened to the public in 1992 and fully completed in 2002.

The design of the park builds on the preexisting land use patterns formed by the site's industrial past. New plantings, gardens, and plaza are woven between rusting blast furnaces, monolithic concrete structures, and snaking railways forming a new hybrid landscape. Elements of play, performance and natural process are framed within the cultural legacy of the region, a narration of past purposes and future possibilities. At the core of the design, the park aims to transform a former industrial engine of the region into a public amenity, and ultimately a cultural emblem.

CASE STUDIES

Gasworks Park

1975

Seattle, USA

Situated on the northern shore of Lake Union in Seattle, Washington, Gasworks Park was designed by landscape architect Richard Haag and was completed in 1975. The park is sited a 19.1 acre former coal gasification plant. In many ways, Gasworks is seen as a seminal project in the transformation of defunct industrial sites into parks. The primary elements of the design are a large earthwork titled Kite Hill, several areas of lawn, and the remaining tower structures and pipework of the former plant. Haag utilized several thousand yards of concrete rubble from building foundations on the site in order to construct the earthen mound. Since the completion of the park, several concerns have arisen having to do with the contamination of soil and groundwater on the site. At one point, these concerns threatened to close the park, and can still be seen in the fencing off of the “forbidden section” of the park in immediate proximity to the preserved gasworks structures.



Gasworks Park - View of remnant structures from Kite Hill



Gasworks Park - Kite Hill



Erie Pier - Mechanical offloading of dredge



Erie Pier - Consolidation coarse material

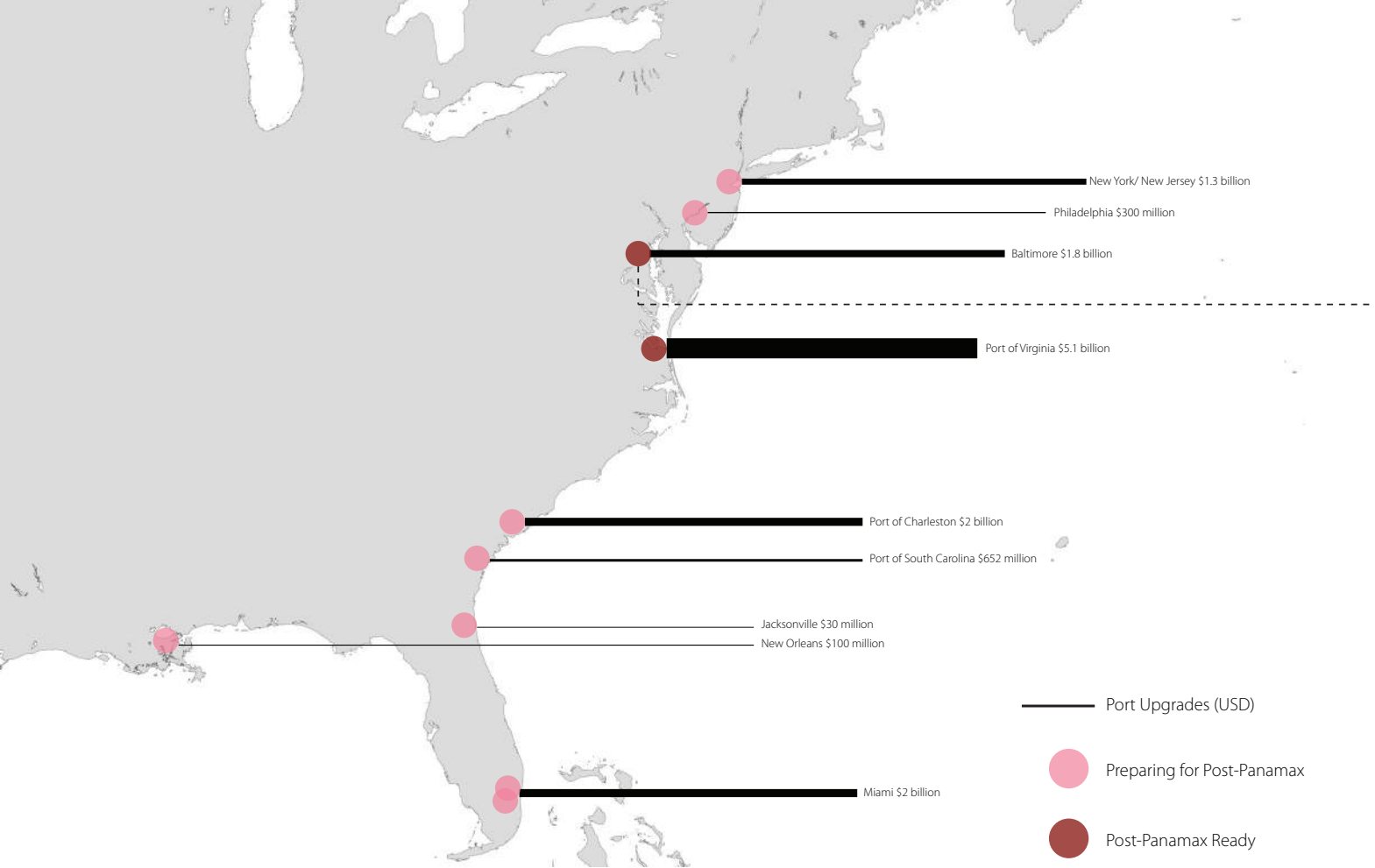
CASE STUDIES

Erie Pier

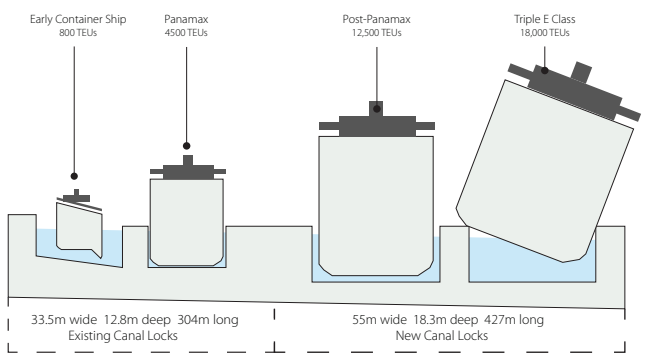
1975

Duluth, USA

Rather than constructing a new dredge containment facility, the port decided to transform the 89 acre Erie Pier into a dredge material processing facility to extend the facilities life. The facility uses a hydraulic process to sort the material into two classes, coarse and fine. According to the Great Lakes Commission report on beneficial reuses of dredge material, the coarse material, primarily sand, has been used since the 1980s in road and other construction projects. The fine material, which the commission describes as “reclaimed soil”, is being utilized in a number of projects including golf course turf restoration, stormwater berm making, top soil for Superior landfill, and as cover for the restoration of a iron ore mine trailings basin. As of 2013, the Minnesota Department of Natural Resources has been planning several other pilot projects in the harbor, including a 75-acre land building habitat restoration project that is projected to use upwards of 300,000 cubic yards of material. [GLC] Duluth Superior provides an excellent example of innovative reuse of dredge material through the transformation of Erie Pier. It also serves as an important precedent for the adaptation of a particular site to meet the changing environmental, financial, and spatial needs of the region.



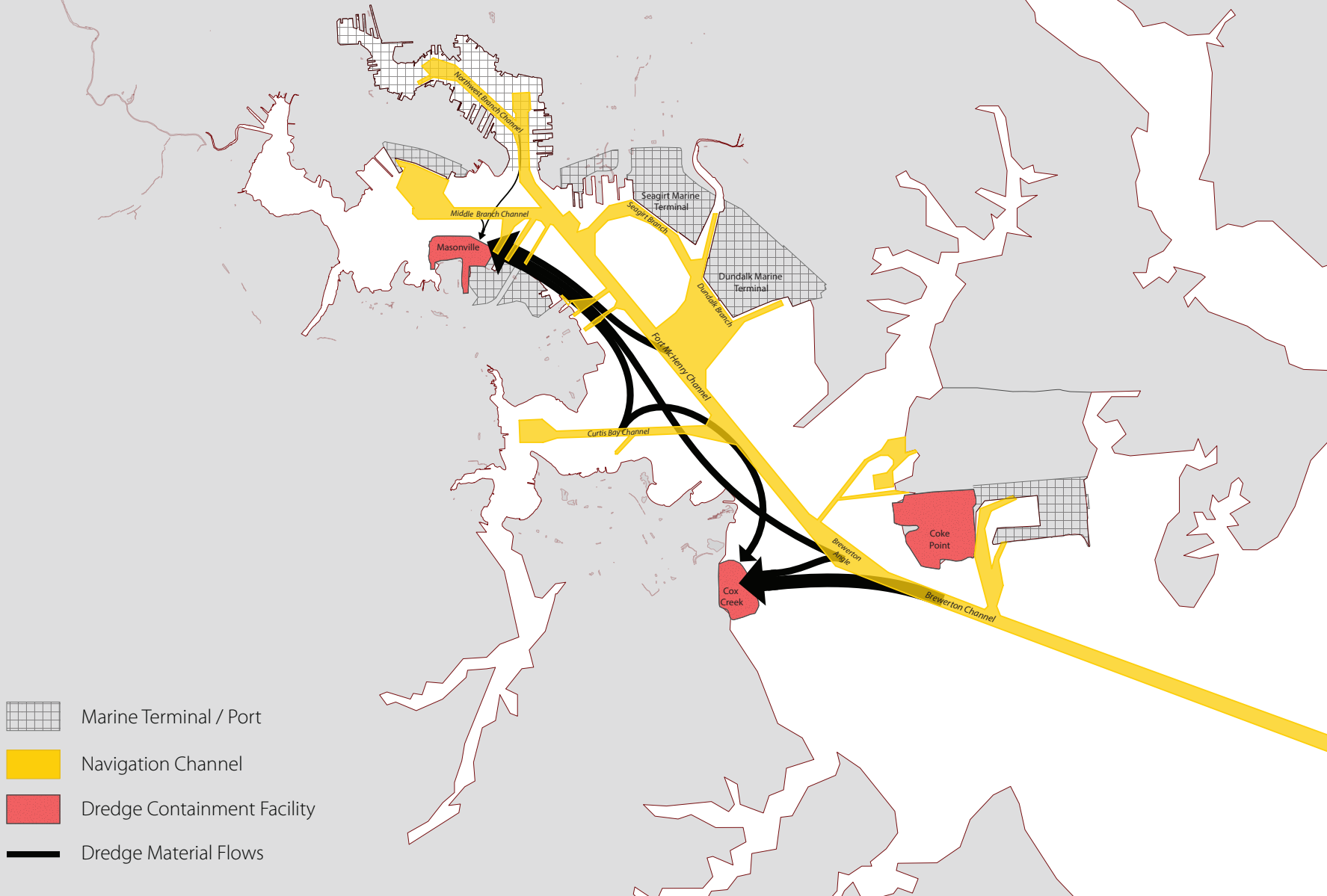
- Port Upgrades (USD)
- Preparing for Post-Panamax
- Post-Panamax Ready



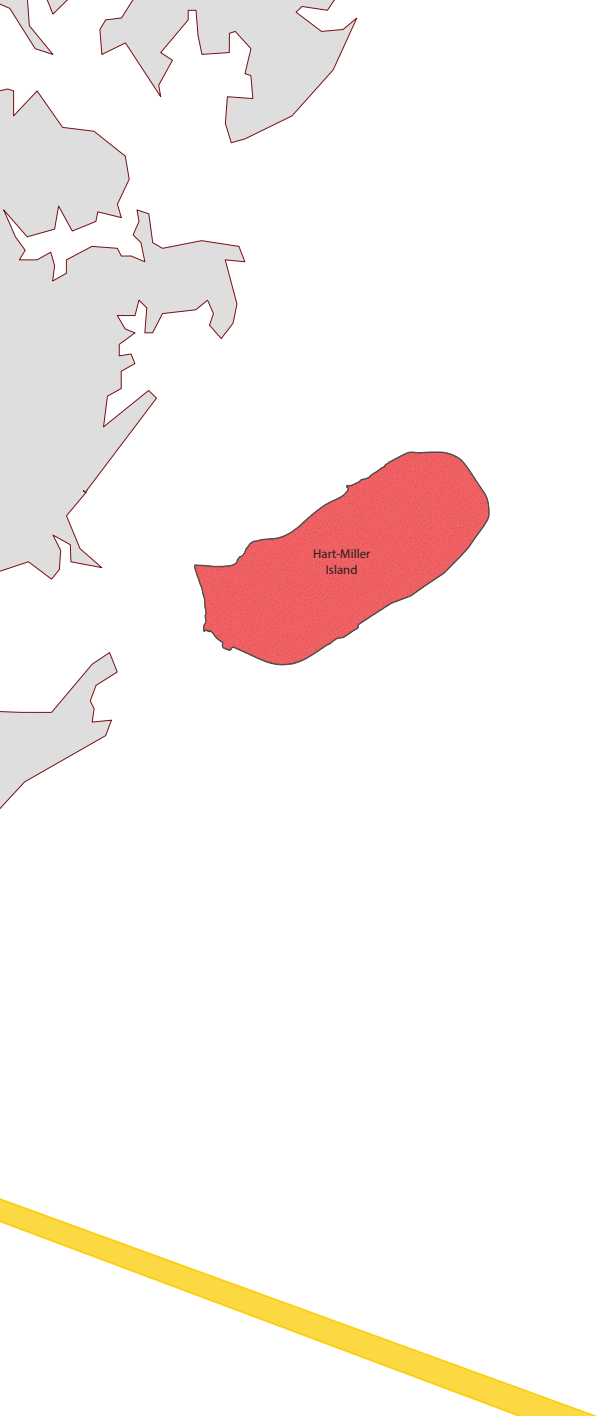
SITING THE PROJECT

Through the research, I discovered that Baltimore's confined disposal facilities are project to be full by 2023. Through this same, research I also discovered that a Peninsula called Sparrow's Point had been proposed as a possible future CDF.

