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**STORMWATER
MANAGEMENT
NETWORK PLAN**



Introduction

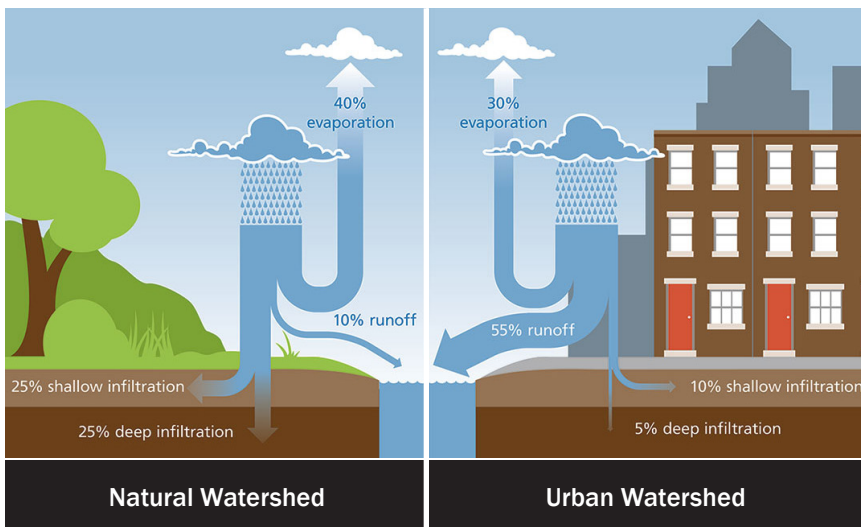
The redevelopment of the Greater Eastern Market (GEM) is important for the economic health of Detroit. New development will increase the area of impervious surfaces due to the large footprints of food business buildings and their corresponding paved areas for vehicle parking and semi-trailer staging.

The Stormwater Management Network Plan (SWMNP) suggests sustainable strategies that require an allotment of green space on each development site that in turn may be used for stormwater management. Development sites collect and convey runoff to the wastewater treatment plant through a network of pipes, ultimately discharging it to a local body of water. The SWMNP looks beyond traditional stormwater management systems, utilizing green stormwater infrastructure (GSI) practices that employ plants and mimic natural systems as a way to manage stormwater. The SWMNP proposes guidelines that will eventually result in the creation of a network of owner-constructed green spaces to aid in the management of stormwater. The GSI options provided by this plan may aid in compliance with the City of Detroit's Stormwater Management Regulations and, if properly maintained, can reduce business owners' drainage charges.

The SWMNP unites transformative landscape methodologies with innovative approaches to stormwater management and makes them operational at the GEM's neighborhood scale. The larger framework, of which the SWMNP is a part, unites the City of Detroit's major programmatic and regulatory initiatives into a single vision for the Study Area that will simultaneously make it both more ecologically focused and more urban as part of the City's plan to redevelop the GEM.

The GEM is intended to accommodate the expanded food business district and integrate it into an existing neighborhood while creating a network of open spaces and connective circulation infrastructure. Urban and natural elements have the potential to introduce complex new systems to the site that will evolve over the course of many years, create interim conditions that are interesting in their own right, and give form, focus, and character to the area's development.

The spatial demands of modern food production and distribution development require the block structure of the GEM to be reconfigured in a manner that supports development and stormwater management practices. The requirements of the ordinance provide unique challenges and opportunities to rethink stormwater management in a district of the city that requires large-footprint buildings and large paved areas for vehicles. The greater the impervious area (roofs and pavement), the larger the dedicated area required for stormwater management. This necessity is often difficult to achieve in urban environments. The spatial constraints of the redevelopment require that stormwater management be considered on a holistic scale for the GEM, while recognizing that development rates and demand are likely to vary across the area. A series of greenways were designed to be implemented incrementally as the market expands to address the stormwater management of the GEM as a whole. These greenways also have the potential to be used for Stormwater Management Practices (SMPs). SMPs are structural, vegetative, or managerial practices used to treat, prevent, or reduce water pollution.



Urbanization increases the area of impervious surface, which increases runoff and decreases infiltration and evaporation in the hydrologic cycle.
Source: Philadelphia Water Stormwater Management Guidance Manual

An Integrated Plan

The SWMNP proposes a robust public realm that provides social and environmental benefits to Eastern Market and its adjacent neighborhoods. Together with the Neighborhood Framework Plan (NFP), the SWMNP is intended to achieve these benefits through a landscape-based vision for the growth of Eastern Market. The basic structure of the SWMNP proposes a series of up to four north-south greenways that are integrated into new development to manage stormwater as part of compliance with the City's Post-Construction Stormwater Management Ordinance (PCSWMO). These greenways are delineated by robust linear tree groves which establish a strong landscape character that will define the GEM. In addition to providing an overall identity, the greenways provide a connective circulation linking the district south to Gratiot Ave and north to existing neighborhood assets. East-west streets and sidewalks complement the greenways by providing a safe connective network linking the GEM through to adjacent neighborhoods. This network of open spaces supports the mobility routes proposed in the NFP supporting pedestrians, cyclists, and vehicles.¹ These greenways also provide robust buffers between the expanded market and adjacent residential neighborhoods.

Existing Policy and the Neighborhood Framework Plan

Historically, managing stormwater from site developments in the City of Detroit had not been required. However, a National Pollutant Discharge Elimination System (NPDES) permit required the City to develop a stormwater control plan for areas of new development and redevelopment. This permit and its associated mitigation plan are required to aid in the elimination of untreated combined sewer overflows within the City. On November 13, 2018, City Council passed Stormwater Management Regulations found under Chapter 56, of the 1984 Detroit City Code, Utilities, Article III, Sewer and Drains, Division 4, Stormwater Management. This City of Detroit ordinance establishes performance standards,

requires an approved Post-Construction Stormwater Management Plan (PCSWMP), and requires periodic inspections during and after construction. The City also published the Detroit Stormwater Management Design Manual, a technical resource for site development projects.

Any development site containing regulated construction activity that involves the replacement or creation of one-half acre (21,780 square feet) or more of impervious surface is subject to the PCSWMO. The Detroit Water and Sewerage Department (DWSD) may also require that any construction activity meeting certain conditions (as specified in the Detroit Municipal Code) must also comply with these requirements. Additional details regarding the applicability threshold can be found in Section 56-3-101 of the Code.²

An aerial photograph of a city grid, likely Chicago, showing a complex highway interchange (I-55 and I-90) and a river (the Chicago River) at the bottom. The city is densely packed with buildings and green spaces.

A Stormwater Management Network Plan

This plan looks beyond traditional stormwater management systems, utilizing green stormwater infrastructure practices that employ plants and take cues from nature to manage stormwater.

