Walworth Run Green Infrastructure Feasibility Study

Northeast Ohio Regional Sewer District

URS

Northeast Ohio Regional Sewer District

Protecting Your Health and Environment

June 30, 2011

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INTRODUCTION

Purpose of Walworth Run Green Infrastructure Feasibility Study

The epidemic of vacant lots and homes in foreclosure has hit Cleveland harder than most cities in the country. In the Walworth Run project area, there are over 3,000 vacant housing units which represents a 16% percent increase as compared to the rest of Cleveland and a 184% increase from the rest of Cuyahoga County (2000 census). Although overall a negative trend for Cleveland and its neighborhoods, these vacancies represent an opportunity for green infrastructure (GI), and if properly planned and implemented could provide open space for residents, water quality benefits to Lake Erie, and means to attract reinvestment.

Completed in 2008, the Train Avenue Greenway Plan (Stockyards Redevelopment CDC, City of Cleveland, URS) preliminarily examined the use of GI within the Walworth Run watershed to infiltrate and store stormwater runoff on vacant properties while also providing green space amenities and redevelopment opportunities. The study conceptually illustrated how the implementation of GI, in conjunction with proposed roadway, green space and trail improvements, could capture the most common storm events (3/4" rain event), and reduce stormwater volume entering the combined sewer system by 35-50%. These measures could help reduce infrastructure costs associated with rebuilding the roadway, improve water quality to Lake Erie, provide space for alternative transportation, reduce heat island effect in the urban core, and provide much needed open space for surrounding residents.

Additionally in 2008, the Re-Imagining Cleveland: Vacant Land Study, a multi-agency, multi-year plan, led by Neighborhood Progress Inc., Cleveland Urban Design Collaborative and the City of Cleveland addressed the reutilization of Cleveland's 3,300 acres of vacant land with urban agriculture, GI, alternative energy capture and sustainable redevelopment. This broad planning study was developed to inspire change for the shrinking population of Cleveland. The plan examined these broad sustainable concepts for neighborhood stabilization and has led to a grant program with the installation of demonstration projects throughout Cleveland.

The Northeast Ohio Regional Sewer District (District) was created in 1972 and is responsible for collecting and treating wastewater for all or a portion of 61 communities across Northeast Ohio as well as providing regional stormwater management and addressing the region's combined sewer overflow (CSO) problem. The District provides wastewater services to over 1 million customers, employs over 600 people, and runs three wastewater treatment plants as well as the regional wastewater collection system. In 2007, The District began the implementation phase of a regional stormwater management program. This effort will expand the District's services to regional stormwater as well as wastewater. With this program, the District plans to address flooding, erosion, and water quality problems across the region; assist communities to minimize new problems and protect roads, bridges, and other infrastructure; and protect and restore waterways as regional economic resources.

In December 2010 a Consent Decree was negotiated between the District, and the U.S. Environmental Protection Agency (EPA). This legal document describes the specific CSO control measures, reduction quantities, performance goals and construction/monitoring time lines the District will perform. A key component of the Consent Decree are appendices 3 and 4 which mandate that the District control an additional 44 million gallons (MG) of CSO volume through GI and spend at least $42 million dollars to build these projects. Appendix 4 also allows the District to propose GI alternatives to replace gray infrastructure where appropriate. The District must meet Appendix 3 requirements and prove these expected outcomes to the U.S. EPA within eight years. To help facilitate this mandate, the District has built upon the Walworth Run Green Infrastructure Feasibility Study to develop a more robust overall District Green Infrastructure Feasibility Study that includes the entire combined sewer service area. Additionally, this larger study will provide expanded, more in-depth engineering results of the sewer system's responsiveness to GI implementation. The Walworth Run document will be used as an educational tool for the overall study, but will remain a standalone product for the neighborhood and stakeholders.

These studies, initiatives, and the Consent Decree laid the ground work of data, coordination and partnership to provide a foundation for the Walworth Run Green Infrastructure Feasibility Study. Through investigation of existing sewer infrastructure, surface topography, vacant land/landbank properties, redevelopment opportunities, potential partners, impervious area, and water ways this study will identify sites that will maximize the effectiveness of GI within the Walworth Run area for the District and partners.