Historically, this site has been one of the most productive steel plants in the country and for decades was a top competitor in the steel industry world wide. Over its life span, the production of steel began to redefine the peninsula both figuratively and literally. Steel slag fines, leftover from the smelting process, were used to incrementally expand the landmass of Sparrow's point to accommodate a growing demand for steel. Before long the peninsula had nearly doubled in size, and completely choked out Humphrey Creek to its north.



-  Marine Terminal / Port
-  Navigation Channel
-  Dredge Containment Facility
-  Dredge Material Flows



DREDGING BALTIMORE HARBOR

As stated previously, dredging represents a necessary function to maintain the safe passage of vessels into and out of the Port of Baltimore. According to the 2013 annual Dredge Material Management Plan Report, 5.24 million cubic yards (mcy) of sediment must be excavated annually to maintain safe channel depths. Currently, there are two operational Dredge Material Containment Facilities (DMCFs) in the Baltimore Harbor, Cox Creek and Masonville, with an additional decommissioned facility, Hart-Miller Island, located just outside of the Harbor. Because of this, the Maryland Port Administration (MPA) is seeking new locations for the future placement of dredge material, as well as exploring reuse of the material through several innovative reuse projects. The following give a brief description of the current state of DMCFs in the harbor.

Hart Miller Island- Located just east of the mouth of the Back River and north east of Sparrow's Point, Hart-Miller Island is an 1,100 acre state park. Between 1981 and 2009, the island was used as a U.S. Army Corps of Engineers (USACE) Dredge Material Containment Facility (DMCF). The project was started with the intention of exploring dredge material as a medium for restoring wildlife habitat, and has since proven to be a success. Since 2009, the dredge material inflow has ceased, and the southern cell of the island is maintained as a wildlife habitat management area, with the hopes that the water quality of the northern cell can be stabilized to accommodate a similar situation.

Additionally, Hart-Millier Island is open to other passive recreational uses, such as boating, swimming and bird

watching. The island is only accessible by personal watercraft, with the western shore offering safe mooring, as well as a 3,000 foot wide sandy beach. (Maryland DNR) (DMMP 2013)

Cox Creek- Located on the western shore of the Potapsco River, one mile south of the Francis Scott Key Bridge, Cox Creek is an active DMCF for dredging operations in the Port of Baltimore. The Site began receiving material in 2005. The site was originally constructed by USACE in the 1960s and operated as a private industrial site until the mid 1980s. Maryland Port Administration (MPA) acquired the site through two purchases in 1993 and 1997.

In order to begin accepting dredge material, renovations were made to the site that included the strengthening and raising the dyke walls to 36 feet to meet the adjoining land. In total, the site has approximately 102 acres of area for dredge material placement. It is estimated that the capacity of the site is around 5 million cubic yards (myc).

As a required portion of the mitigation for constructing the dyke, MPA has restored/improved 11 acres of the adjacent Swan Creek wetlands. The restoration reopened tidal flows into the wetlands, cleared numerous invasive plants, and planted several native species. The improvements also included the placement of reef balls offshore to protect from beach erosion and to help increase aquatic biodiversity.

In the fall of 2013, the Cox Creek facility received approximately 450,000 cy of dredge material from a maintenance project at the Bremerton Angle channel. (DMMP 2013) Currently, the Cox Creek site is being explored as a possible site for the staging of innovative reuse projects.

Ports / Marine
Terminals

Locust Point
1706-1840s

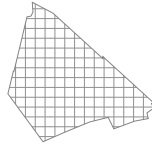


Dredge Material
Containment Facilities

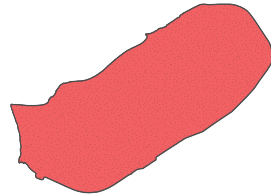
1770s - 1970s



1960-present



Hart-Miller
Island



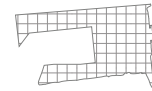
1990-present



Masonville



Future



Cox
Creek



Sparrow's
Point





Masonville- Along with Cox Creek, Masonville containment facility is the only other operational DMCF in the Baltimore Harbor. Located one mile south of the Hanover Street Bridge, the facility is named after an extinct town along the Baltimore & Ohio Railroad. The site became operational in 2010, and has since played a crucial role in absorbing the shortfall of placement areas after the closure of Hart- Miller Island. According to the 2013 DMMP report, Masonville received approximately 48,000 cy of dredged material in 2013.

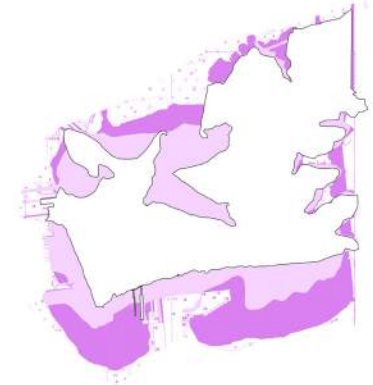
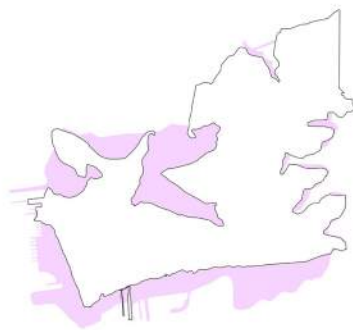
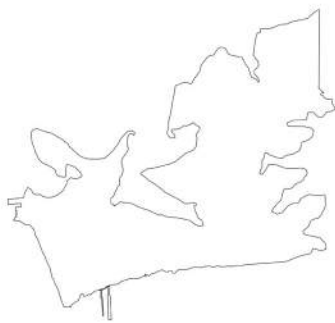
Masonville represents part of the enormous effort to improve the environmental health of the harbor. Neighboring the DMCF, Masonville cove is a protected shoreline habitat area. Cleanup efforts of this area have been absorbed as part of the state and federal permitting regulations for containment facilities. Restoration efforts have included the removal of over 60,000 tons of debris, removal of invasive species, and a continually evolving planting regiment to restore wetland ecologies of the site. Since efforts began, the site has evolved into a exemplary piece of the harbor restoration effort, as well as an educational resource for the area.

Coke Point- Coke Point is an artificial peninsula located at southwestern corner of Sparrow's Point. Historically the point was part of the steel mill complex of Sparrows Point. The 300 acre site was first proposed as a DMCF in 2003 by the Harbor Team, and again in 2011. Sparrow's Point has also been proposed as a pilot location for testing innovative reuses of dredge material, under the MPA's "Innovative Reuse of Dredge Material" program.

SPARROW'S POINT

Sparrow's Point is a low-lying peninsula on the northern bank of the Patapsco River where it meets the main branch of the Chesapeake Bay. The original landmass, which for the purposes of this study is referring to the pre 1885 landmass, was part of the two major geologic formations, the Patapsco and the Talbot. The Patapsco formation, which sits underneath the Talbot formation, is comprised primarily of high density clay and sand, and the Talbot primarily of silt sand and clay of low to moderate density. (USGS) This landmass would remain largely unaltered until the next generation of sedimentary additions began in the late 19th century.

In stark contrast to the underlying formations of Sparrow's Point, the next era of land building on the peninsula would be defined primarily by anthropogenic process. In 1887 the Pennsylvania Steel Company Purchased land at Sparrows



1857

1887

1889

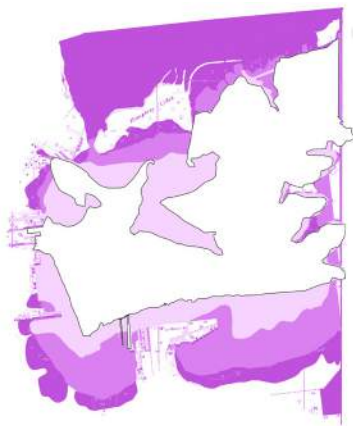
1892

1916

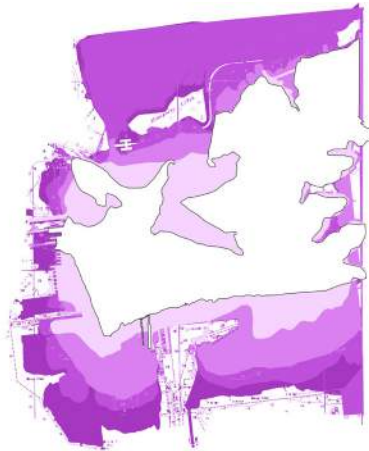
1957

Point with the intention of constructing a blast furnace for the production of steel in close proximity to the Atlantic Ocean. Prior to this time, the land had been sparsely populated with farms and family homes, remaining largely rural in character. In 1889 steel production began on the point, marking the beginning of a rather rapid transformation of the site. Shortly thereafter, the town of Sparrow's Point began housing workers from the steel plant as well as a newly opened shipyard.

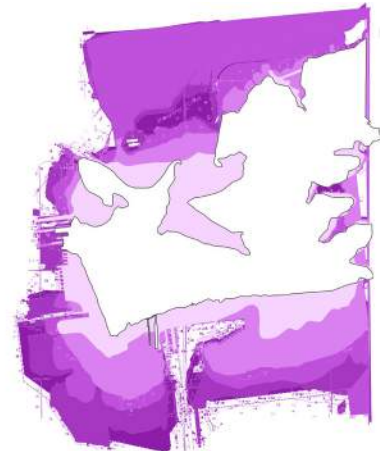
In 1916, Bethlehem Steel purchased the plant from the Pennsylvania Steel Company, and announces a \$50 million expansion. As steel production continues to increase, so do the physical extents of the peninsula. During the production of steel several by-products emerge, including slag from ore smelting, and fly ash from the coking process. In the case of Sparrow's Point, slag laid the foundation for expanding the very process that produced it. The figure to the right illustrates the infilling and expansion of the peninsula over the



1971



1978



2011

2012

2014

portion of its steel making lifespan. Recent coring samples reflect that areas that we're formerly open water contain the thickest layer of slag material, in some places reaching a thickness of up to 40 feet.

The refuse of the mid century production boom continued to expand the site well into the second half of the 1900s. By the 1950s production at the mill had increased dramatically, and in 1957 the mill produced over 8 million tons of steel, making it the most productive steel mill in the world. In 1960 the plant employed more than 30,000 people, the largest personnel numbers it would ever record. Over the next decade, the plant continued to expand, and by 1970, the plant covered approximately 5,000 acres, making it the largest steel plant in the country.

This boom, however, was short lived. In 1971, Bethlehem Steel laid off 725 employees from Sparrow's Point, and 2,500 company wide. The only beacon of hope came in 1974, when Bethlehem Steel recorded a international annual profit record of \$342 million. The second half of the decade leads to increasing competition from foreign production, which in turn leads to substantial temporary layoffs within the company and consequently at Sparrow's Point.

Despite inconsistencies in profits and production, 1978 brought with it the introduction of the "L" blast furnace, which boasted a \$200 million price tag. The investment, however, did not avert the signs of trouble early in the decade. In February of 1997, the company agreed to a \$50 million deal with the EPA to clean up the decades of degradation to the surrounding environment. Shortly following that deal, in 2001, Bethlehem Steel files for Chapter 11 bankruptcy.

The transfer of Bethlehem Steel to International Steel Group marks the beginning of a slow and painful end to the steel industry on Sparrow's Point. Shortly after this transfer, the company which had purchased the shipyard from Bethlehem Steel in 1997, files for Chapter 11 bankruptcy. The yard is sold at auction in 2003 with plans to rehabilitate it, however these plans fail to accumulate into anything substantial, thus marking the end of ship production at Sparrow's Point.