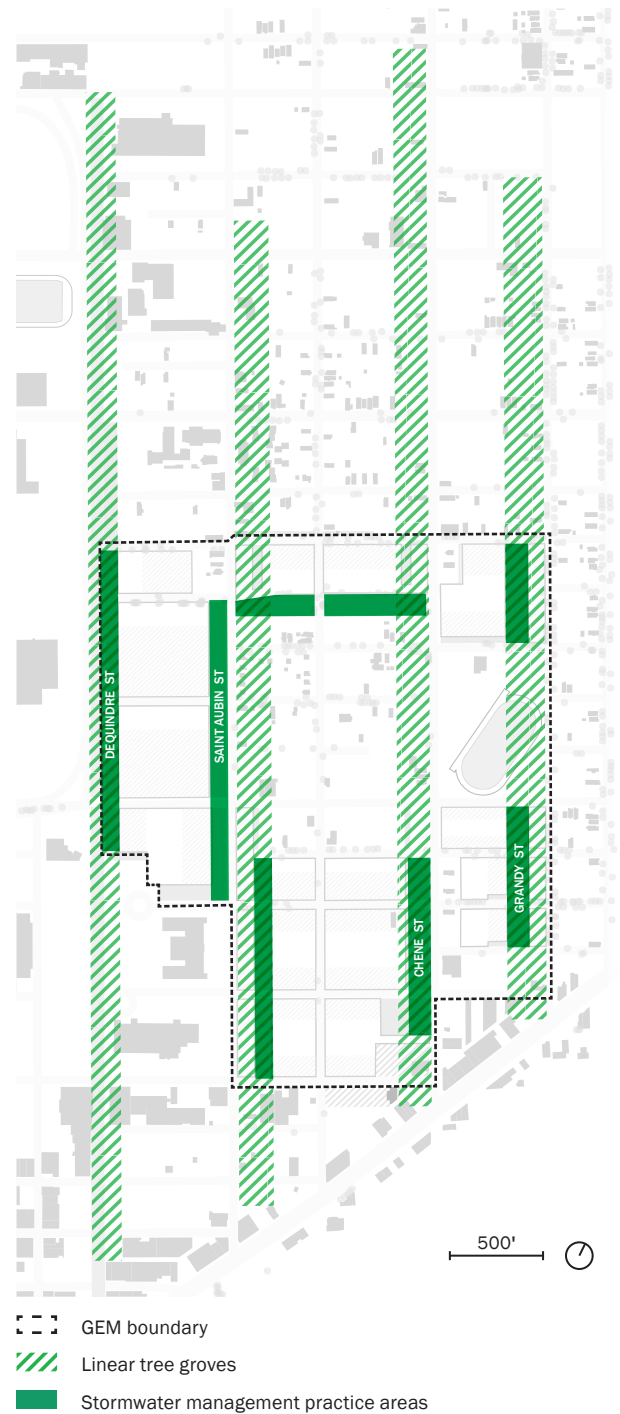
STUDY AREA

GEM

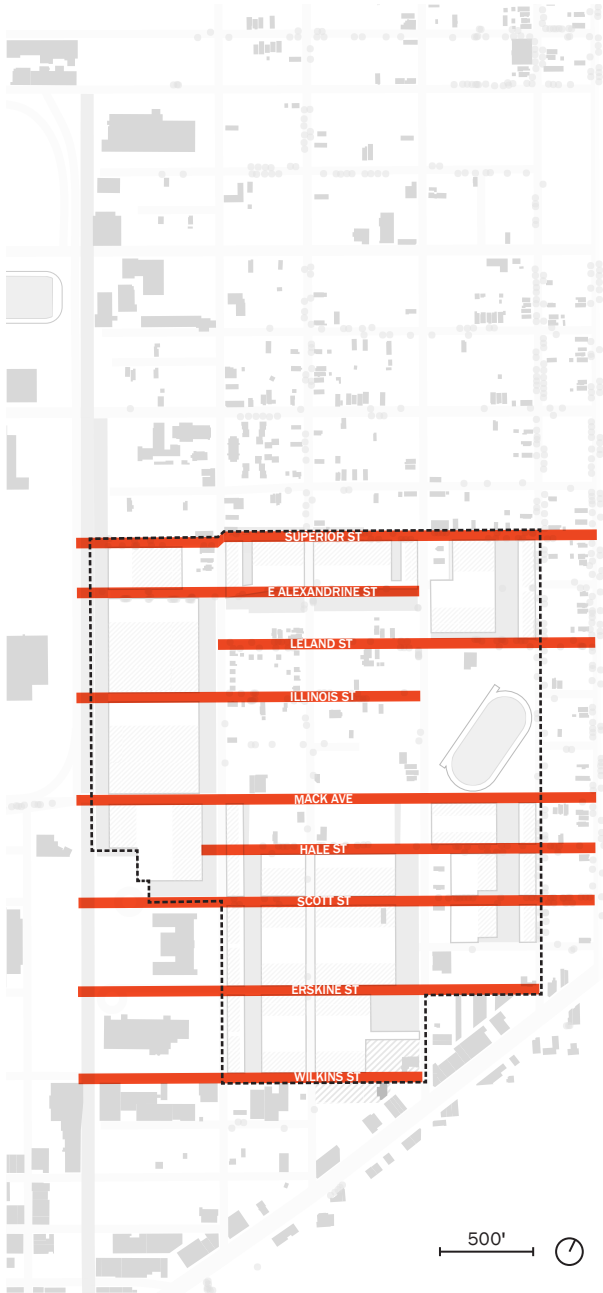
Benefits to Eastern Market and Surrounding Neighborhoods

The SWMNP proposes a robust public realm that provides social and environmental benefits to Eastern Market and its adjacent neighborhoods. The NFP and SWMNP establish a landscape-based vision for the expansion of Eastern Market. The basic structure of the plan proposes a series of four linear north-south greenways that may contain stormwater management landscapes. These greenways will be defined by robust, linear tree groves which will establish a strong landscape character across the GEM. In addition to providing an overall identity, the greenways may be utilized for stormwater management and will provide connective circulation linking the district south to Gratiot Ave and north to existing neighborhood assets. The greenways will also provide robust buffers between the market expansion and adjacent residential areas to the north and east. East-west streets and sidewalks complement the greenways by providing a safe connective network of sidewalks linking the GEM to these adjacent East Side neighborhoods and Midtown and the Woodward corridor to the west.

Four Greenways

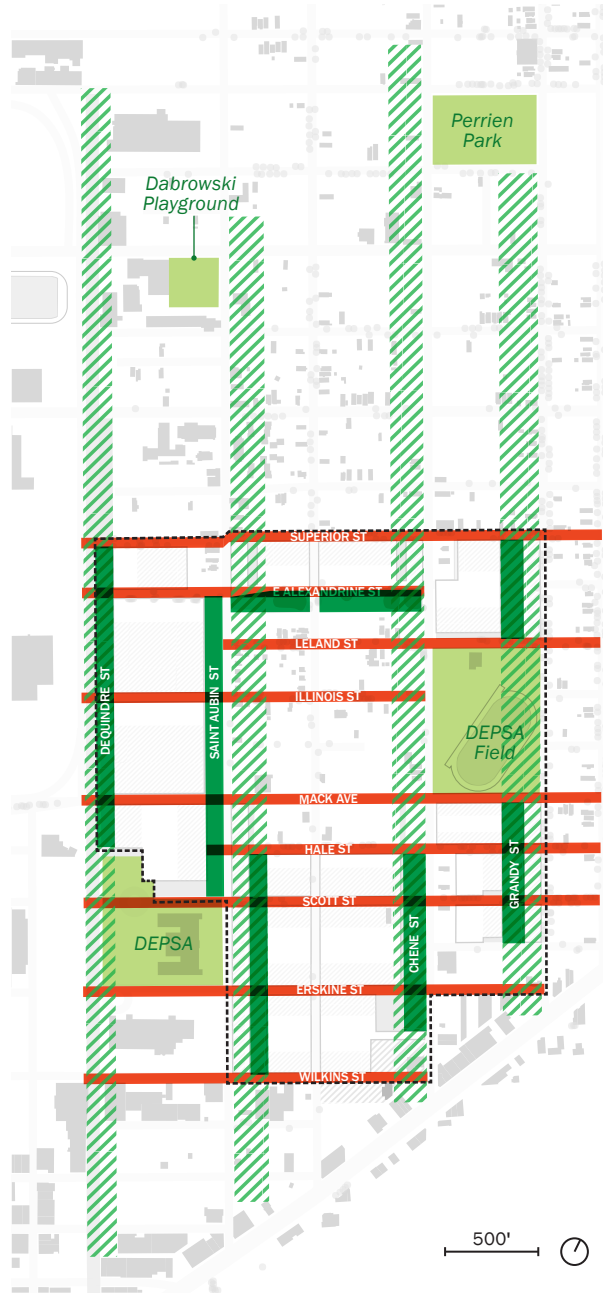


Streets and Sidewalks



- GEM boundary
- █ Streets and sidewalks

A Connected Green Network



- GEM boundary
- ▨ Linear tree groves
- █ Stormwater management practice areas
- █ Streets and sidewalks
- █ Neighborhood parks and institutional landscapes

Goals and Objectives

A series of goals and objectives form the foundation for the SWMNP:

The SWMNP WILL:

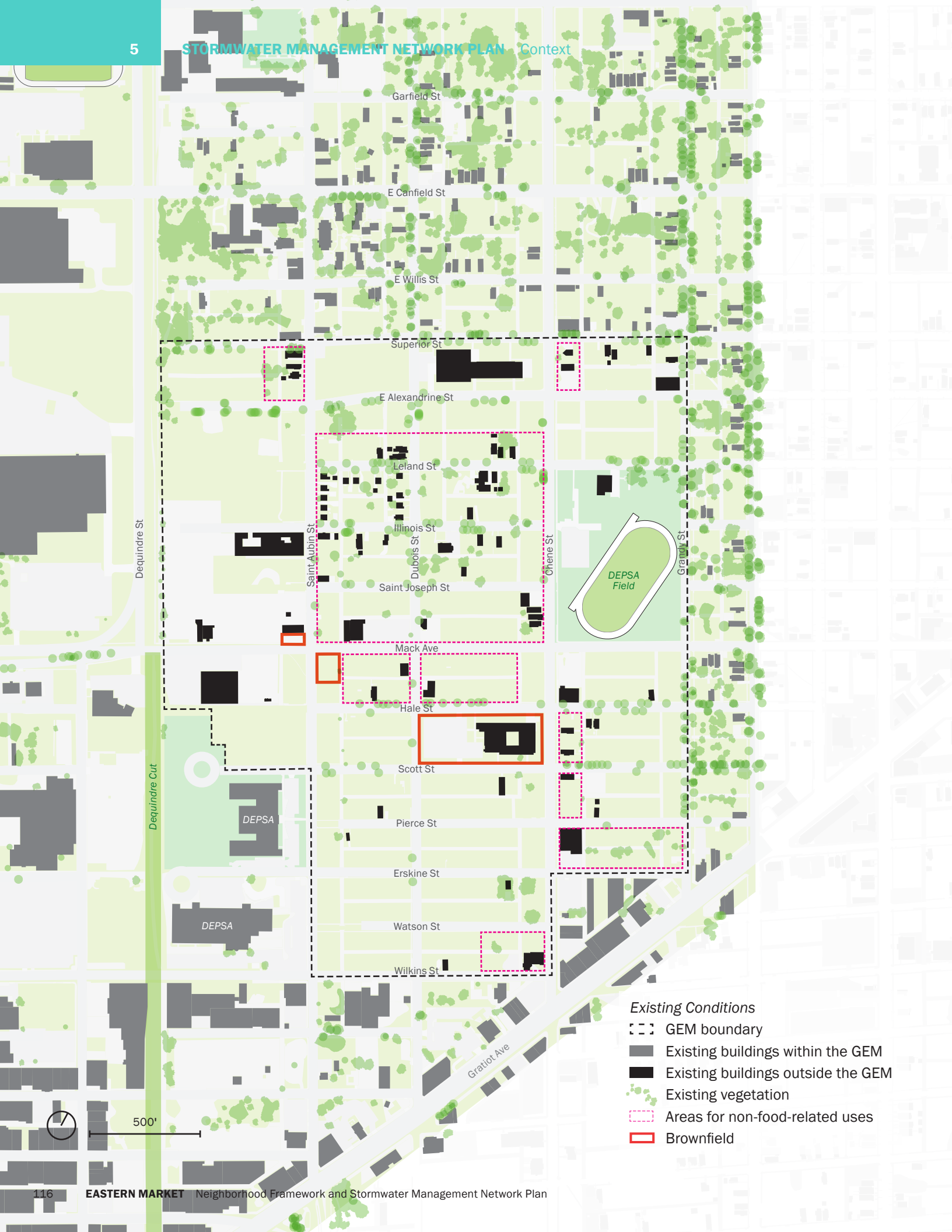
1. Provide a comprehensive vision for how property owners and developers could manage stormwater as part of redevelopment activities in the GEM.
2. Layout conceptual designs for managing stormwater runoff from proposed new development in a way that provides benefits to property owners, abutting property owners, and the larger community.
3. Provide a flexible framework that will support the existing Eastern Market neighborhood and accommodate market expansion over a 15- to 20-year horizon.
4. Demonstrate a commitment from the City to encourage neighborhood benefits through the restoration and creation of open space.
5. Provide a unified vision for how the GEM can be developed in a manner that ensures existing and future residents and businesses will not be negatively impacted by market expansion through the creation of impervious surfaces.
6. Provide concepts for the greenways that aid in both compliance with the PCSWMO and obtaining green credits.
7. Establish design guidelines that ensure an intentional integration of landscape spaces that allow access and provide environmental and social benefits to the community.
8. Establish design guidelines that supplement the City of Detroit Stormwater Regulations guiding future landowners in developing solutions to manage their stormwater using the greenways.

The SWMNP will NOT:

9. Provide engineered solutions for managing stormwater in the greenways.
10. Suggest a single landowner for the open space greenways.

Stormwater Management Landscape

The greenways have the potential to manage stormwater as well as provide an enhanced and connective public realm for the GEM and its adjacent neighborhoods.



Existing Conditions

- GEM boundary
- Existing buildings within the GEM
- Existing buildings outside the GEM
- Existing vegetation
- Areas for non-food-related uses
- Brownfield



500'

Context

The GEM has large vacant tracts of land occasionally dotted with houses. Neighboring areas can benefit from redevelopment so long as the needs of the residents are respectfully considered in future planning. The GEM's close proximity to the Core Market and existing City infrastructure presents opportunities for parcel consolidation. The GEM affords a unique opportunity to rethink how an urban food district can be integrated into the city while improving quality of life and including green space. This SWMNP will suggest innovative stormwater management thinking into the build-out plan for an expanding Eastern Market.

Existing Neighborhood Landscape Character

The majority of the GEM is vacant land with a small number of houses. There are a few industrial parcels located between Dequindre and Saint Aubin Streets. A few institutions operate in the area, such as the Detroit Edison Public School Academy (DEPSA) and its associated playing field, along with some active churches. The Dequindre Cut provides recreational green space for the neighborhood and there is a scattering of small neighborhood parks throughout the rest of the Study Area. One potential means of expanding neighborhood open space would be to allow access to greenways and any future stormwater management features to be designed within them.

Topography and Soils

The Study Area is relatively flat. Generally, the entire Study Area is gradually sloped toward the southeast and the Detroit River, like much of Detroit. The terrain is so flat that road infrastructure, including paved streets, alleys, curbs, gutters, and the associated combined sewer network, define the existing drainage patterns within the GEM far more than topography or soil conditions.³

The dominant drainage class for most of the Study Area soils is "somewhat poorly drained," according to the Natural Resources Conservation Service. Another measure of drainage, hydrologic soil group,

indicates that essentially all of the Study Area soils drain poorly. Each development site will need soil borings analyzed to plan for adequate SMPs and to ensure there is no contamination from previous uses. If soil contamination is present, it does not necessarily eliminate the implementation of the open space greenway, but it could eliminate the potential for the space to be used for some GSI practices or comply with the PCSWMO. Topography and soils have a direct impact on the design of SMPs. Sites with relatively flat topography and poor drainage often suggest that SMPs need to function at a localized scale. For the purpose of this plan the SMPs are internalized to each development site.

There is a significant level of uncertainty regarding existing soil and subgrade conditions within the GEM. This is because the area was once a dense residential neighborhood and a number of building foundations may remain below the surface of the ground. Prior to conducting any detailed design and engineering, landowners or developers must commission a number of critical site investigations that will inform the SMP design. These should include subsurface reports, soils characterization, and environmental and geotechnical investigations. In addition, infiltration testing is critical before the project advances to the design and engineering phase for compliance with the PCSWMO. It is also recommended that a detailed site survey, including a geophysical analysis, be commissioned by the landowner or developer to discover any foundations that remain, but are not visible.

Tree Canopy

East of the Dequindre Cut in the residential neighborhoods, the tree canopy is consistent and full. Introducing shade trees in the core and planting them for expanding growth is a relatively straightforward way to enhance the appearance of the area and the personal comfort of people walking in the neighborhood and market. Moreover, a more consistent canopy throughout the district could help absorb air pollutants and buffer noise.



Existing Storm Sewer System

- GEM boundary
- 4"-12" exterior diameter storm sewer
- 15"-24" exterior diameter storm sewer
- 27"-42" exterior diameter storm sewer
- 48"-72" exterior diameter storm sewer
- 75"-138" exterior diameter storm sewer

Brownfields

There are three listed brownfields within the GEM.⁴ These brownfield designations relate to buried fuel tanks, but the exact level and type of contamination will require further physical and environmental investigation to be known. Additional brownfields may be present, but they are not currently registered with the State of Michigan. The Detroit Brownfield Redevelopment Authority offers assistance to promote the revitalization of environmentally distressed and blighted areas within the boundaries of the City of Detroit.