Goals and Objectives

The Train Avenue Greenway Plan explored revitalization concepts in the Stockyards neighborhood area of the historically significant Walworth Run stream corridor. Through a multi leveled public involvement process, concepts were developed creating a green and complete street corridor that would be a neighborhood open space amenity, reconnect the area to downtown through trail links, and reutilize adjacent vacant land with GI to help control stormwater runoff and beautify the neighborhood. Building upon this study, the Walworth Run Green Infrastructure Feasibility Study focuses on this culverted stream, which is now the Walworth Run combined sewer with an outfall to the Cuyahoga River - CSO 080. This study concentrates on educating the neighborhood about GI benefits, illustrating how these measures can assist with neighborhood enhancement, discusses their general CSO reduction benefits and performs outreach to develop four feasible conceptual plans.

The District Green Infrastructure Feasibility Study that is currently underway will focus on the Consent Decree goals of 44MG CSO reduction with $42 million dollars for GI implementation over an eight year period. As these goals are more specific than the Walworth Run Green Infrastructure Feasibility Study, the overall plan may or may not support implementation of all conceptual plans developed within this study. The plans shown in Section 4 were developed to provide the greatest amount of CSO volume capture. Funding for the implementation of conceptual projects defined under the Walworth Run Green Infrastructure Feasibility Study will be considered under the overall Green Infrastructure Feasiblity Study and Green Infrastructure Plan for the District. This larger Study and Plan will be completed by December 2011. Appendix D identifies additional funding sources that could be procured by local entities outside of the District Green Infrastructure Feasibility Study.

In addition to identifying areas to reduce CSO volumes, this study's conceptual plans address the ancillary benefits such as building strong neighborhoods, reduction of heat island effects, spurring redevelopment, providing space for alternative transportation and providing open space amenities where little exists. This study offers publicly acceptable GI solutions that are adaptable to redevelopment in ultra urban neighborhoods.

This report was prepared by the Northeast Ohio Regional Sewer District under award NA09NOS4190080 from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce through the Ohio Department of Natural Resources, Office of Coastal Management. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, Department of Commerce, Ohio Department of Natural Resources, or the Office of Coastal Management.



Walworth Run Green Infrastructure Steering Committee

As this study builds on work completed in the Train Avenue Greenway Plan, a majority of the steering committee members for that study were asked to participate on the Walworth Run Green Infrastructure Steering Committee. The Walworth Run drainage area overlaps a number of Community Development Corporations (CDC's) and council wards, requiring coordination and cooperation with multiple non-profits, City Council members, and business districts. This group is responsible for providing guidance on the strategic direction of the study and assisting with neighborhood input.

This Committee met three (3) times during the project - May 24, 2010, September 30, 2010 and May 6, 2011. Notes and sign in sheets from these meetings can be found in Appendix D.

Note: During this study, after selection of the subshed boundaries and analysis of inventoried information, the Stockyards and Clark Metro CDCs combined with the Detroit Shoreway CDC. Due to the time frame of the merger within the study period, these boundary changes are not reflected in this document.

Photo of Steering Committee Meeting #2

Cleveland City Council
Joe Cimperman, Ward 3
Brian Cummins, Ward 14
Matt Zone, Ward 15

City of Cleveland:
Division of Traffic Engineering
Rob Mavec, Chief Traffic Engineer
Division of Engineering & Construction
Rick Switalski, Admin. Bureau Manager
Office of Sustainability
Jenita McGowan, Sustainability Manager
Planning Commission
Jim Danek, Assistant Director
George Cantor, Chief City Planner
Trevor Hunt, Assistant City Planner

Cuyahoga County Planning Commission
Carla Regener, Associate Senior Planner

Detroit-Shoreway CDC
Jennifer Spencer, Project Manager

Greater Cleveland Regional Transit Authority
Danielle Willis, Planning Team Leader/ Sustainability Coordinator

Local Business Owners
Laszlo Horvath, Aries Industries

Northeast Ohio Regional Sewer District
Kyle Dreyfuss-Wells, Manager Watershed Programs
Frank Greenland, Director of Watershed Programs
Devona Marshall, Planning Manager
Linda Mayer-Mack, Environmental Specialist
Kellie Rotunno, Director of Engineering & Construction
Denis Zaharija, GI Project Manager

Ohio Canal Corridor
Tim Donovan, Executive Director

Stockyard Redevelopment CDC
Matt Martin, Vacant Property Manager
Adam Stalder, Housing & Land Re-utilization Mgr.