During the remainder of the first decade of the 2000s, the property changes hands two more times, first to Mittal Steel Co. in 2005, and next to OAO Severstal in 2008. In 2011, the property again changes hands, being bought by RG Steel. Shortly thereafter, RG Steel files for bankruptcy and puts the property up for sale once again. The acquisition is made by Environmental Liability Transfer and Hilco Trading for \$72 million. The systematic dismantling and sale of individual parts of the property begins, beginning with the sale of the newest portion of the plant, the cold mill. The final transfer to date occurred in September of 2014, when Sparrow's Point LLC purchased the property for \$110 million from the liquidation group.

At present, Sparrow's Point is unused, but remains a prime location for new development, industry and reuse. It boasts over 6 miles of continuous shoreline, direct access to shipping channels, a deepwater port, immediate adjacency to I-695, extensive rail infrastructure and a lineage of productive use. The above features, along with the degraded nature of the site and its proximity to harbor dredging operations, make Sparrow's Point an ideal location for the development of new types of dredge material management in Baltimore Harbor.

MATERIAL SYSTEMS

BENEFICIAL REUSE OF DREDGE

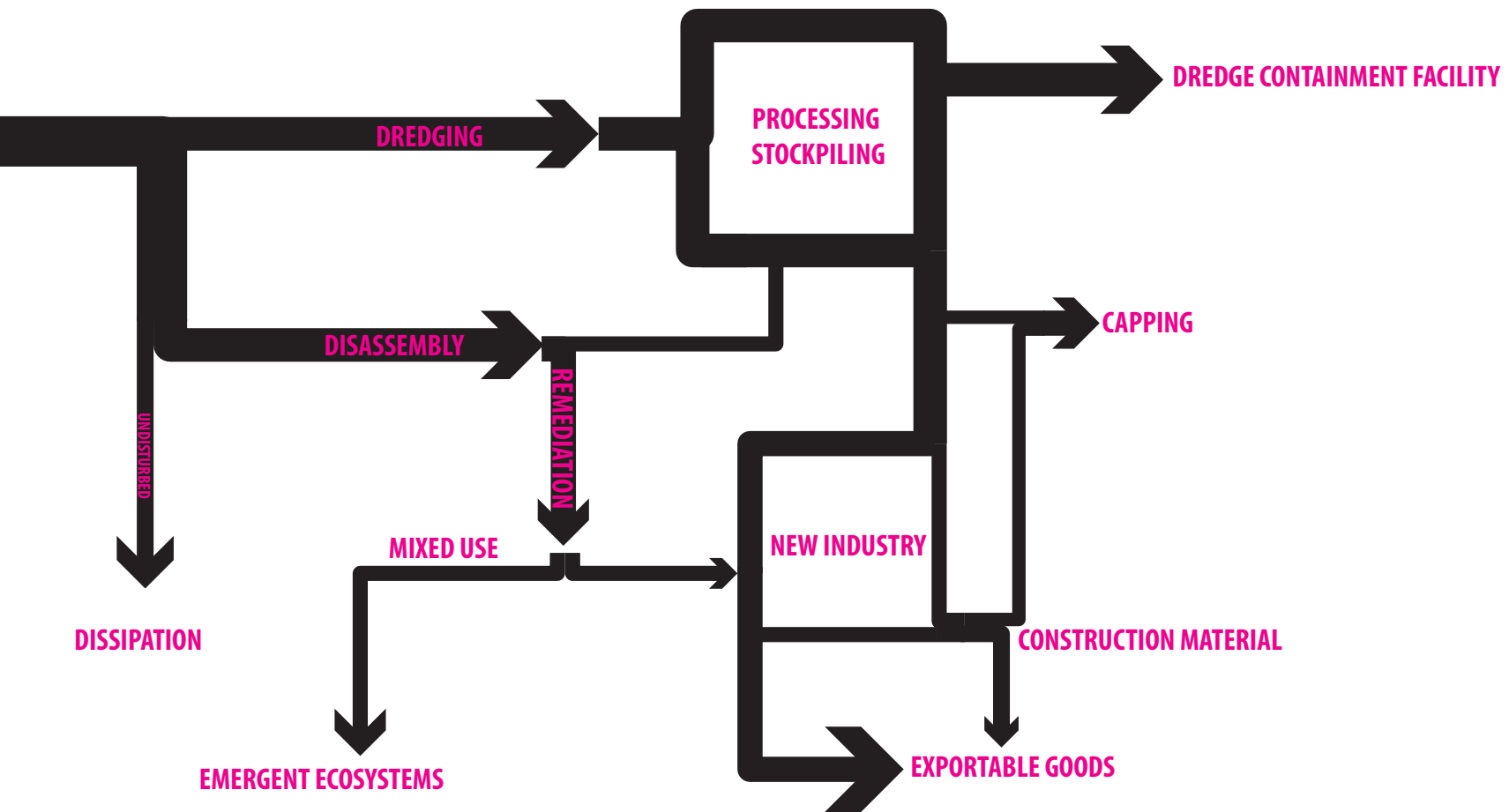
Based on specific site conditions and the nature of the operation, the composition of this sediment can vary, requiring different means handling and using the material. Most often, dredged material is deposited in designated open water dumping areas or placed as fill in DMCFs like Cox Creek and Masonville. In some cases, dredge is utilized in land building operations such as beach nourishment or habitat restoration like Poplar Island when toxicity levels are low. In smaller ports or operations where dredge placement is more flexible, different reuse strategies have been employed, including landfill cover, construction fill and mine land reclamation.

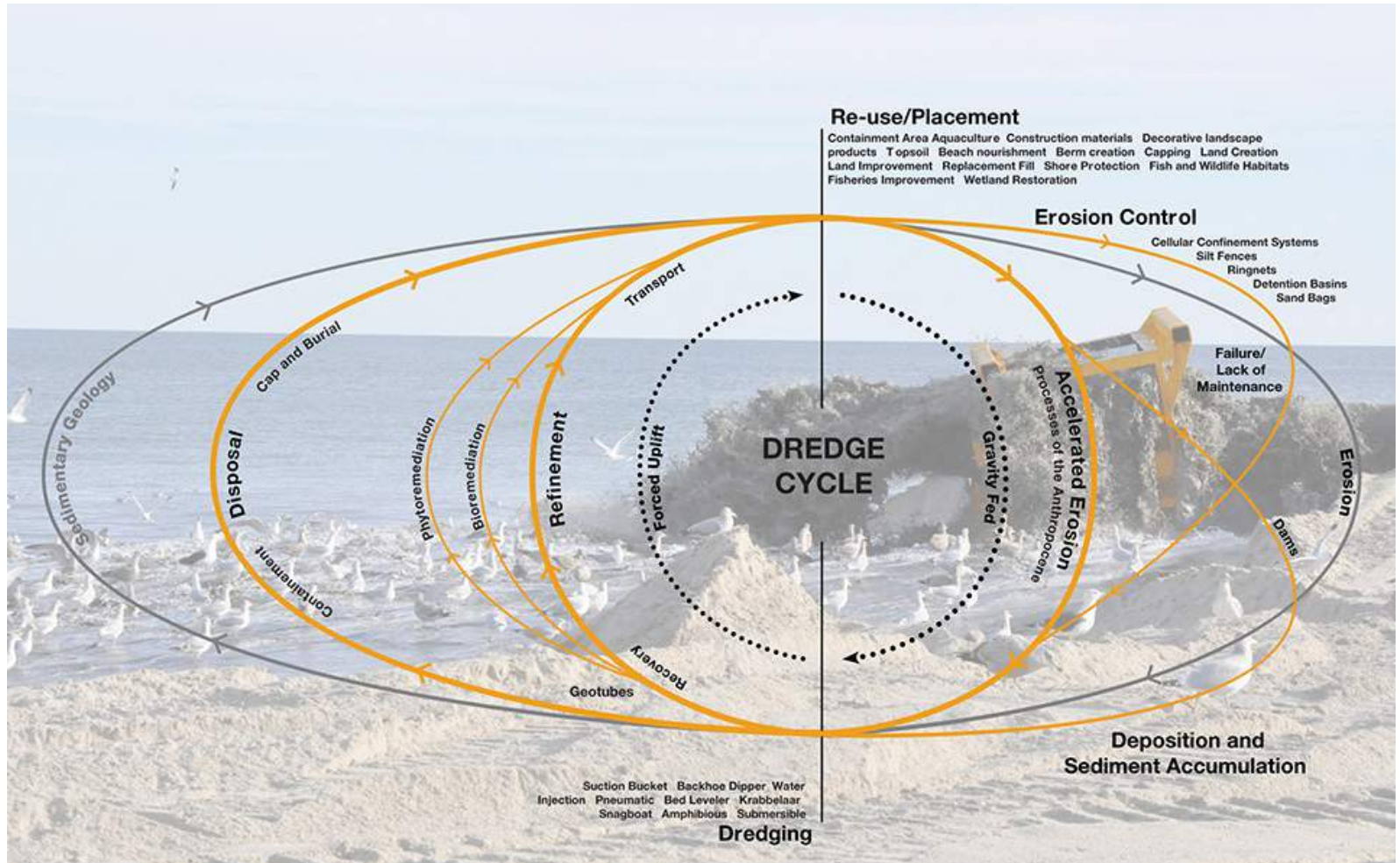
Following suit with smaller ports, the Maryland Port Administration's "Innovative Reuse of Dredge Material" program hopes to recycle approximately 500,000 cubic yards of dredge by the year 2023. Under current state law, dredge material from the Baltimore Harbor shipping lanes must be placed in confined disposal area because of contamination levels. As illustrated by other ports however, the reuse of the material can be beneficial to the surrounding region from both an environmental and financial standpoint. The cost of constructing new containment facilities not only increases public spending related to dredging, it also consumes valuable waterfront property in the harbor. As mentioned above, the port currently operates only two dredge material containment facilities, both of which are expected to reach capacity by 2023.

To alleviate the costs of continually developing dredge

SHIPPING CHANNEL

FORMER INDUSTRIAL SITE





Dredge Cycle - by Dredge Research Collaborative

containment facilities, some Great Lakes ports have explored the creative ways to reuse dredge material, specifically the Port of Duluth-Superior. The port has done so by testing dredge in numerous ways, including construction backfill, bituminous aggregate additive, mine land reclamation, landfill cover, top soil creation, habitat restoration, and stormwater pond buffering. At the center of this reuse exploration is the conversion of a contained dredge facility (CDF) at Erie Pier, into a dredge processing facility.

As discussed in the case studies, rather than constructing a new dredge containment facility, the port decided to transform the 89 acre Erie Pier into a dredge material processing facility to extend the facilities life. The processing facility uses a hydraulic process to sort the material into two classes, coarse and fine. According to the Great Lakes Commission report on beneficial reuses of dredge material, the coarse material, primarily sand, has been used since the 1980s in road and other construction projects. The fine material, which the commission describes as “reclaimed soil”, is being utilized in a number of projects including golf course turf restoration, stormwater berm making, top soil for Superior landfill, and as cover for the restoration of a iron ore mine trailings basin. As of 2013, the Minnesota Department of Natural Resources has been planning several other pilot projects in the harbor, including a 75-acre land building habitat restoration project that is projected to use upwards of 300,000 cubic yards of material. [GLC] Duluth Superior provides an excellent example of innovative reuse of dredge material through the transformation of Erie Pier. It also serves as an important precedent for the adaptation of a particular site to meet the changing environmental, financial, and spatial needs of the region.

It is important to note that reuse of dredge material can often be limited by composition of the material itself. The fine grained nature of most dredge material makes it highly compressible. This attribute often restricts its reuse to situations where structural integrity is not a priority. Additionally, dredge material can contain varying concentrations of contaminants. The possibility of these contaminants leaching into ground water or being absorbed into plant material, can hinder the reuse in proximity to wildlife habitat or in situations where human contact is likely. Remediation is possible, however, through processes involving plants, such as phytoremediation which uses the direct uptake and/or metabolization of contaminants by plants or associated bacteria to remove them from the soil. These processes can be an economically viable and successful solution to contamination in situations with a suitably long time horizon or in areas where a less invasive approach is desired.

The example of Duluth-Superior in reuse of dredge material and retrofitting of an industrial site suggests promising possibilities for the future of dredge as valuable commodity. By viewing dredge material as a resource that is excavated, rather than a by-product that requires disposal, new opportunities for development around the material become evident. In considering the proposed DMCF site at Sparrow's Point, one can find that the industrial legacy of the point was in fact built upon the refuse of its own production, steel and blast furnace slag.

Although slag material was once discarded and treated as waste material, it has since become a valuable supplement

to many construction materials. Slag has become especially valuable as a substitute in concrete mixtures, in some cases replacing up to 70-80% of cement content. [12] During a pilot innovative reuse project, Schnabel Engineering studied the reuse of dredge material from Baltimore Harbor in combination with steel slag fines. The project tested the structural stability of fill made from the combination of the two materials, as well as the mobility of heavy metals over a 360 day period. At the completion of the study, it was concluded that the addition of SSF to dredge material greatly improved its structural integrity. The study also found that the alkalinity of the SSF helped to immobilize arsenic and other heavy metals found in the harbor dredge material. These findings help overcome a critical limitation to the reuse of dredge material, rendering it as a plausible foundation for the repurposing of former industrial sites like Sparrow's Point. Further, local production, processing and management of materials like slag and dredge, especially on an already degraded site, helps to reduce both associated cost and risk of transportation of the material to another location. When dealing with materials in situations of remediation, this type of strategy can be advantageous from both a financial and environmental standpoint.