The following resources can be used to learn more about brownfield locations and policies in the area:

The City of Detroit Brownfield Redevelopment Authority (DBRA)

<http://www.degc.org/public-authorities/dbra/>

Michigan Department of Environment, Great Lakes, and Energy (EGLE) Environmental Mapper

<https://www.mcgi.state.mi.us/environmentalmapper/>

EGLE Facilities Inventory

<https://secure1.state.mi.us/FacilitiesInventoryQueries/>

Existing Water and Combined Sewer Network

In general, within the Study Area, it appears that all parcels have gas mains, electrical lines, water mains, and sewer mains readily available without the need for long utility extensions. Unneeded utilities can be removed as streets are taken offline as part of redevelopment. Parcels for future development contain existing sewer and water infrastructure that can be removed as part of the development project construction. The condition of the existing sewer infrastructure is relatively unknown. Investigations and existing conditions surveys need to be undertaken by the landowner or developer at the time of detailed site engineering and design.

Generally, the network of sewers in the Study Area flow southeastward toward the Detroit River and the large interceptor there ultimately directs flows to the wastewater treatment plant on the far west side of the city. Sewers running under Saint Aubin and Chene Streets serve as the primary collectors in the GEM. These north-south collectors range from 25 to 72 inches in diameter. It is important to note that all future SMPs that utilize infiltration require a 10-foot setback from DWSD sewers. Therefore, even sewer interceptors that are not connected to the GEM sewers, but are located nearby must be considered within the GEM wastewater system. The North Interceptor East Arm under Mack Ave is the largest sewer line in the Study Area and is far larger than local sewers. It runs from the northeast Detroit suburbs to the wastewater treatment plant.



Gratiot Ave

Chene St

Gratiot Ave looking southeast toward Downtown
Photo: Alex MacLean, 2014





Saint Aubin St

Mack Ave

Intersection of Mack Avenue and Chene Street looking northwest through the GEM
Photo: Alex MacLean, 2014



A Block Plan for Market Growth

The existing residential block structure will be modified to provide development sites large enough to meet the demands of modern food businesses and greenways that may also function as stormwater management practices. Select street segments in the GEM will be decommissioned so that two existing blocks can be merged into one larger block for food business development.

Existing and Proposed Land Uses

The GEM comprises significant tracts of vacant land, with scattered residential and institutional uses throughout and large industrial uses north and east of Saint Aubin St. Existing industrial areas and most of the vacant land will be converted to food production and distribution uses. The area with the densest concentration of houses today, between Mack Ave and E Alexandrine St and between Saint Aubin and Chene Streets, will remain for residential use. Future processing and distribution facilities will be buffered from existing homes by areas of mixed commercial and residential use along Mack Ave and Chene St, and by live-work uses along Saint Aubin and Grandy Streets. Residential uses in the proposed mixed-use and live-work areas may be denser than the single-family fabric that exists in the area today. The greenways support the proposed land use changes by providing landscape buffers between different uses. The greenways are primarily located adjacent to live-work and residential areas providing a landscape transition between food business and residential areas.

Proposed Block Plan

The block plan has been designed to reorganize the existing road network, creating larger blocks that accommodate the demand for larger building footprints that meet the needs of new food business development in the GEM.⁵ The block structure is intended to provide adequate space for stormwater management and create a network of greenways. Each block would feature a landscape buffer that separates food processing and distribution from live-work or residential uses.

These proposed greenways have the potential to be used for on-site stormwater management and could potentially serve as shared SMPs for neighboring sites. Shared SMPs accept runoff from multiple privately owned development sites with different owners. Agreements would need to be reached with the landowners in compliance with the city's stormwater management regulations. Public paths will run through these greenways to provide passive recreational opportunities, which may be further enlivened through the integration of public art. Trees planted in these greenways will vary in species to accommodate the types of SMPs chosen to implement in the landscape buffer area.⁶

Greenway and SMP Siting Criteria

The greenways are sited to optimize the potential for landowners to incorporate SMPs that may obtain Green Infrastructure Credits to offset DWSD drainage charges and achieve compliance with the City of Detroit PCSWMO. Additional considerations were established to capture a broader list of considerations that could influence the design of the publicly accessible greenways.

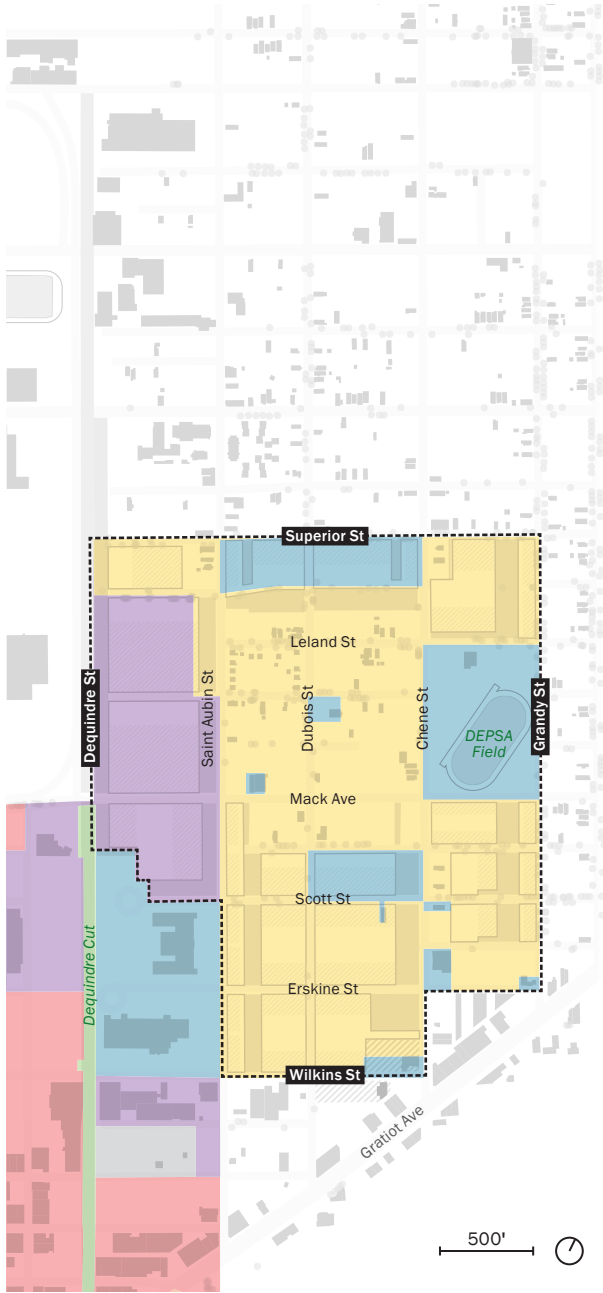
Required Siting Criteria

1. Does not remove culturally significant structures
2. Supports economic development potential
3. Inclusive and publicly accessible
4. Considers public safety with adjacent land uses