Tremont West Development CDC
Chris Garland, Executive Director
Kristen Trolio, Community Organizer

WIRE-Net/CIRI CDC
Michael Hoag, Vice-President of Redevelopment

Walworth Run Green Infrastructure Advisory Committee

The Walworth Run Green Infrastructure Advisory Committee includes the members of the ReImagining Cleveland Vacant Land Use Steering Committee. This group is a long standing committee of the ReImagining a More Sustainable Cleveland effort, led by the Cleveland Foundation, Neighborhood Progress Inc., ParkWorks, and the Cleveland Urban Design Collaborative of Kent State University. The Committee includes representatives from the City of Cleveland, Cuyahoga County, the District and local and regional non-profits leading the way to find opportunities to repurpose the growing vacant land properties in and around the City of Cleveland. This Committee has been meeting for approximately one year to discuss alternative and long term reuse options for these properties, including stormwater management. The transition of the ReImagining Committee into the Green Infrastructure Advisory Committee is a great opportunity for the District to capitalize on an existing structure of local decision makers with a deep background in GI and vacant land reuse issues. This Committee will look beyond Walworth Run to the District's overall GI efforts.

This Committee met on May 3, 2011. A sign in sheet from this meeting can be found in Appendix D.

City of Cleveland
- Planning Commission
  - Jim Danek, Assistant Director
  - Michael Bosak, Planner
  - George Cantor, Chief City Planner
  - Trevor Hunt, Assistant City Planner
- Department of Community Development
  - James Downing, Development Officer

City of Shaker Heights
- Kamla Lewis, Director, Neighborhood Revitalization Department

Cleveland Metroparks
- John Mack, Chief of Natural Resources

Cleveland Museum of Natural History
- Jim Bissell, Curator of Botany, Coordinator of Natural Areas, Director of the Center for Conservation & Biodiversity
- Renee Boronka, Associate Director, Center for Conservation & Biodiversity

Cuyahoga County
- Dorothy Baunach, Interm. Economic Dev. Director

Cuyahoga County Planning Commission
- Carol Thaler, Program Officer

Cuyahoga Soil and Water Conservation District
- Jan Rybka, Director

DS3 - Duluk Strategic Sustainable Solutions LLC
- Mark Duluk

Greater Cleveland Regional Transit Authority
- Maribeth Feke, Director of Planning

KSU Cleveland Urban Design Collaborative
- Terry Schwarz, Director

Neighborhood Capital Corporation
- Kim Kimlin, Executive Director

Neighborhood Progress, Inc.
- Joel Ratner, President & CEO
- Bobbi Reichtell, Sr. Vice President for Programs
- Stephen Love
- Lilah Zautner, Sustainability Manager
- Erika Meschkat
- Wayne Morteliseli

Northeast Ohio Regional Sewer District
- Mardele Cohen, Community Relations Specialist
- Kyle Dreyfuss-Wells, Manager Watershed Programs
- Linda Mayer-Mack, Environmental Specialist
- Darnella Robertson, Government Affairs
- Kellie Rotunno, Director of Engineering & Construction
- Rachel Webb, Watershed Team Leader
- Betsy Yingling, Manager of Watershed Technical Support

The Ohio State University Extension, Cuyahoga County Office
- Morgan Taggart, Community and Market Gardens
- Andy Hudak

ParkWorks
- Ann Zoller, Executive Director
- Lora DiFranco, Project Manager

Slavic Village Development
- Marlene Weslian, Neighborhood Development Officer

Trust for Public Land
- Dave Vasarhelyi, Project Manager

USEPA Region 5
- Brooke Furio, Sustainable Local Government Lead, Superfund Division, Community & Land Revitalization Branch

West Creek Preservation Committee
- Dave Lincheck, Executive Director
- Derek Schafer, Conservation Project Manager/ Watershed Coordinator