INDUSTRIAL SITE RECLAMATION

In many recent projects, landscape architects have grappled with the numerous constraints of redesigning former industrial sites. These spaces are often littered with derelict structures, buried utility lines, piles of debris, and plumes of contamination. The layout and existing infrastructure may have very little to do with proposed designs or desired programs of use, but removal of such altogether can prove to be very costly. To compound the issue, questions of historic preservation and what should remain on the site have potential to spark heated debates and result in public disapproval. Most often, the treatment of industrial sites involves the displacement of contaminants to another location and the overlay of new recreational activities set amongst artifacts of past uses. In some cases, the site is leveled all together, and its history is undetectable through the newly overlaid use. In order to understand how landscape architects might find alternate modes of operation when repurposing these spaces, it is first important to understand how these solutions have evolved. The following will briefly describe three examples of landscape architects interventions on former industrial sites.

Gasworks

Situated on the northern shore of Lake Union in Seattle, Washington, Gasworks Park was designed by landscape architect Richard Haag and was completed in 1975. The park is sited a 19.1 acre former coal gasification plant. In many ways, Gasworks is seen as a seminal project in the transformation of defunct industrial sites into parks. The primary elements of the design are a large earthwork titled Kite Hill, several areas of lawn, and the remaining

tower structures and pipework of the former plant. Haag utilized several thousand yards of concrete rubble from building foundations on the site in order to construct the earthen mound. Since the completion of the park, several concerns has arisen surrounding contamination of soil and groundwater on the site. At one point, these concerns threatened to close the park, and can still be seen in the fencing off of the “forbidden section” of the park in immediate proximity to the preserved gasworks structures.

Duisburg Nord Landschaftspark

The second examples exists on a much larger scale. Duisburg Nord Landschaftspark, designed by german landscape architect Peter Latz, is part of a 568 acre master plan on the former site of steel mill and industrial park. The park was opened to the public in 1992 and fully completed in 2002.

The design of the park builds on the preexisting lands use patterns formed by the site’s industrial past. New plantings, gardens, and plaza are woven between rusting blast furnaces, monolithic concrete structures, and snaking railways forming a new hybrid landscape. Elements of play, performance and natural process are framed within the cultural legacy of the region, a narration of past purposes and future possibilities. At the core of the design, the park aims to transform a former industrial engine of the region into a public amenity, and ultimately a cultural emblem.

Westergasfabriek

The last example addresses both pragmatic concerns of contamination as well as cultural attitudes toward the environment and industry. Westergasfabriek is the former site of a nineteenth century gasworks in Amsterdam, Netherlands.

The 28 acre site was designed by Kathryn Gustafson of Gustafson Porter (UK) and Gustafson Guthrie Nichol (USA).

A guiding principal for the park was to reflect changing attitudes toward the environment and landscape through contemporary form. The design team sought to contain any contamination onsite as in order to simply displace problem to another location. A particular challenge then became the management of the and disposal of contaminated soils and materials. Polluted material exceeded expectations prior to demolition, and in many cases, alterations to the demolition and remediation plan were necessary. Highly contaminated soils were excavated and contained on site, often forming the basis for new landforms. In their place, new soils were used to fill excavated voids in order to retain existing grades around buildings.

These buildings became venues for cultural events and activities, and the surrounding landscape a new ecologically sensitive green space. Within the green space, the variation of native plantings and more curated varieties strikes a balance between natural settings and human needs, reinforcing Gustafson's principal idea for the park, and the relationship man has with nature.

The design of Westergasfabriek is not only a thoughtful display of culturally sensitive design, but also a consciousness of the reciprocal relationship between the designed landscape and landscapes of extraction or deposition. In choosing to retain the contamination within the site, Gustafson shows an understanding of both the cultural and ecological effects of designing on contaminated sites. In an article entitled "Reciprocal Landscapes: Material Portraits

in New York City and Elsewhere”, Jane Hutton describes this relationship between material choices made in construction of designed landscapes, and the landscapes these materials are sourced from.

“As the Central Park reservoir was first filled with water, 700 km to the northeast 60 to 120 men and ten pair of oxen’ were cutting stone in Spruce Head Quarry of the Fox Islands for the reservoirs’ gatehouses.” [8]

In this passage, Hutton is describes the connection and transformation that two otherwise unrelated landscape have through the construction of a single project. She goes on to describe the how large contracts and unsteady demand for granite from the Fox Island quarries caused boom-bust conditions, leading to the formation of unions to protect the rights of stone cutters, the passage and amendment of laws surrounding the production and cutting of out-of-state stone, and the eventual edging out of the Fox Island quarries by cheaper inland competition. Through this lens, one can see that as a direct result of the construction of some of Central Park’s most iconic structures, a second landscape of extraction and exploitation is created. [8]

The above examples can provide a basis for landscape architects approaches to the design of industrial sites. Through the retention of industrial artifacts and site organization, these precedents reveal to the user a sites past that was very different from the present condition. In all of these examples however, what is often lost is the working character of the site. These former gasworks and steel mills used to be some of the most productive sites in their respective regions. When considering how these sites

should be reused, is there an opportunity to retain some of this productive character in the evolution of these types of landscapes? Can the re-habilitation and re-use of the site help prepare former industrial sites for a productive future? Building off of the example of repurposing Erie Pier in Duluth, and the cultural narrative and material treatment of projects like Westergasfabriek, a hybrid recreational and productive future for Sparrow's Point might be realized through the processing and reuse of dredge material.

DESIGN

MINING SPARROW'S POINT

As mentioned previously, a large portion of the present day Sparrow's Point peninsula has been built over the last one hundred years through anthropogenic depositions consisting primarily of slag material, a by-product of the steel making process. Through its use as fill, slag allowed numerous expansions to take place at Sparrow's Point, in many ways laying the foundation for the robust industrial history of the site. With the era of steel production now over for the peninsula, this slag material will be mined as a valuable resource in staging the next era of Sparrow's Point.

Similar to the concept of reusing dredge material, the steel making industry at Sparrow's Point had also leveraged by-products of its operations for the continuation and expansion of its function. The excavation process provides new opportunities on the site aside from the reuse of the material. The incremental mining of the site for slag material, will ultimately unearth a landform similar to that of the pre industrialized point. After the excavated slag is combined with dewatered dredge material, a strategic refilling of the excavated areas allows the restoration of shallow water environments that had been previously filled in the peninsula's expansion. With this in mind, the deposition of slag can begin to be seen as both a figurative and a literal resource.

SLAG DEPOSITION THICKNESS



THICKER THINNER

EXCAVATION

Mining Slag

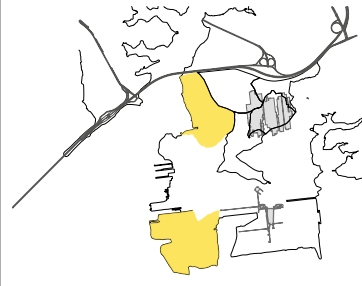
Slag created in the process of steel making was used as a foundation for expanding operations at Sparrow's Point.

In order to once again form the foundation for new uses on the site, this granular aggregate material will be mined and combined with dredge.

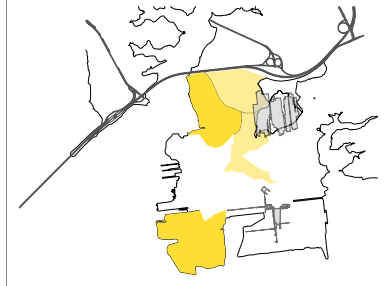
EXISTING



PHASE 1



PHASE 2

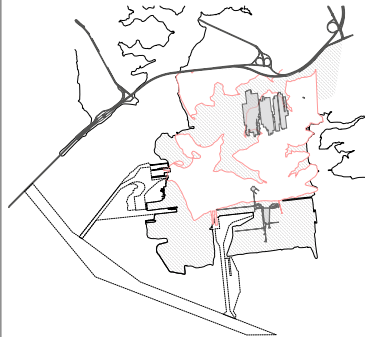


FILL

Hybrid Dredge Filling

A significant portion of the landmass of Sparrow's Point has been created through the process of filling previously inundated areas.

Filling will again be used as a process of re-shaping the peninsula. Additions will be used to supplement former highlands, as well as create new landforms, revealing a new hybrid landscape as rising sea levels inundate former marshes and tidal wetland areas once again.

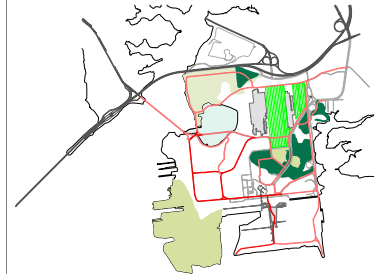


VEGETATION

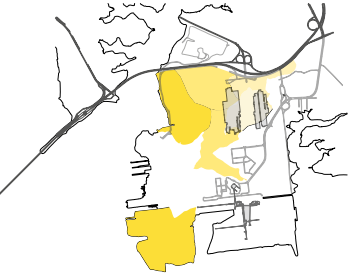
Ecological Function + Production

Vegetation has already begun to re-establish in lesser disturbed areas of the site. The planting strategy for Sparrow's Point will serve to encourage successional qualities, while embracing production land use systems.

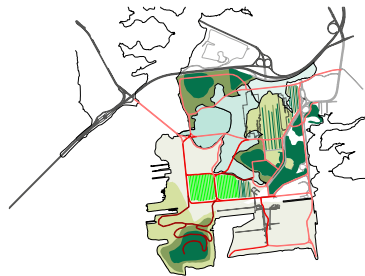
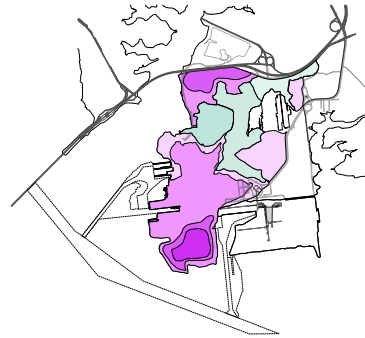
The next era of Sparrow's Point is envisioned as both a passive and productive landscape. Cultivation of nursery plots will serve to plant the newly filled areas, supplement existing vegetation, and promote a consciousness of the productive nature of the site's history.



PHASE 3



PHASE 4



A study conducted by a Rutgers University Professor concluded that an 80/v20 mixture of dredge to steel slag fines substantially increased the structural integrity of dredge material and significantly increased the regeneration of plant material compared to dredge material on its own. Building on the History of the Site, the next phase of Sparrow's Point, through deposition, excavation, and remaking, will continue to layer, reorganize and thicken the productive history of this peninsula. Using dredge as its primary medium, the rejuvenation of the site will explore the material in three different forms.