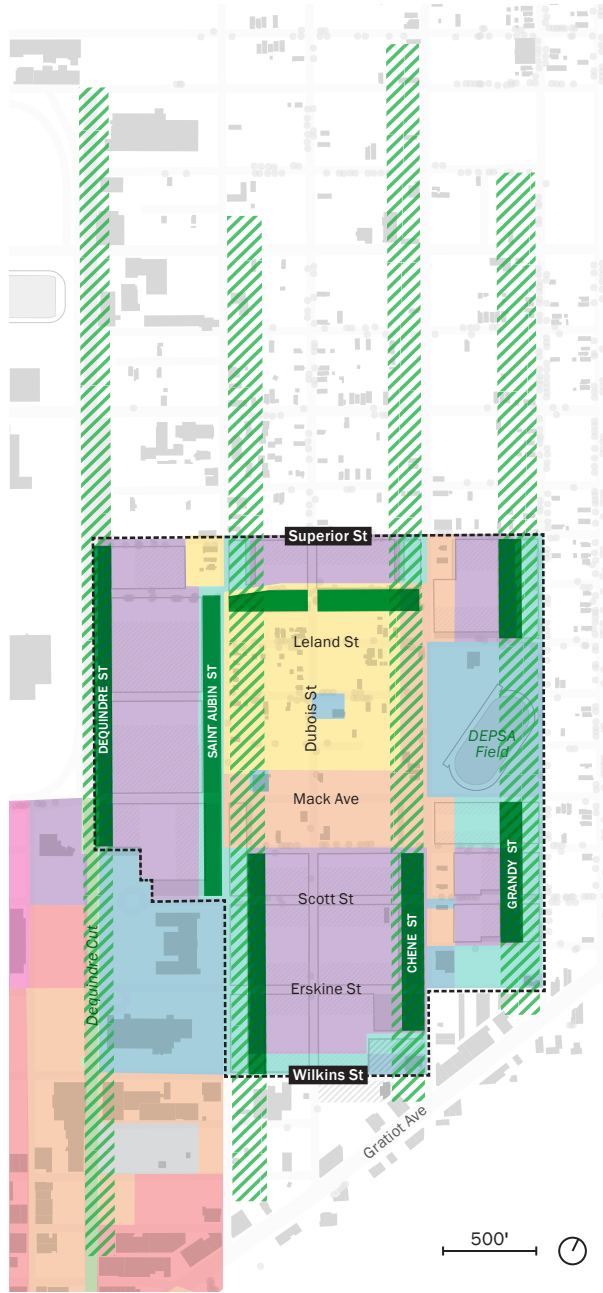
Additional Considerations

5. Preserves healthy mature trees
6. Provides benefits to local schools and cultural institutions
7. Enhances multimodal connectivity within the district
8. Avoids relocation of major sewer utilities (a major utility is defined as any sewer line greater than 24" diameter)

Existing Land Use



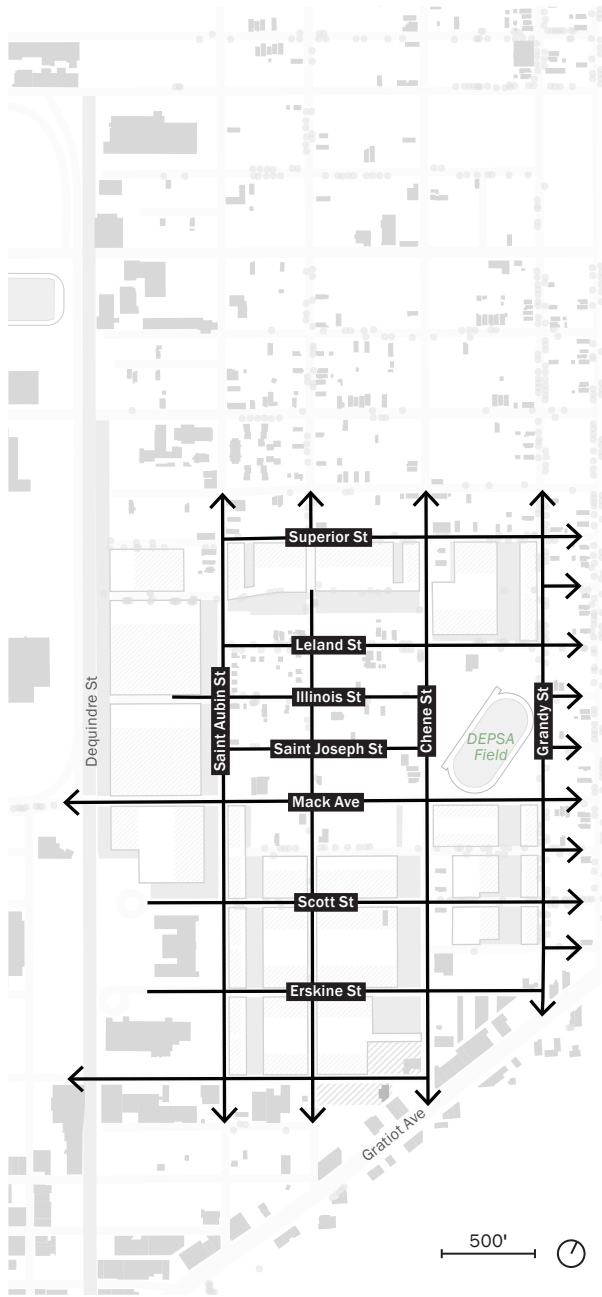
Proposed Land Use with Greenways



- GEM boundary
- Residential
- Production-distribution
- Office-retail
- Institutional
- Utility
- Residential/office-retail
- Greenway

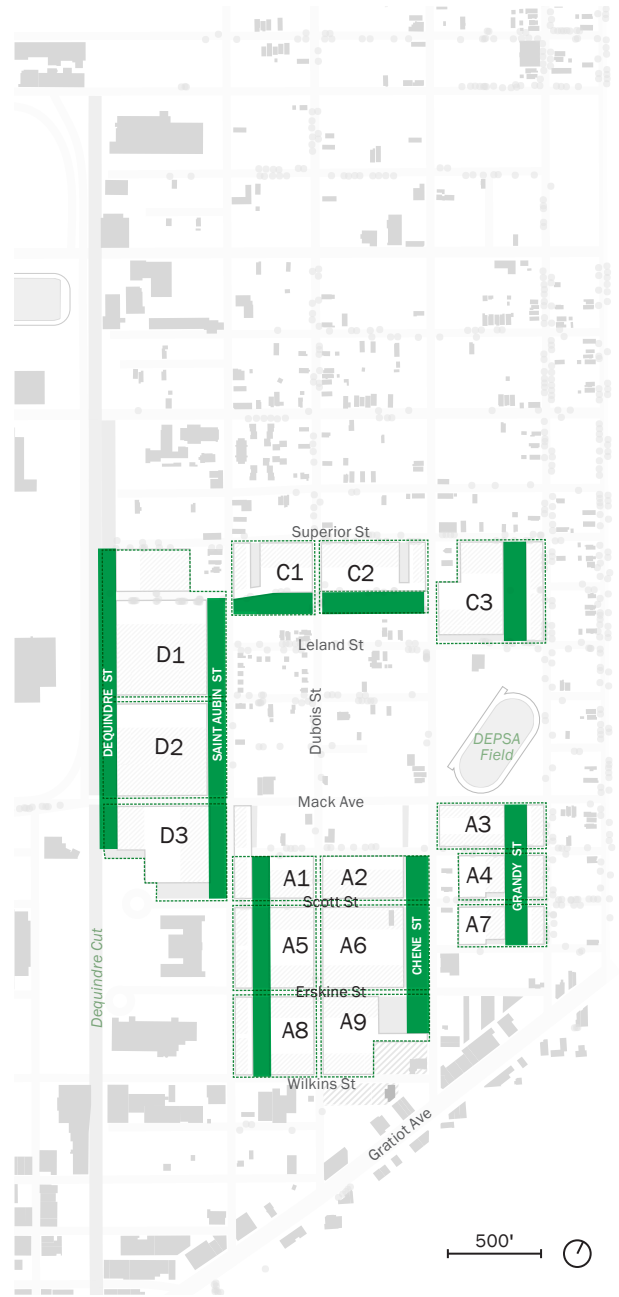
Proposed land uses within the GEM strengthen the mixed-use corridors of Saint Aubin and Chene Streets while protecting residential areas and allocating parcels for new food business development. The four greenways work with the proposed land uses by providing transitions and buffers between residential and food business uses.

Proposed Street Plan



By decommissioning select segments of streets in the GEM, two existing blocks can be merged into one larger block to provide development sites of the necessary size.

Proposed Block Plan with SMP Areas



Development parcels
 Stormwater management practice areas



Block Plan and SMP Areas

- GEM boundary
- Development parcel
- Stormwater management practice area
- Areas for non-food-related uses

Greenways

The SWMNP utilizes the physical structure of the proposed GEM block plan and establishes up to four greenway corridors.⁷ The linear greenways along Dequindre, Saint Aubin, Chene, and Grandy Streets between Gratiot Ave and E Canfield St can be developed as SMPs for the adjacent businesses while providing an enhanced and connective public realm for the GEM and its adjacent neighborhoods. GSI built in the greenways could manage a portion of the on-site stormwater volume needed to comply with the City's PCSWMO.