Western Reserve Land Conservancy
- Julia Musson, Associate

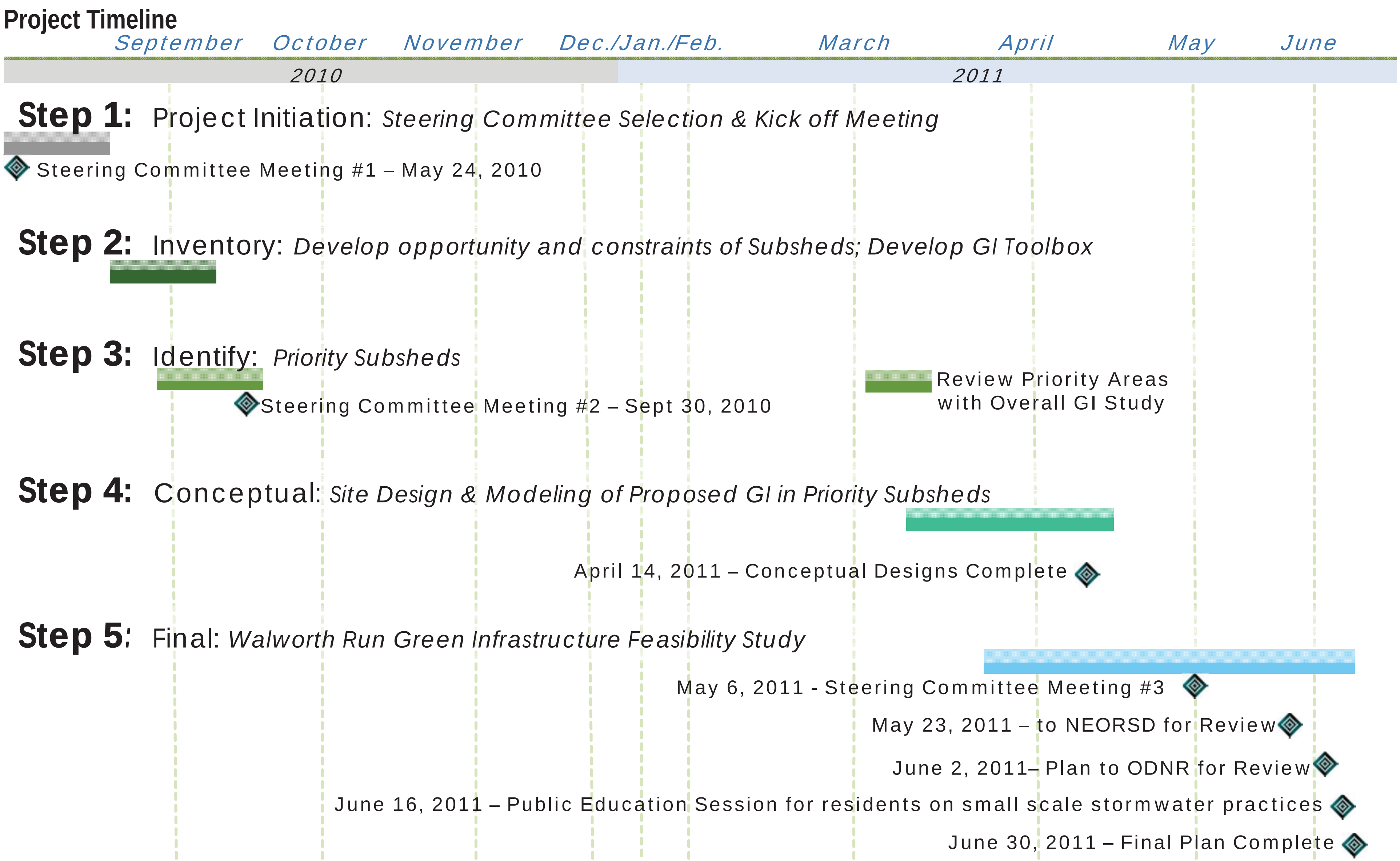

Figure 1.1: Project Timeline

Walworth Run Watershed vs Sewershed: A Brief History

Figure 1.2 Walworth Run 1869

Walworth Run is a tributary of the Cuyahoga River running from east to west. At one point in Cleveland's history it acted as a line of division between western and southern districts of the City. In the late 19th century, Walworth Run played a significant role in the surrounding neighborhood's daily life; providing a natural open space for residents as well as fulfilling many functional needs of the agricultural and other early urban milling industries.

Figure 1.3 Ohio City Neighborhood from Scranton Heights (1851) clevelandmemory.org

As industry and populations increased in the City, Walworth Run went from a pastoral channel into a discharge point for the contaminating by-products of slaughter houses and industry. With the stream quickly undergoing a transformation from an amenity into a community blemish, the City made the decision to engineer and construct a combined sewer that would capture both the sanitary water and stormwater.