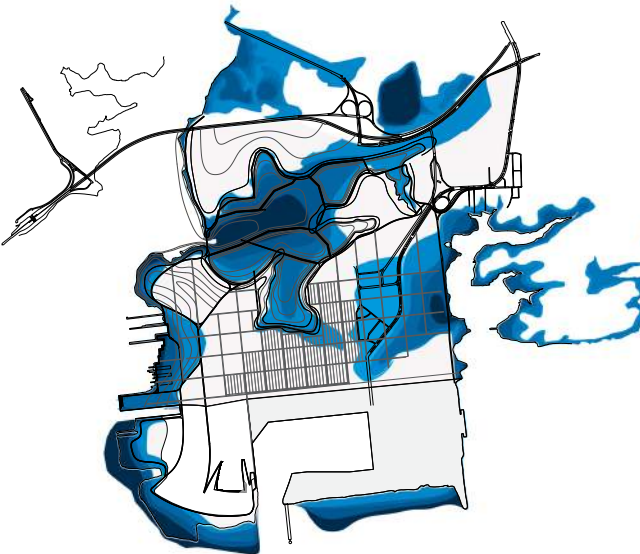
EXISTING TOPOGRAPHY - FLOOD RISK



MINOR FLOODING

SEVERE FLOODING

ALTERED TOPOGRAPHY - FLOOD RISK



MINOR FLOODING

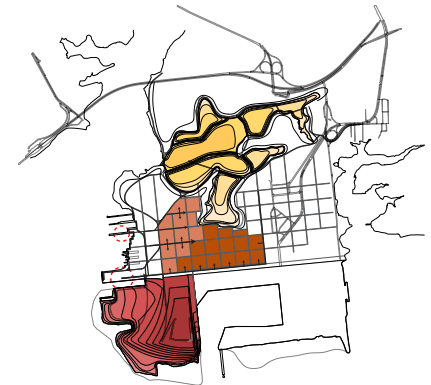
SEVERE FLOODING



Building Sparrow's Point

Dredge Processing as Industry

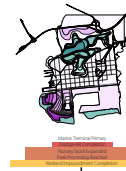




2025



2035

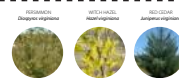
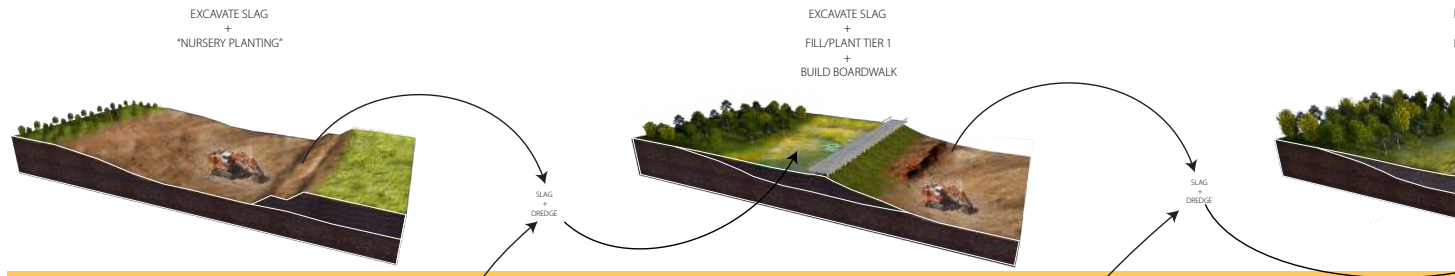


2045



2055

Slag Excavation



Dredge Processing



Marine Receiving Dredge Material
Slag Mining Begins
Wetland Remediation Construction Begins

2016



Marine Terminal Construction
Dredge Processing Construction
Wetland Remediation Construction
Slag Mining & Wetland Remediation Construction

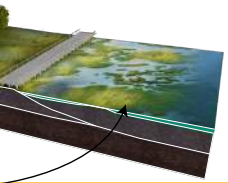
2025



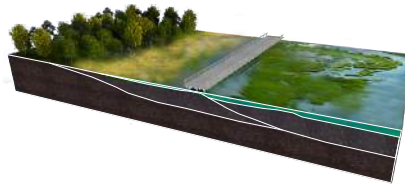
Marine Terminal Operational
Dredge Processing Construction
Wetland Remediation Construction
Slag Mining & Wetland Remediation Construction

2035

FILL/PLANT TIER 2
+
FILL/PLANT TIER 3



INUNDATION VARIABILITY
+
ADAPTATION



SUCCESSION
+
GROWTH



FLAND HASTGRAS
Dactyloctenium

SAT HEDONOR CORGRAS
Spartina patens

FRANS CORGRAS
Spartina patens



AMERIKAN BLERICH
Sagittaria

SAVIC RISIA
Sagittaria



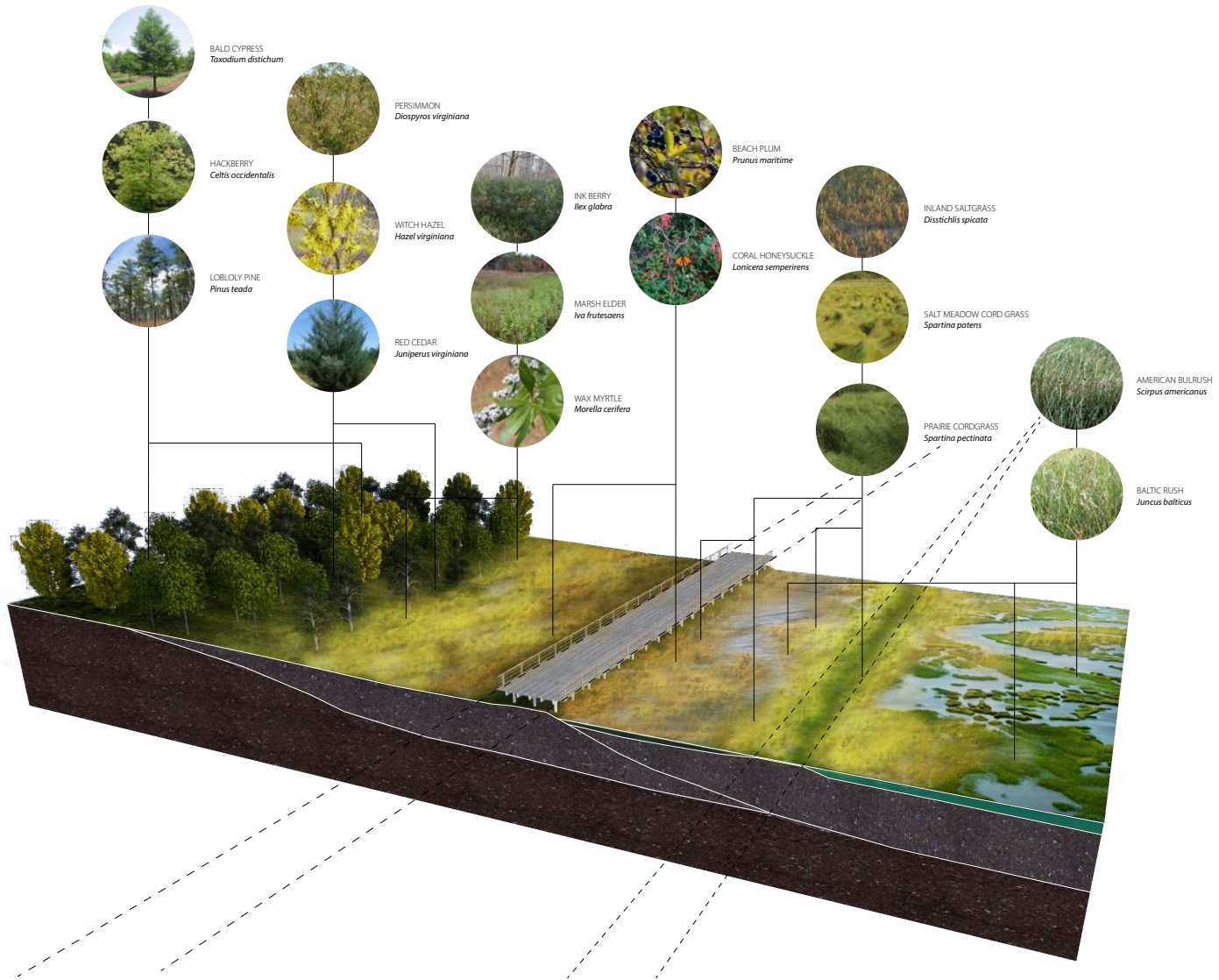
Marine Terminal Primary
Change in Compensation
Capacity Reached
Peak Processing Reached
Wetland System Measures Completion

2045



Change in Compensation
Capacity Reached
Peak Processing
Wetland System Measures

2055

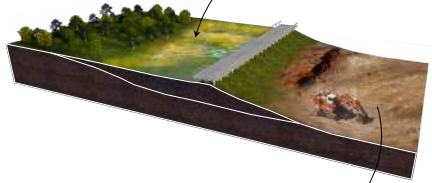


EXCAVATE SLAG
+
"NURSERY PLANTING"