Design Characteristics

Continuity

The greenways will be constructed incrementally and may not be contiguous initially because individual parcels within the GEM will be redeveloped at different times. Because the framework will take a number of years to implement, a consistent and bold design vision is very important. The publicly accessible greenways will be defined by robust linear groves of trees, simple and easy-to-maintain ground cover, and a pedestrian path network connecting one end of the greenway to the other. The greenways follow a series of straightforward design guidelines described in an appendix to this report.⁸

Linear Tree Groves

The linear groves of trees are the most significant character-defining element within the greenways of the GEM. The species of trees selected should grow to be tall and robust and be tolerant of weeks of root inundation, especially in the late winter or early spring. The selected trees are typically bottomland or floodplain species that are best adapted to withstand flooding if a developer chooses to develop the greenways as GSI. To ensure that the groves have a strong and continuous presence, they will be primarily composed of Bald Cypress and Dawn Redwoods. These trees will be complemented by a number of secondary species.⁹

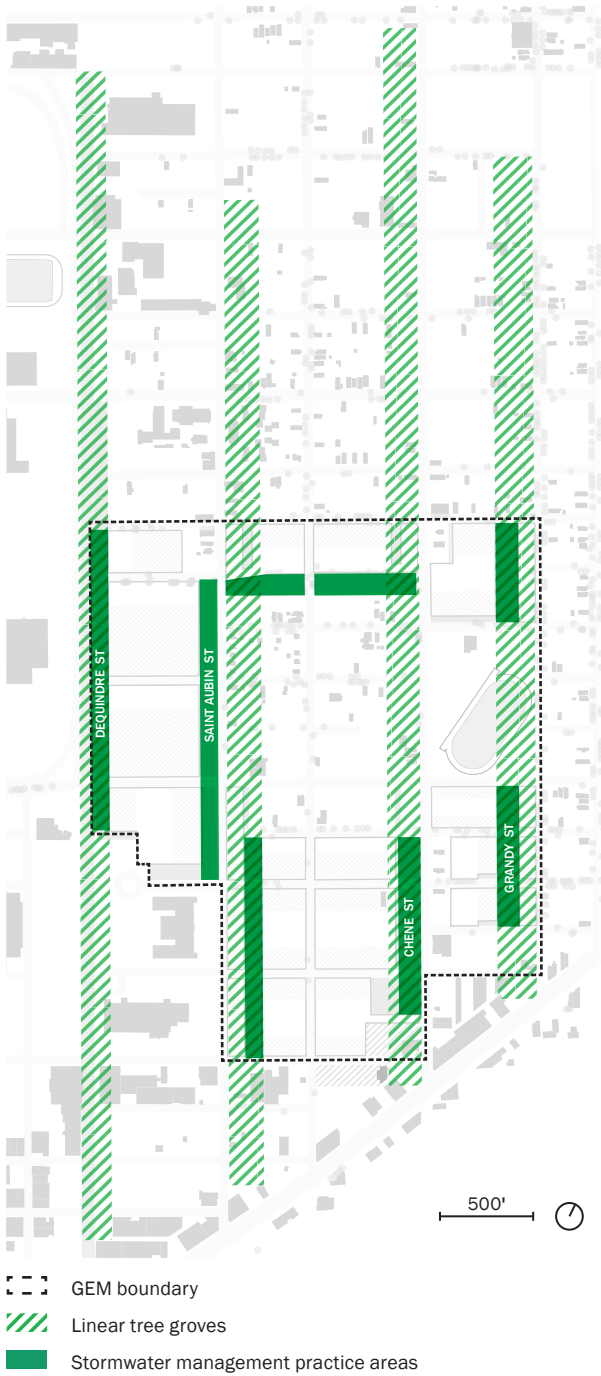
Ground Cover

In GSI plants typically prevent erosion, slow water movement, hold or convert pollutants, encourage wildlife, and enhance infiltration and evapotranspiration (the combined evaporation of water from the soil and from plant surfaces like leaves and flowers). Plant species or mixes should be selected to meet critical objectives and survive the extremes of local climate conditions. Native grasses produce fibrous root systems that tolerate fast-moving water. Woody and herbaceous species add aesthetic value, provide wildlife food and habitat, assist with evapotranspiration, and prevent erosion. It is also important that the ground cover species be easy to maintain. This plan recommends a durable meadow mix comprised of short plant species that are easily mowed for maintenance purposes.¹⁰

Path Network

The greenways support connectivity within the GEM and adjacent neighborhoods. Each greenway will include an 8'-wide limestone gravel path (MDOT 26A aggregate) that serves as an off-sidewalk circulation path continuously connecting one end of the corridor to the other. The edge of pathways should be maintained by regularly mowing a 3'-wide strip on both sides of the path.¹¹

Four Greenways with SMP Areas



Example of a Linear Tree Grove's Growth



The publicly accessible greenways will be defined by robust linear groves of trees, simple and easy-to-maintain ground cover, and a pedestrian path network connecting one end of the greenway to the other. This series of images shows the trees as they are being planted, three years after planting, and at maturity.

Public Benefits

The greenways provide an opportunity to improve mobility and provide passive recreation spaces throughout the GEM. The path network will enhance access from areas south of Gratiot Ave north to the DEPSA track and field, Perrien Park, Dabrowski Playground, and the Dequindre Cut. Small pocket parks or other public recreation amenities could be designed into the greenways. However, these programs cannot be included at the cost of compromised stormwater management. Funding sources for such amenities may vary, but could occur in collaboration with certain developments.

The most significant program of the GEM landscape is the connective landscape, which could be enhanced by the stormwater management features. This landscape will be publicly accessible, providing safe and shaded routes through the district.

Environmental Benefits

The greenways are marked by the presence of robust linear groves of trees and would complement other SMPs that could be constructed while providing structure for the linear public space. Mature trees can perform a multitude of environmental, social, and economic services. Water quality and flow, for example, can be dramatically improved by planting, not just trees, but the right trees. The tree groves encourage evapotranspiration as well as stormwater soil infiltration. By matching specific tree species to sites, trees can fulfill particular functions in the landscape. In urban settings, trees can reduce the amount of runoff and pollutant loading.

Trees intercept and absorb air pollution from the atmosphere. Increased tree canopies in cities also include carbon sequestration benefits that can be attained at higher rates by planting tree species that grow to be large. Trees lower air temperatures, making urban areas more inhabitable for humans and wildlife. Green spaces such as the greenways help offset the formation of heat islands by establishing microclimates through shading and evapotranspiration, and thus also reduce the energy needed to cool buildings during hot periods. In addition, trees planted as wind breaks can significantly reduce heating costs for buildings during the winter. Other ecological benefits of the greenways include establishing habitat (shelter, food, and water) for birds, mammals, insects, amphibians, and reptiles. Patches of vegetation such as those in the greenways and or on green roofs provide habitat.

Greenway SMP (Early Stages of Growth)



A conceptual rendering from the viewpoint of standing in the greenway of block A8 looking north toward Erskine St.

Greenway SMP (15–20 Years of Growth)

The design for each swale must include engineered soils and infrastructure so that the swale adequately drains within a 24-hour period following a rain event. The topography of the swales must accommodate an accessible path network that transverses the entire length of each greenway.

Stormwater Management Network Plan

The SWMNP establishes a flexible framework for managing stormwater that responds to the proposed block plan and phased development of the GEM. It suggests a proactive approach to compliance with the City of Detroit's PCSWMO and aims to assist the City and private businesses in achieving solutions to stormwater management. The SWMNP uses nature to drive design in a way that not only offers stormwater management solutions, but also creates a network of connected greenways and opens up the district in the interest of accessibility.

City of Detroit Post-Construction Stormwater Management Ordinance

The PCSWMO, approved by the Board of Water Commissioners and the Detroit City Council in 2018, requires stormwater management practices to mitigate infrastructure and water quality impacts of stormwater runoff from impervious surfaces. The ordinance requires regulated projects to install controls to manage the amount of stormwater that enters the city's infrastructure and the rate at which this stormwater enters the system. In addition, project applicants will be required to submit a Post-Construction Stormwater Management Plan (PCSWMP) which specifies how these controls will accomplish the required level of management. Implementation of the PCSWMP is required during the project and proper operation and maintenance of the controls will be required after the project is complete.