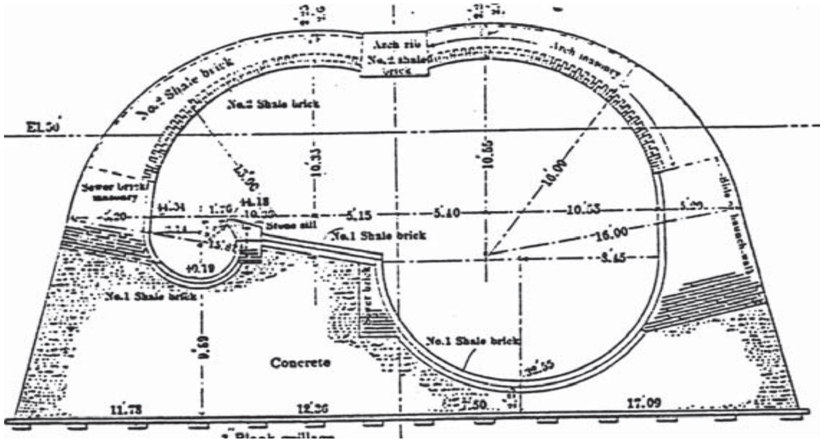

Figure 1.4: Typical section of Walworth Run Combined Sewer; "Notes on American Society of Civil Engineers "Transactions Paper No. 1011", The Walworth Sewer, Cleveland, Ohio, Presented October 4th, 1905" Notes prepared by Graham Knott, Brown and Caldwell Consultants, September 20, 1996

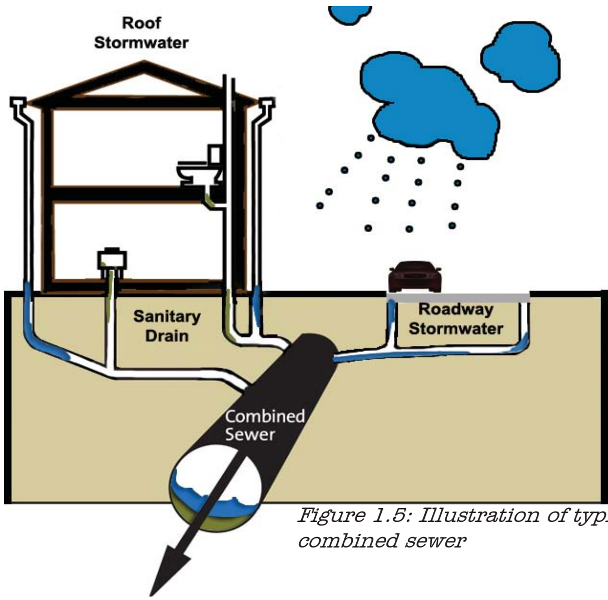

Figure 1.5: Illustration of typical combined sewer

The 16.5' diameter brick combined sewer pipe (left) was constructed over the course of six years (1897-1903) and was seen as a successful solution to the polluted stream that was bisecting the neighborhood. Since its construction, the urban landscape around Walworth Run has undergone vast changes. The largest single impact affecting the function of the combined sewer has been the exponential growth of Cleveland creating large swatches of impervious areas.

Combined sewer systems were built to capture sanitary water and stormwater, and transport the combined wastewater to a facility for treatment prior to returning it to our lakes and streams. When large storm events occur, the volume of water in the combined sewer increases to a point where capacity is exceeded, allowing for portions of the wastewater to overflow into a natural water way without treatment. Walworth Run's CSO 080 discharges into the west bank of the Cuyahoga River (photo of outfall below).

Photo of Walworth Run CSO 080 discharge outlet into Cuyahoga River

Defining the Study Boundary

The Walworth Run CSO is Cleveland's largest on the west side, discharging 320 million gallons of combined sewer overflow per year and accounting for 77% of all the untreated discharge in the Westerly Wastewater Treatment Plant Service Area (Westerly CSO Phase II Facilities Plan, NEORSD December, 1999). Combined sewage discharge occurs approximately 43 times per year or approximately once every nine days.

At the turn of the century when the Walworth Run CSO was constructed, the watershed evolved into a sewershed enlarged by a system of interconnected underground pipes. A sewershed is comprised of the sanitary water and/or combined stormwater/sanitary water that drains to a single outlet. The drainage pattern is no longer solely based on natural topography but is also dictated by the elevation of drainage structures, roadway grading, directional pipe slope, and other engineered structures.