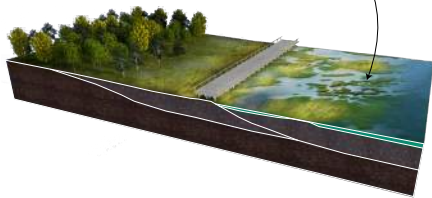
SLAG
+
DREDGE

EXCAVATE SLAG
+
FILL/PLANT TIER 1
+
BUILD BOARDWALK

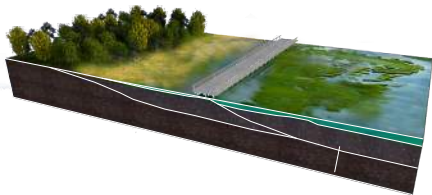


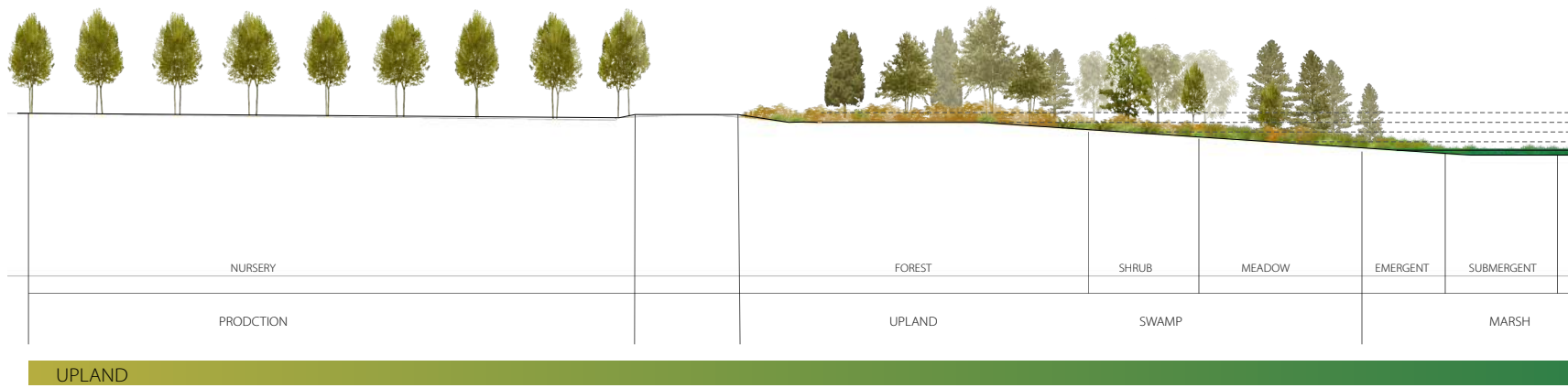
SLAG
+
DREDGE

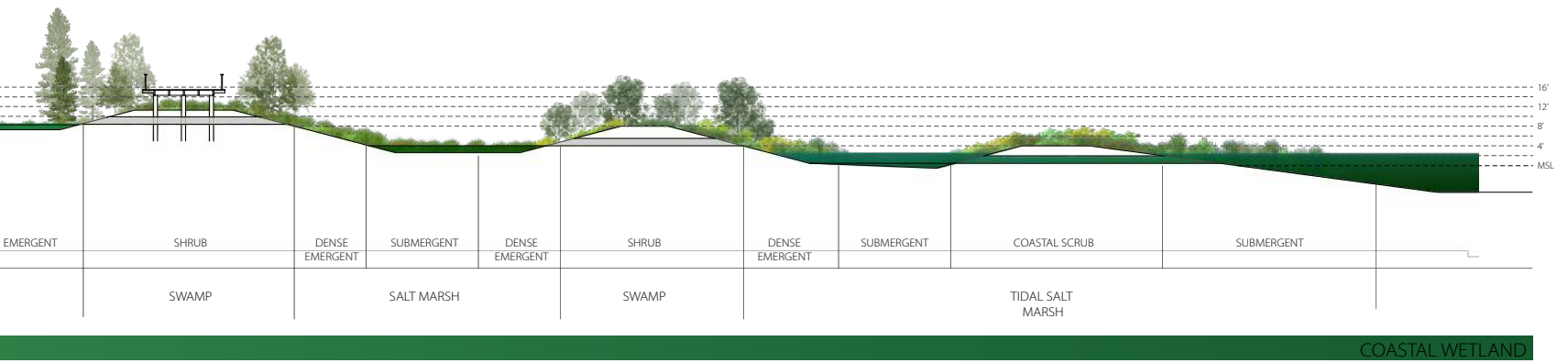
FILL/PLANT TIER 2
+
FILL/PLANT TIER 3



INUNDATION VARIABILITY
+
ADAPTATION



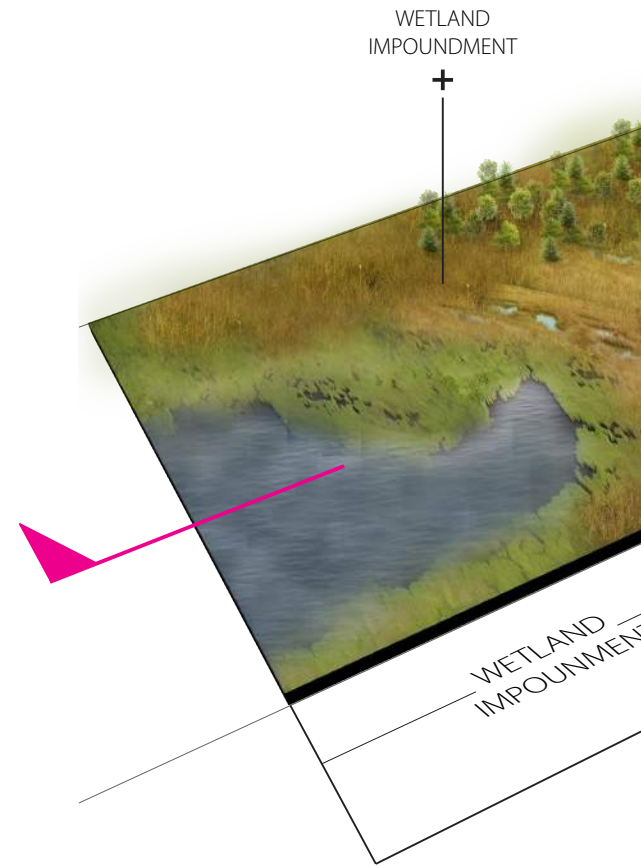


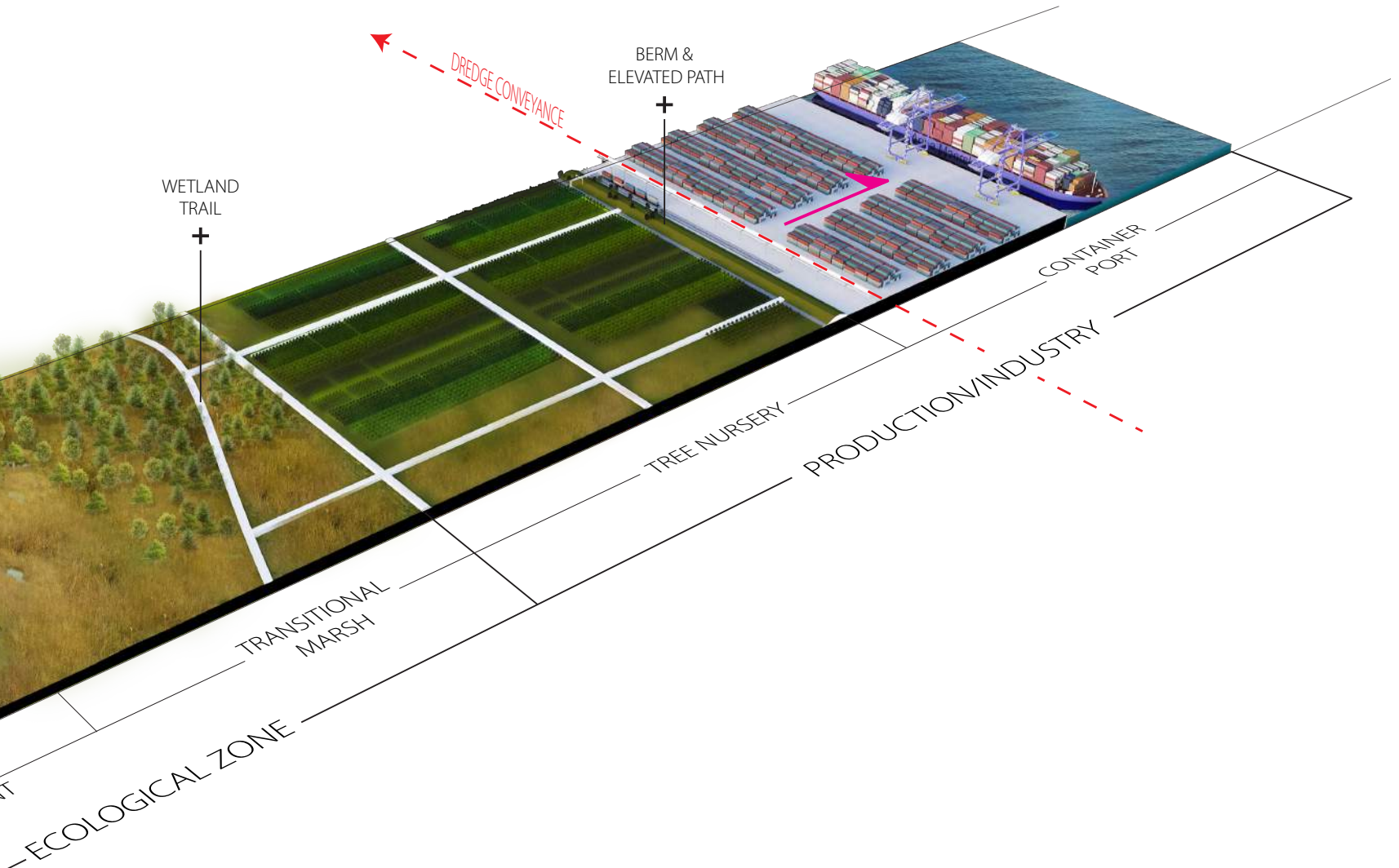


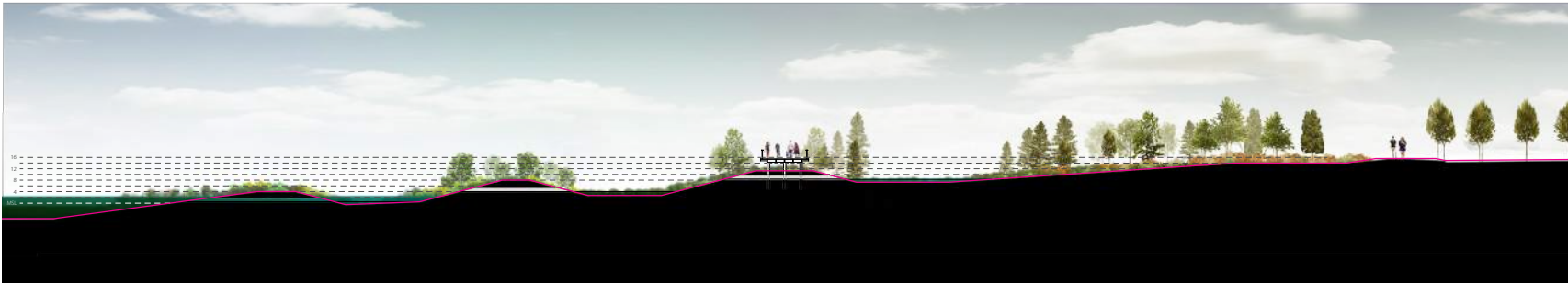
COASTAL WETLAND

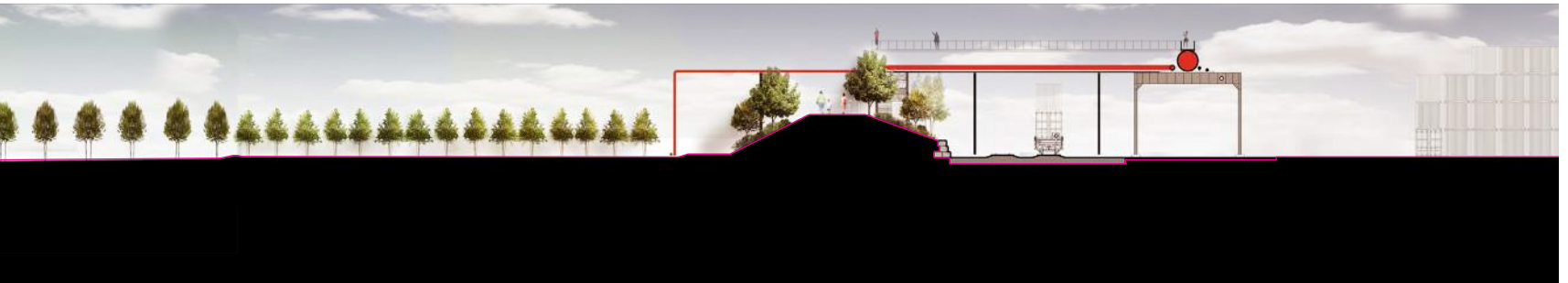
1 | DREDGE AS MATERIAL SYSTEM

First it explores dredge as a material system through a series of constructed wetland impoundments. These impoundments will function to re-establish natural ecological buffers that help to mitigate storm surge, rising sea levels, and filter runoff. They will showcase the material as a substrate for the cultivation of more naturalized systems.