DWSD sought and secured the unanimous approval of the Board of Water Commissioners (August 2018) and the Detroit City Council (November 2018) to implement the City of Detroit's first stormwater management regulations by adopting the PCSWMO. DWSD created this ordinance to become a more sustainable city that also meets federal and state stormwater management regulations. It is now included in Chapter 56 of the 1984 Detroit City Code,

Utilities, Article III, Sewers and Drains, Division 4, Stormwater Management.

Historical development and redevelopment activities in Detroit have not been subject to stormwater management requirements. This lack of a consistent, proactive approach to managing the stormwater runoff from impervious, hard surfaces flowing to Detroit's combined sewer system has contributed to overflows of untreated sewage entering the Detroit and Rouge Rivers. It has also caused localized flooding and basement back-ups, leading to public health and safety risks and property damage.

Detroit's Stormwater Management Regulations are in response to DWSD's National Pollutant Discharge Elimination System (NPDES) and Municipal Separate Storm Sewer System (MS4) permit obligations to develop stormwater control requirements for areas of new development and/or redevelopment.

The City's Stormwater Management Regulations are applicable to most land development that creates/replaces one-half acre (21,780 square feet) or more of impervious surface. Projects that meet this threshold must:

- Develop and submit a PCSWMP as part of the overall site plan
- Submit the PCSWMP review fee
- Obtain DWSD approval for the PCSWMP
- Obtain all necessary permits for construction
- Construct approved stormwater management practices in the approved PCSWMP
- Receive a Certificate of Occupancy from the Building, Safety Engineering and Environmental Department
- Perform annual inspections and allow DWSD on site to perform annual inspections
- Ensure the PCSWMP includes a restrictive covenant and easement agreement for DWSD access

The Stormwater Management Design Manual is a technical resource for developers and property owners that guides stormwater management site design to meet the regulations. The Design Manual enables DWSD and other key City departments to maintain uniformity with stormwater design standards and to conduct effective and efficient design reviews. It also allows developers the flexibility to choose stormwater controls. The Design Manual also includes information on alternative options for compliance with the Stormwater Management Regulations if retaining stormwater on-site is not feasible, as well as design and PCSWMP submittal checklists.

Implementation of the PCSWMO further advances efforts by DWSD to avoid future costs in constructing additional Wet Weather Treatment or combined sewer overflow control facilities to comply with federal and state NPDES regulations.

Detroit Water and Sewerage Department Drainage Charge

Since 1975, most DWSD customers have been paying for drainage as part of their water and sewer bills. State regulation requires DWSD to work toward eliminating combined sewer overflows. Together with the business and nonprofit community, DWSD is using GSI to meet permit requirements and make Detroit one of the “greenest” cities in America.

DWSD launched a drainage charge credit program in October 2016. A drainage charge credit is a reduction in the drainage charge to a property based on the implementation and continuing proper operation of Stormwater Management Practices (SMP). SMPs focus on reducing runoff and improving water quality. SMPs help maintain natural hydrologic cycles through site grading, vegetation, soils, and natural processes that absorb and filter stormwater. SMPs include, but are not limited to, green roofs, blue roofs, rain barrels

and cisterns, permeable pavements, bioretention areas, vegetated swales/dry swales, curb and gutter elimination, vegetated filter strips, sand/organic filters, and constructed wetlands. Customers are encouraged to adopt sustainable SMPs, such as GSI, that reduce stormwater flows to the drainage system, enhance the natural environment, and protect against flooding and sewer overflows. The installation of SMPs that result in a measurable reduction in volume and/or peak flow rates will qualify the property owner for a credit to their bill. By installing SMPs, a credit of up to 80% of the drainage charge could be obtained for volume reduction and controlling peak flow rates. The remaining 20% of the charge is a mandatory base cost.

In order to be eligible for a drainage charge credit, the SMP must be approved by DWSD. To obtain a drainage charge credit, the property owner will need to meet eligibility requirements, apply for and receive an approval from DWSD, and fulfill ongoing operations and maintenance requirements.

To be eligible for a credit, the SMPs must:

- Be located on a property that is geographically located within DWSD’s Drainage Service Area
- Reduce annual runoff volume and/or control peak flow rate
- Document design and performance in a manner acceptable to DWSD
- Comply with all applicable city, county, state, and federal construction, building, and stormwater codes and permits
- Be fully installed and functioning properly
- Not create a safety hazard or nuisance

Compliance with the PCSWMO and Maximizing Drainage Credits

Any new development or redevelopment over one-half acre (21,780 square feet) must comply with the PCSWMO. This includes performance standards that ensure water quality, channel protection, and flood control. Once a development site has constructed SMPs to comply with the ordinance, the development is eligible to apply for drainage credits.

When complying with the ordinance for the flood control standard, the size of the site dictates the size of the storm a site must comply for. Sites less than 5 acres in area need to manage a 10-year, 24-hour storm event; sites over 5 acres must manage a 100-year, 24-hour storm event. To obtain any drainage credit for detention, a minimum 2-year, 24-hour storm event must be managed. To obtain the maximum 40% credit, a 100-year, 24-hour storm event must be managed.

The PCSWMO requires that a volume of stormwater equivalent to one inch across the site (also known as a 90th-percentile storm event) be retained on-site. By complying with the ordinance and retaining one inch of rain on-site, 30% of the available 40% retention drainage credits may be received by property owners. Landowners and developers that are not required to comply with the ordinance may still choose to construct SMPs to obtain drainage credits.

DWSD Stormwater Reference Documents

The following resources can be used to learn more about the City's stormwater management policies:

City of Detroit Stormwater Management Regulations

<https://detroitmi.gov/departments/water-and-sewerage-department/customer-care/stormwater-management-regulations>

City of Detroit Post-Construction Stormwater Ordinance

<https://detroitmi.gov/sites/detroitmi.localhost/files/2019-02/Ordinance%20-%20Post-Construction%20Stormwater.pdf>

City of Detroit Stormwater Management Design Manual

<https://detroitmi.gov/sites/detroitmi.localhost/files/2018-11/Stormwater%20Mgmt%20Design%20Manual%202018-11.pdf>

A Guide to the Non-Residential Drainage Charge

<https://detroitmi.gov/departments/water-and-sewerage-department/drainage-charge/nonresidential-drainage-credits>

A Guide to the Drainage Charge Credits

<https://detroitmi.gov/document/guide-drainage-charge-credits>

A Balanced System

The NFP and SWMNP were developed as an integrated planning effort. The result is a framework that strikes a balance between development goals and a sustainable approach for stormwater management within the GEM. To facilitate this integrated planning approach, three scenarios were studied that closely integrated the built form and landscape of future development in the GEM.¹² It is important to note that compliance with the PCSWMO is the responsibility of individual property owners on their parcels; the concept scenarios that follow are broad ideas of how stormwater may be managed in the GEM. Each of the three studied scenarios manages stormwater differently and provides different opportunities for the amount of water that can be managed. As a result, they each have unique built form and public space implications. The scenarios were developed to facilitate a discussion of how SMPs might appear and interact with the surrounding neighborhoods. The feasibility of each scenario was also considered for how it may assist

business owners and property developers to comply with Detroit's Stormwater Management Regulations and DWSD's GSI credit program.

In coordination with the stormwater planning assumptions, a Storm Water Management Model (SWMM) was used to study how differently scaled stormwater facilities would respond to the built form of the GEM's market expansion. The SWMM is a dynamic rainfall and runoff simulation that can be used for continuous or single-event study of the quantity and quality of surface and subsurface hydrology. The model was developed to simulate rainfall, runoff, evaporation, infiltration, and groundwater connection for roofs, paved areas, grass areas, swales, wetlands, and pipes within the GEM. The hydrology component of SWMM operates on a collection of subcatchment areas divided into impervious and pervious areas with and without depression storage to predict runoff and pollutant loads from precipitation, evaporation, and infiltration losses from each of the subcatchment areas. The model allowed the planning team to accurately represent combinations of low-impact development controls within the Study Area to determine their effectiveness in managing stormwater within the GEM. The SWMM model was created using published data of the existing soil conditions and topography of the GEM.¹³

Each of the scenarios operates based on two sources of runoff. The first source is roof runoff, which is roughly half of the total runoff from impervious surfaces within the proposed development sites. The other half of impervious site runoff comprises paved areas related to truck staging areas and parking on the development sites. It is not a requirement that the sources of water be separated, however, there may be advantages to separation. Roof runoff would be relatively cleaner water while pavement runoff may contain suspended solids, oil, grease, metals from vehicles, and salt from snowmelt. Pavement runoff will need to be directed to a pretreatment facility prior to entering an SMP. Each scenario

identifies SMPs such as green or blue roofs, cisterns, porous pavement, and filter strips, as well as potential shared stormwater management practices.