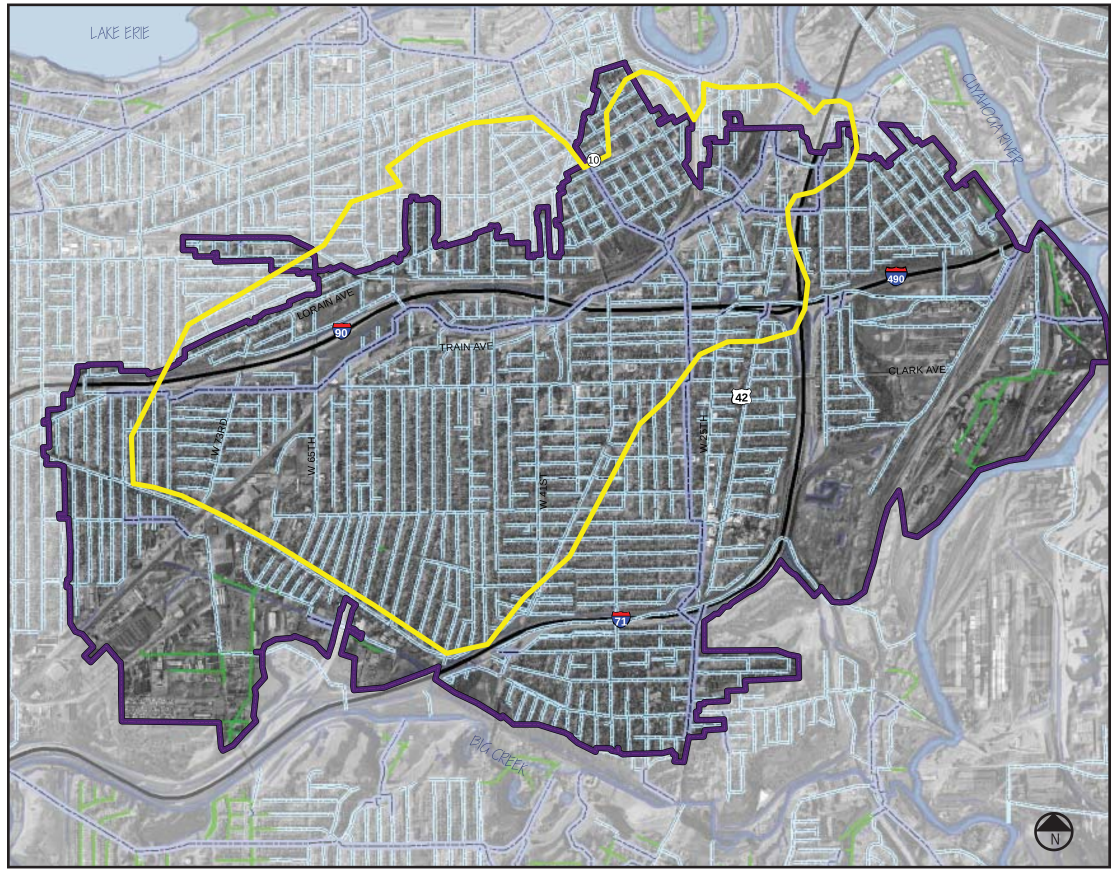

Figure 1.7: Walworth Run Sewershed (purple) vs. Watershed (yellow)

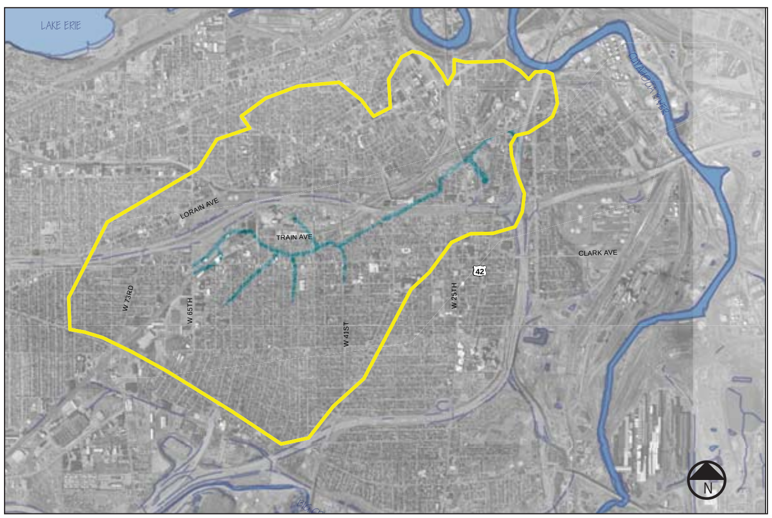

Figure 1.6 : Walworth Run Watershed

The image to the left illustrates the 2,125 acres of natural watershed for Walworth Run based on topography and historical stream records, shown in yellow. The image above illustrates the comparison between that watershed (yellow) and the CSO 080 sewershed (purple). The 4,355 acre Walworth Run sewershed boundaries are defined by manmade structures and generally follow the alignment of the sewer grid. For this study, the CSO 080 sewershed shown in purple was used as the project boundary.

Defining Subsheds

With quantitative goals of additional CSO volume reduction established by the District, sub-dividing the sewershed was an effective way to evaluate areas for viability of GI implementation. During the study, these subdivisions were called subsheds. To create these subsheds multiple natural and political divisions were considered.