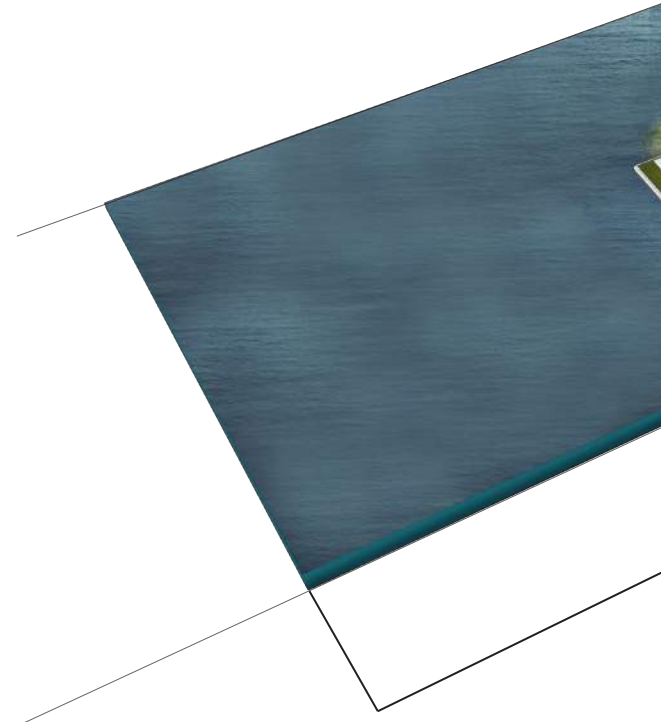


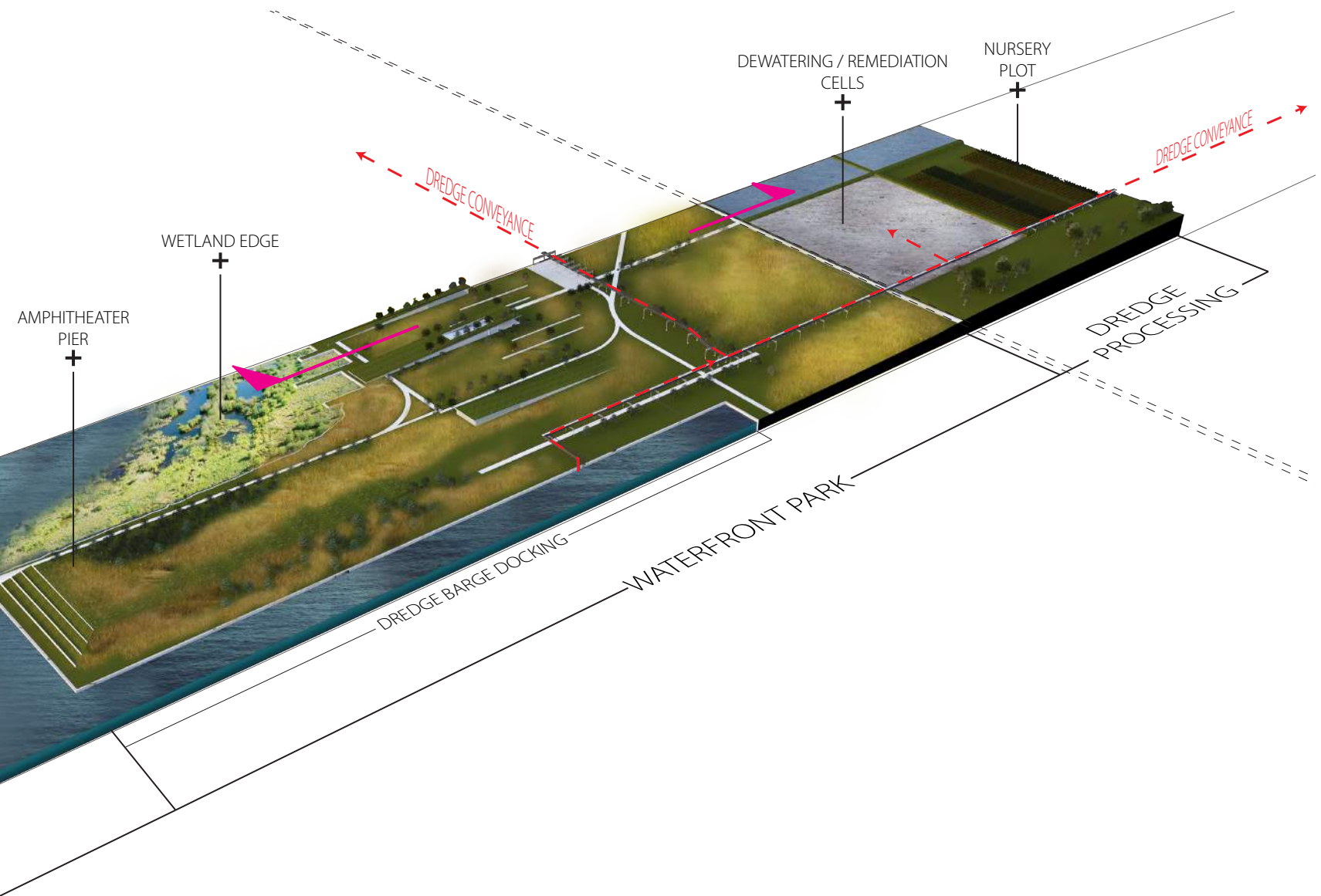


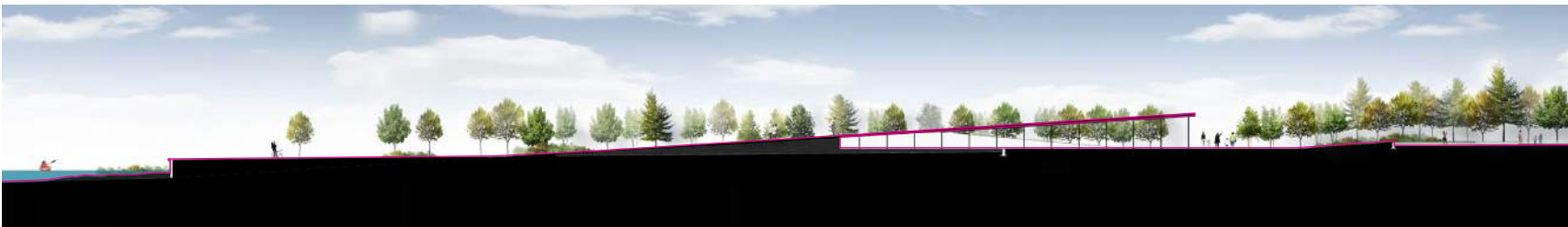


2 | DREDGE AS PRODUCT

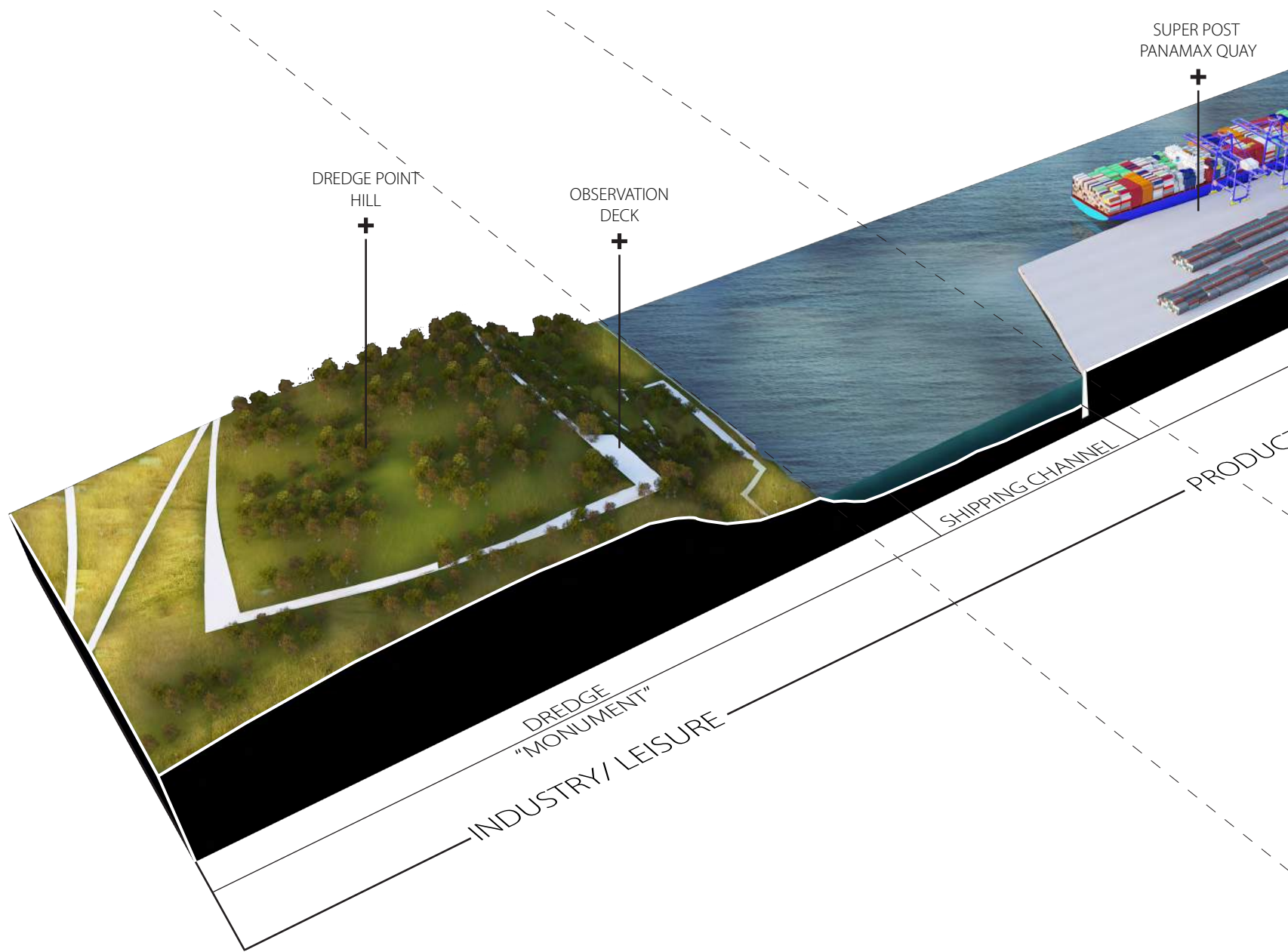
Second, it utilizes dredge as a product. Through a series of gridded cells, dredge material will be used to generate two types of products. In the first, dredge will be used to nourish tree nursery production through flooding. In the second dredge will be dewatered, remediated, and combined with steel slag to produce a hybrid soil. These resulting products can then be used both on site, as well as to be exported to other remediation sites in the region.