The final build-out of the GEM does not need to solely rely on using any of the three scenarios in totality. The final development could use a combination of the recommendations presented in this document.¹⁴ The GEM will be developed on a site-by-site basis and each property owner is responsible for managing the stormwater on their land. There may be potential for several property owners to manage stormwater and comply with PCSWMO in a shared SMP adjacent to their development site.

The alternative scenarios were intended to demonstrate multiple ways in which the goals of stormwater management and the reduction of drainage charges could be achieved. The basic geometries of the features combined with the volume calculations are critical to meeting the stormwater management goals for the greenways. Stormwater features within the greenways need to be dry most of the time to provide a linear network of paths and open space that knits the district together and enhances connectivity through the district. Greenways will adhere to a set of specific design guidelines developed to achieve and maintain continuity.¹⁵

Scenario Studies for Stormwater Management Options

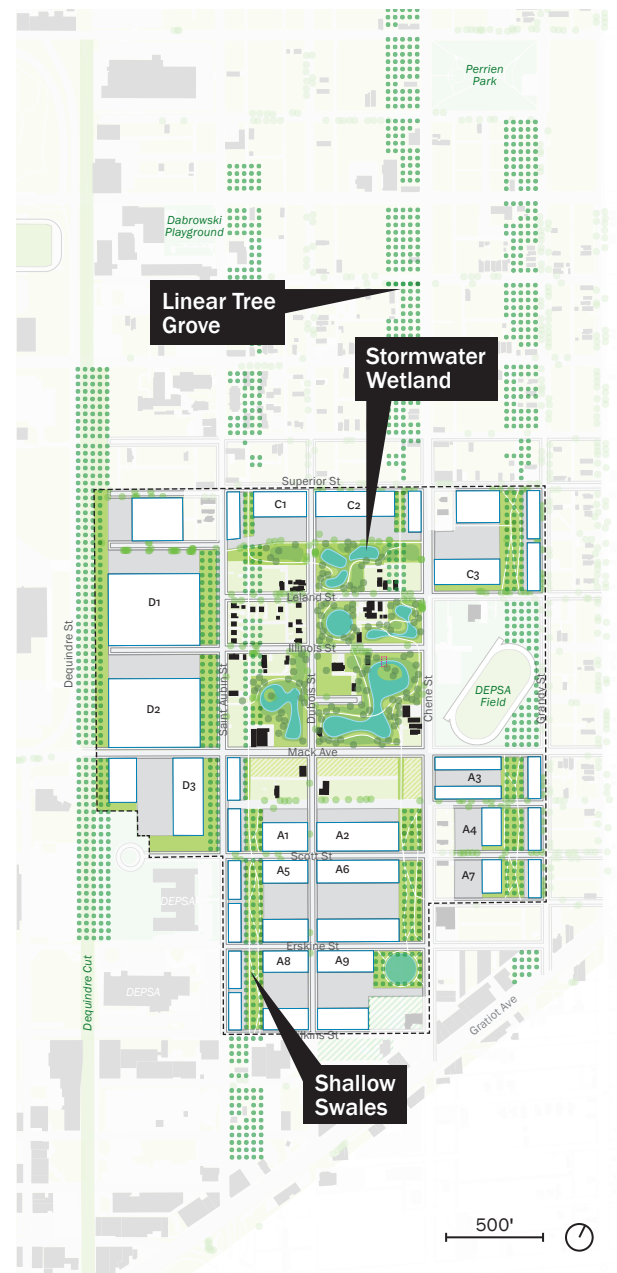
Each of the three studied scenarios manages stormwater differently and provides different opportunities for the amount of water that can be managed. As a result, they have unique built form and public space implications. Each scenario assumes that the owner would construct the stormwater management and greenway infrastructure according to the design guidelines that accompany this framework.¹⁶

Scenario 1 proposes that relatively clean roof runoff be conveyed through a piped network to a stormwater wetland park.¹⁷ This landscape would be located north of Mack Ave, south of E Alexandrine St, and between Saint Aubin and Chene Streets. All pavement runoff generated by future development would be directed into a series of shallow swales. These two different types of stormwater management features would connect to four linear tree groves that work as connective corridors through the district. The stormwater wetland area would be designed as an asset to the neighborhood, providing walking paths and a parklike landscape.

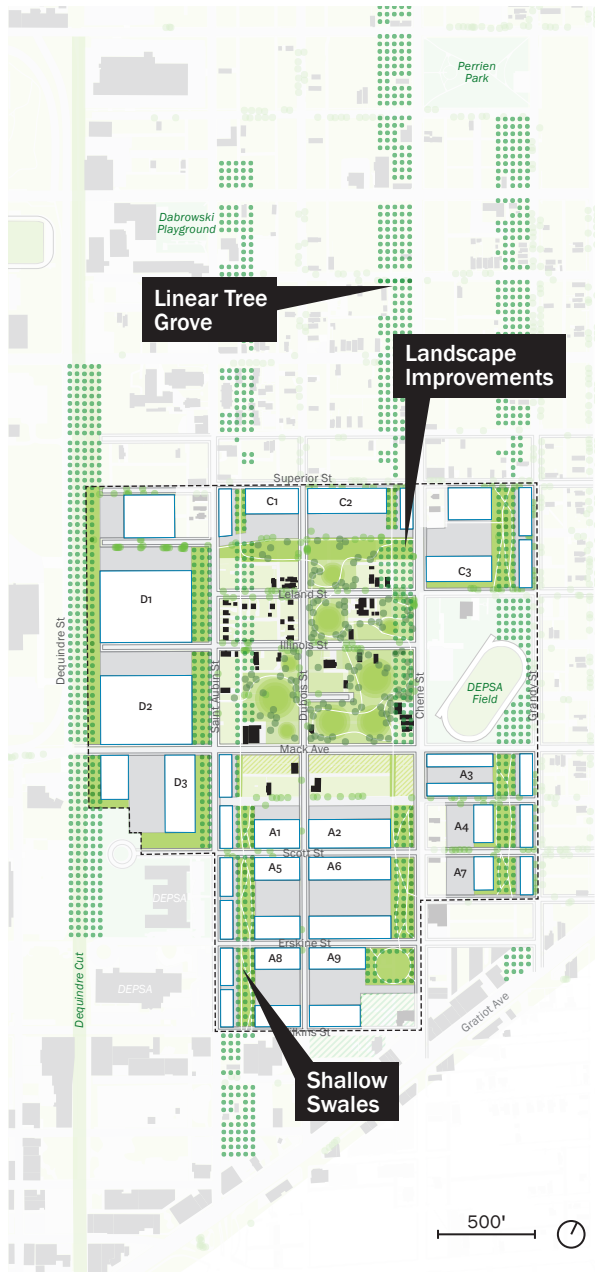
Scenario 2 proposes that relatively clean roof runoff be conveyed through a piped network to a series of subgrade storage facilities (storage tanks) located below shallow swales located within each development site.¹⁸ All of the site runoff generated by the proposed development sites would be directed into a series of shallow swales similar to Scenario 1. These two different types of stormwater management practices would connect to four linear tree groves that work as connective corridors through the district.

Scenario 3 proposes that all runoff from the proposed development sites is directed to a series of linear wetlands located within each development site.¹⁹ Four linear tree groves would work as connective corridors through the neighborhood to organize the district.

Scenario 1
Stormwater Management Wetland and Shallow Swales



Scenario 2
Shallows Swales and Subgrade Storage



Scenario 3
Linear Wetlands