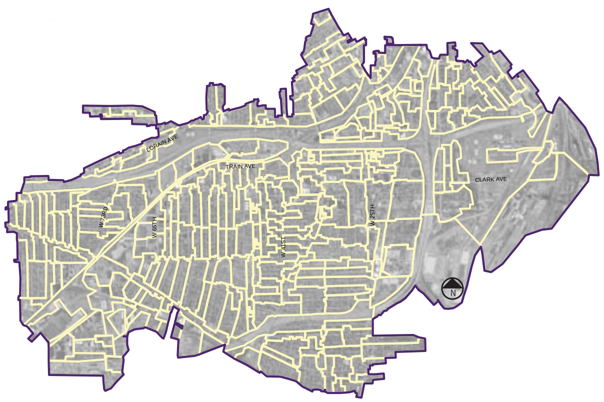

Figure 1.8: Sewer Modeling Catchment Divisions

Within the District's Walworth Run sewer system electronic model there are smaller drainage areas delineated called catchments. Catchments allows for the calculation of flows and outline where pipes combine into a known junction point. Catchments vary in size ranging from 2 to 200 acres. Catchments are important in determining the most viable areas for GI implementation as each is modeled for the volume of stormwater runoff entering into the wastewater system during multiple storm events. Knowing where the greatest volume of runoff is, coupled with other analysis, can pinpoint areas where GI can have the greatest impact on the reduction of CSO volume. However, due the typically small size of catchments, utilizing these areas alone as subsheds is not effective.

The development of the Interstate Highway system in Cleveland played a significant role in dictating the establishment of neighborhoods, social divisions, and infrastructure boundaries. Interstates 90, 490, and 71 are three significant corridors that pass through the Walworth Run sewershed. These roads are physical divisions that create an impasse for natural water flow and result in catchments divisions, neighborhood divisions and visual divisions.

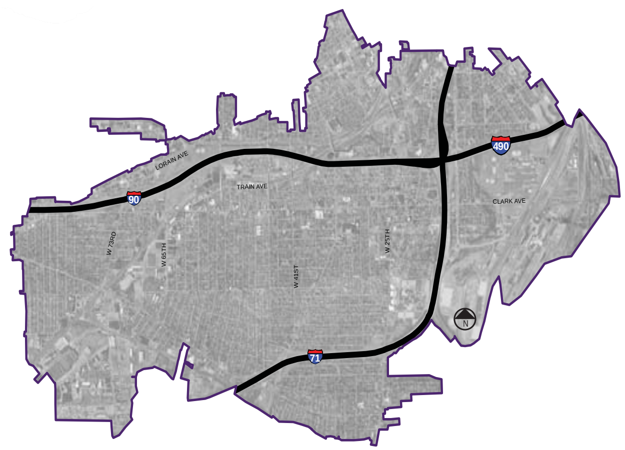

Figure 1.9: Highway Divisions

Cleveland's Community Development Corporations (CDC) address problems of economic, physical and social distress

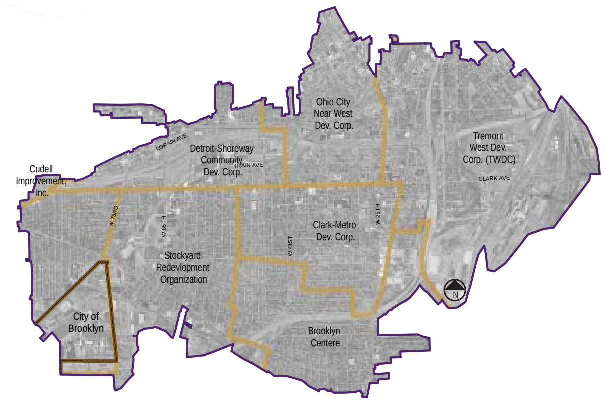

Figure 1.10: Neighborhood and CDC Divisions

in neighborhoods throughout the City. Their approach focuses on building assets for people and communities. CDC's have the ability to leverage other resources for the community through public and private sources, and maintain an ongoing presence and commitment to the community and its inhabitants. There are five CDC's within the Walworth Run sewershed. With the development and future implementation of GI projects, it is paramount to have the support and input from each of these CDC's and integrate their ideas and goals into the plan.

During this study, after selection of the subshed boundaries and analysis of inventoried information, the Stockyards and Clark Metro CDCs combined with the Detroit Shoreway CDC. Due to the time frame of the merger within the study period, these boundary changes are not reflected in this document.