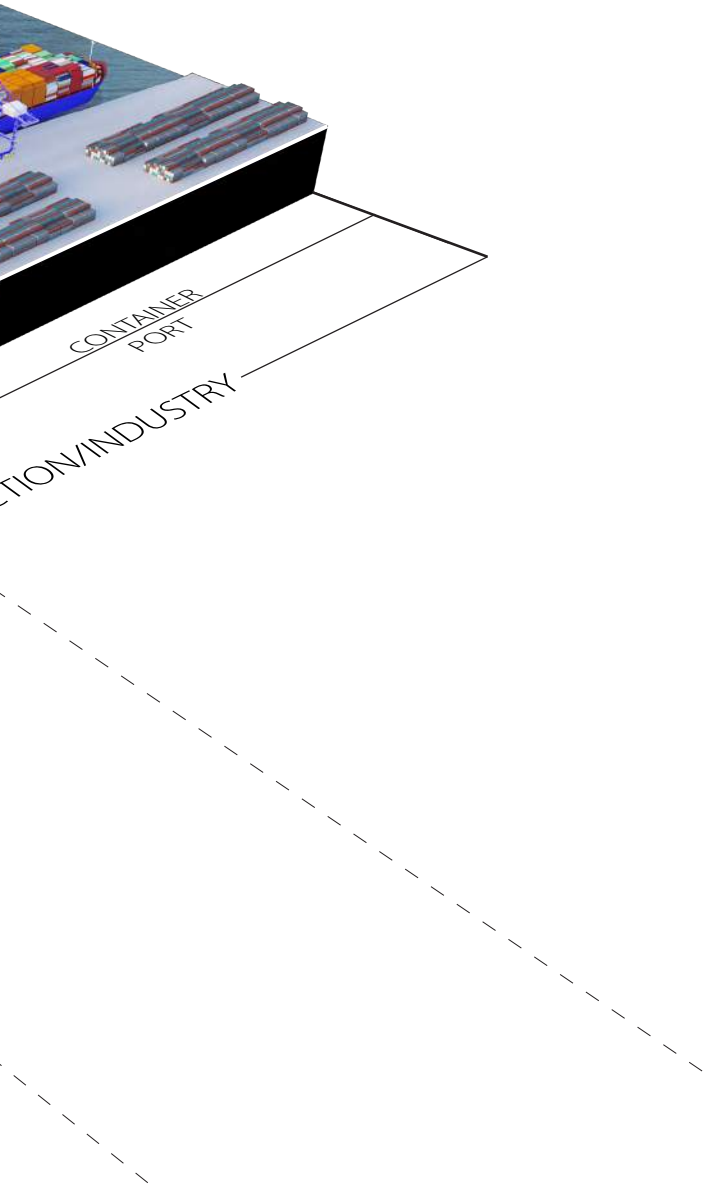






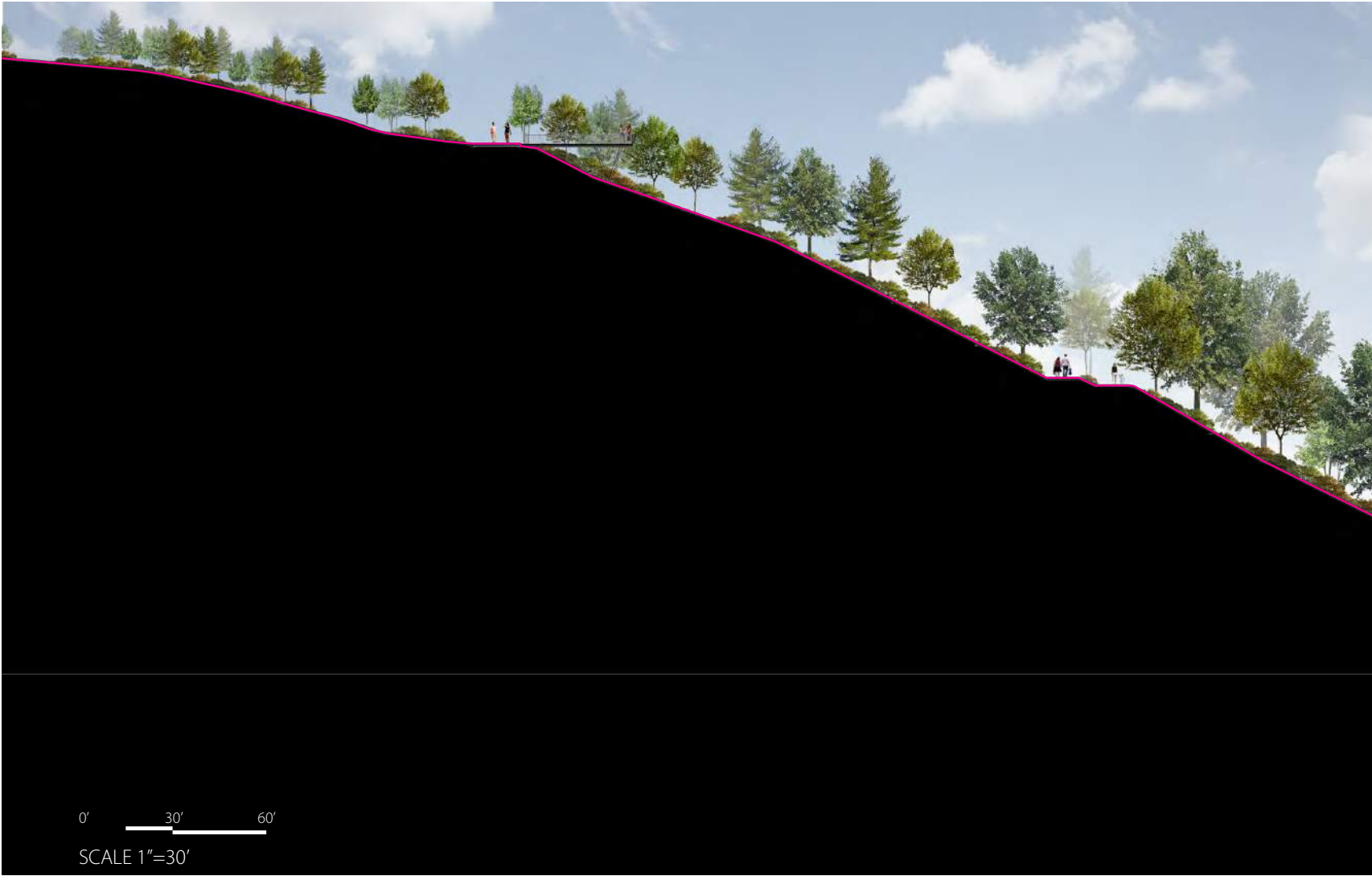


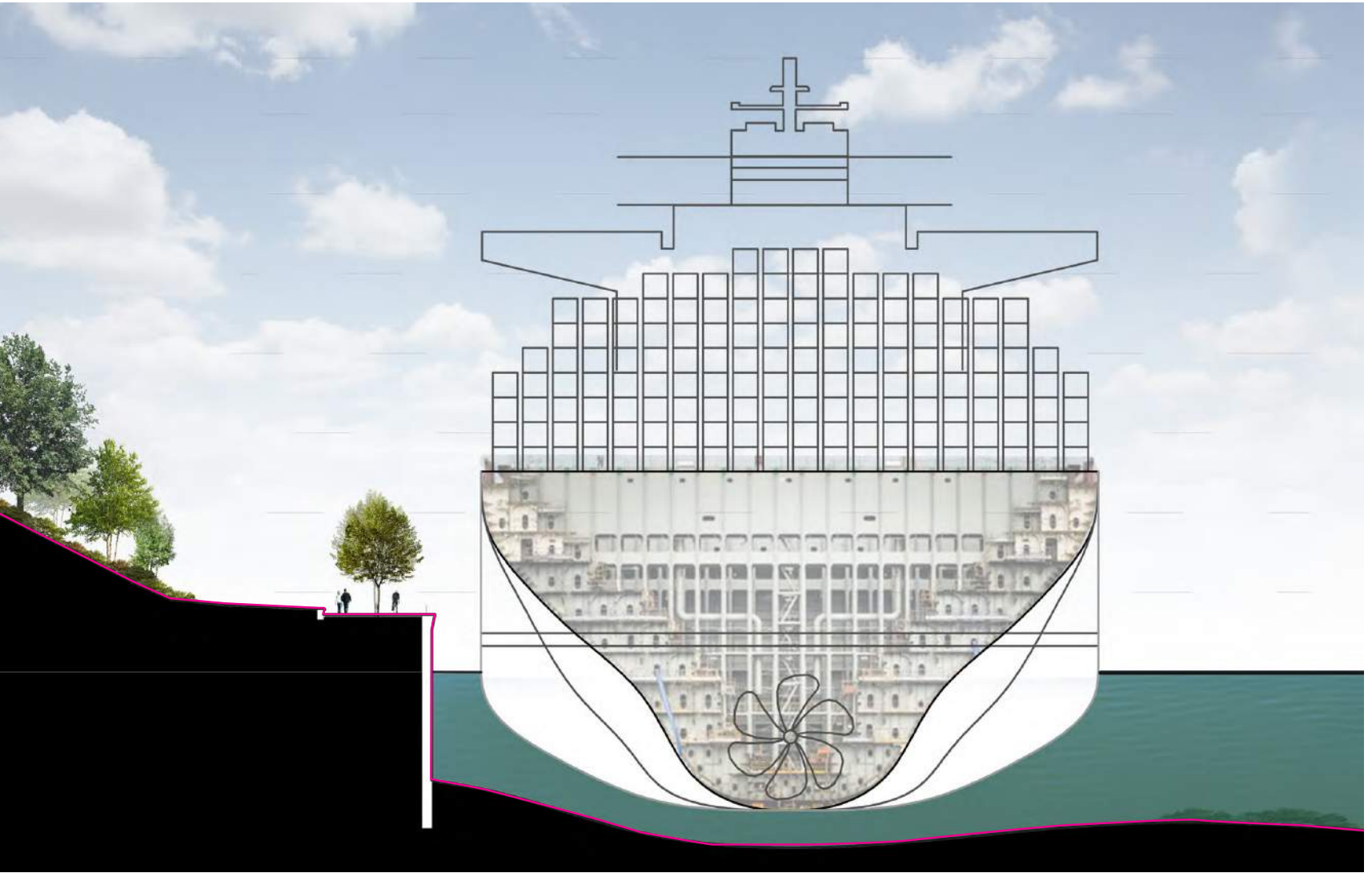


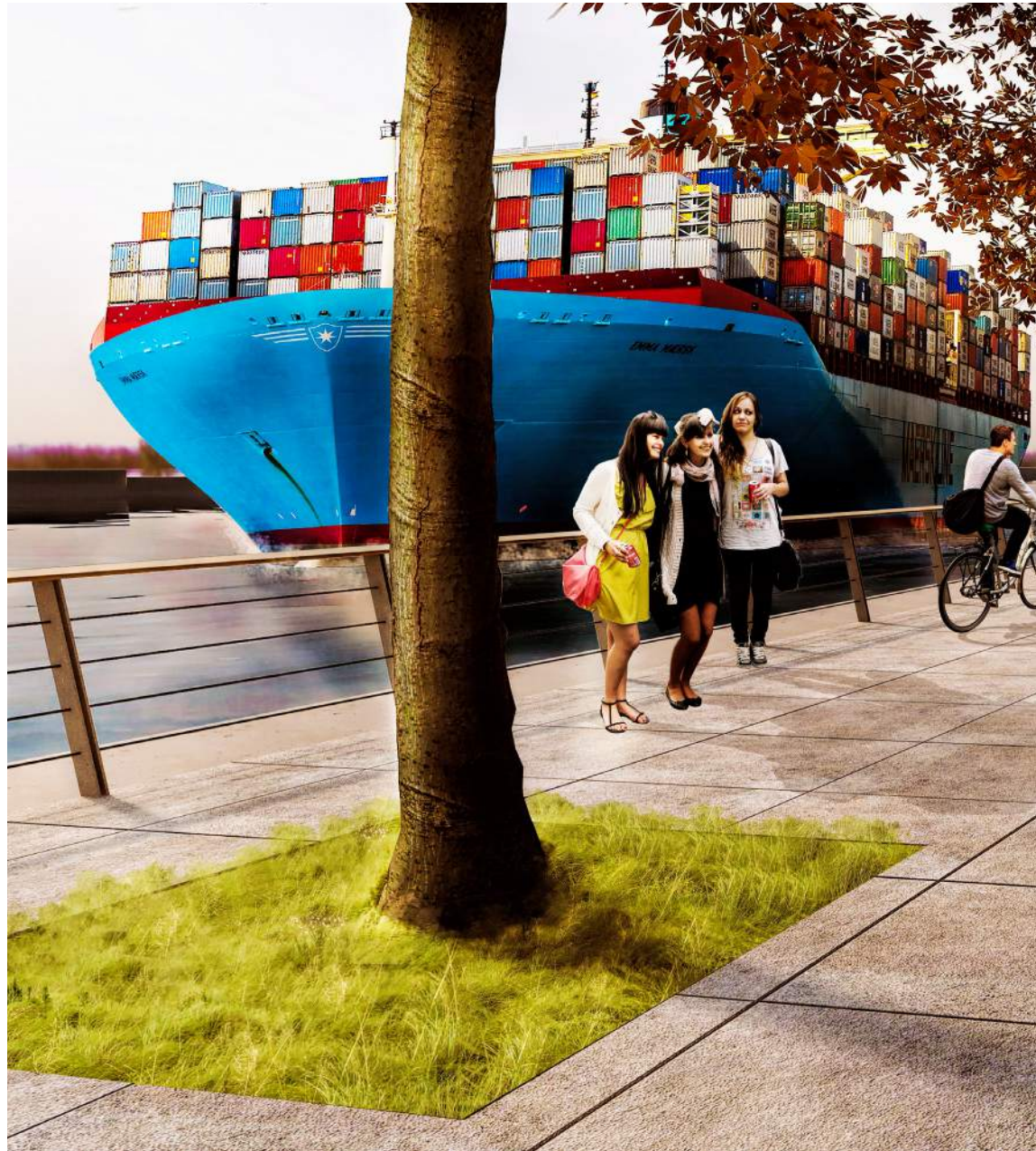


3 | DREDGE AS MONUMENT

The third and final use of the material will speak to the spectacle of the operation. The earthen monument, while functioning to retain hazardous material onsite, it is primarily a monument of scale. Moreover, it speaks to the larger purpose of this landscape design, by rendering visible both the volume of earth moving involved in dredging for port maintenance, as well as sheer size of the vessels that are required to transport goods around the globe. It connects the material to the operation, and reinforces the notion of a more holistic approach to designing future urban landscapes.













CONCLUSION

As infrastructural and technological advances allow larger ships to enter our ports, the requirement of deeper channels and more extensive dredging operations will place a greater demand on areas to dispose of dredge material. Considering this necessity of dredging operations, and the abundance of material it produces, the question of what is done with this material and what it becomes is pressing for so many major ports throughout the United States. Recent explorations into the beneficial reuse of dredge suggest that it might be viewed as a material with substantial design opportunity, rather than an excess to be dealt with.

By choreographing the flows of this material, port maintenance operations can be leveraged to become catalysts for the development of new urban greenspace, industry, and recreation, reconnecting the material to operation. This thesis suggests a possible future for these operations in the Baltimore Harbor, arguing a more holistic approach to designing the future of our urban land-use systems.

By rendering visible the operations that are required to sustain twenty-first century urban lifestyles, it reinterprets the urban working waterfront. Through this approach, it becomes part of a larger conversation about the changing relationship between landscape, infrastructure and industry. From production, to extraction, to consumption, and restoration, it provokes the contemplation of the complete lifecycle of materials and goods, using a unique set of experiences and proximities. At its core, Sparrow's Point sets out to define a new typology of working landscape, one that

challenges the design of modern urban waterfronts, insisting on the integration of social and productive environments, to strengthen awareness of context, and cultivate a new sense of place and identity.

BIBLIOGRAPHY

- Aquino, Gerdo & Hung, Ying-Yu. 2013. *Landscape Infrastructure: Case Studies by SWA*. Basel, Switzerland. Birkhauser Verlag GMBH.
- Belanger, Pierre. 2009. "Landscape As Infrastructure". *Landscape Journal* 28 (1), p. 79-95.
- Berger, Alan. 2009. *Systemic Design Can Change the World*. Amsterdam, Netherlands. SUN Publishers.
- Berger, Alan. 2006. "Drosscape", *The Landscape Urbanism Reader*. New York. Princeton Architectural Press
- Calkins, Meg. 2009. *Materials for Sustainable Sites*. Hoboken, New Jersey. John Wiley and Sons.
- Davis, Brian. 2013. "Landscapes and Instruments". *Landscape Journal* 32(2): 293-308.
- Grubb, D.G., Wazne, M, and Malasavage, N.E., 2010a. "Characterization of slag fines for use as a dredged material amendment," *GeoFlorida 2010: Advances in Analysis, Modeling and Design*, Geotechnical Special Publication No. 199, D. Fratta, A.J. Puppala, and B. Muhunthan (eds.), ASCE, pp. 10.
- Hutton, Jane. "Reciprocal Landscape: Material Portraits in New York City and Elsewhere", *Journal of Landscape Architecture* 8:1 (2013): 40-47.
- Holmes, Rob. 2014. "Excavations, Shockwaves, and Limits". (presented at "The Five Thousand Pound Life: Land" at Cooper Union Institute, New York, New York, September 26, 2014).
- Saunders, William S. 2012. *Designed Ecologies: The Landscape Architecture of Kongjian Yu*. Basel, Switzerland. Birkhäuser Publishers.
- U.S. Environmental Protection Agency. 2012. "Evaluation of the Brownfield Program". Office of Solid Waste and Emergency Response. 6.
- 2013 Annual Report to the DMMP Executive Committee

LIST OF IMAGES

- 1 Sectional View of Maersk Triple E Class under construction
- 6 Westergasfabriek - "Natural" vegetation
- 6 Westergasfabriek - Earthen berm, canal and lawn
- 7 Duisburg Nord - Plaza space with remnant structures
- 10 Gasworks Park - View of remnant structures from Kite Hill
- 10 Gasworks Park - Kite Hill
- 11 Erie Pier - Mechanical offloading of dredge
- 11 Erie Pier - Consolidation coarse material
- 27 Dredge Cycle - by Dredge Research Collaborative

IMAGE SOURCES

The images listed below are for educational purposes only and were reproduced according to fair use law. All other images, drawings, and illustrations are by the author.

1. Sectional View of Maersk Triple E Class, <http://www.viralstack.com/wp-content/uploads/2014/10/wiper1.jpg>
2. Westergasfabriek, http://www.gustafson-porter.com/wp-content/uploads/2013/09/Gustafson-Porter_Cultuurpark-Westergasfabriek_028_.jpg
3. Westergasfabriek, <http://www.gustafson-porter.com/wp-content/uploads/2013/07/002.jpg>
4. Duisburg Nord, <http://www.landezine.com/wp-content/uploads/2011/08/33-Landschaftspark-Duisburg-Nord.jpg>
5. Gasworks Park, http://upload.wikimedia.org/wikipedia/commons/3/3b/Gas_Works_pano_01.jpg
6. Gasworks Park,
7. Erie Pier, extracted from 21st Ave West Pilot Porject Duluth-Superior Harbor presentation to Open Water Summit by Jim Sharrow given on 14 May, 2014
8. Erie Pier, extracted from 21st Ave West Pilot Porject Duluth-Superior Harbor presentation to Open Water Summit by Jim Sharrow given on 14 May, 2014
9. Dredge Cycle, By http://dredgeresearchcollaborative.org/wp-content/uploads/2013/06/Dredge_7.jpg