Utilizing existing neighborhood divisions for subsheds would not divide the study area enough while utilizing single catchments alone would produce insubstantial volume of reduction in CSO events. For this reason, the final subshed outlines are an aggregate of catchments based upon natural divisions created by roadways, land uses and neighborhoods.

To focus in areas where substantial GI can be most effective, the study set each subshed at roughly 30 - 150 acres in size. Exceptions to this are areas where single ownership or single land use is present, such as the steel yards in Subshed 26. Forty-two (42) subsheds are identified in the image to the right. Utilizing these areas, a physical inventory and analysis was applied to determine which of these subsheds offered the most feasible potential for future GI projects.

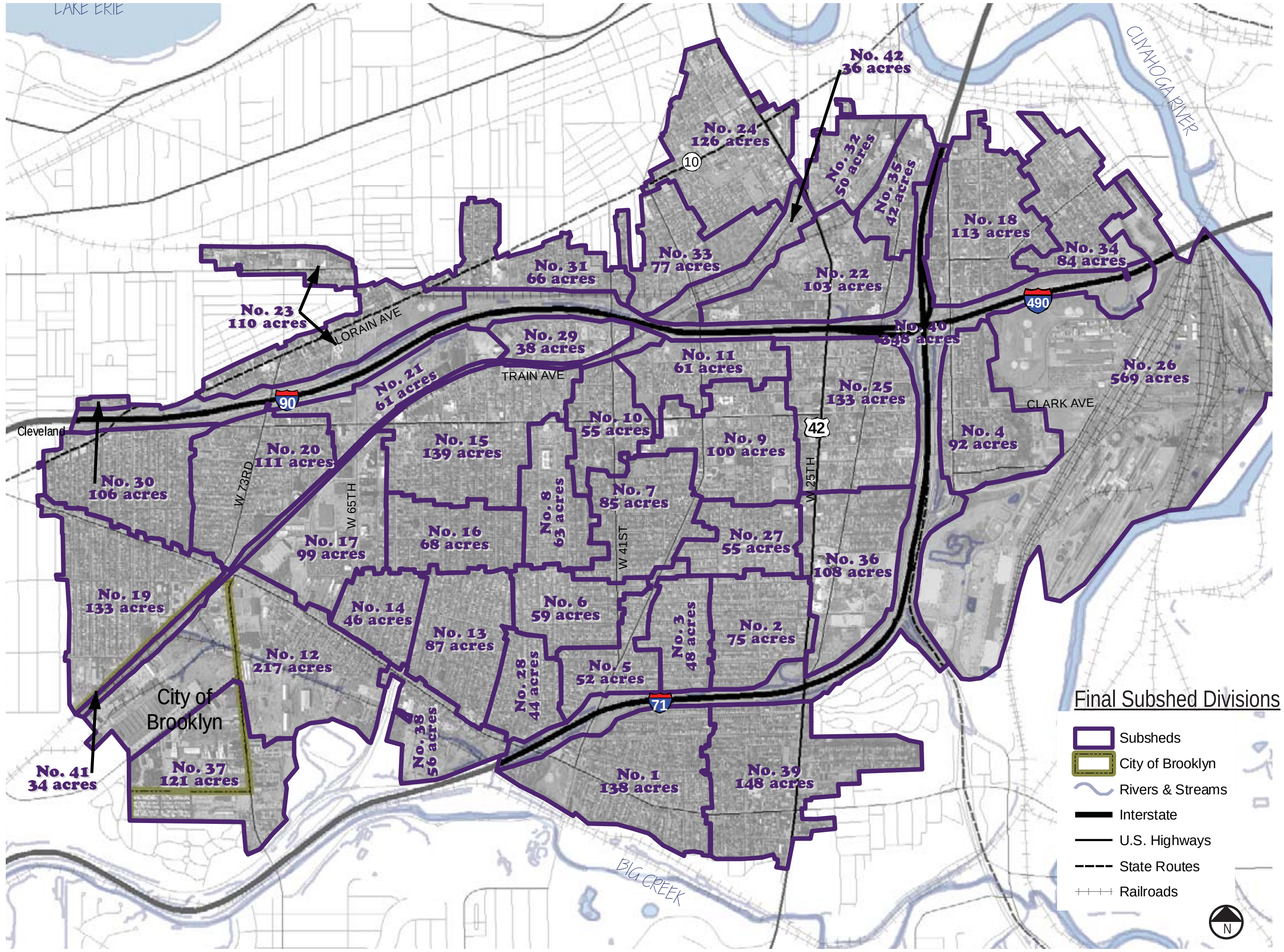

Figure 1.11: Final subshed divisions

Inventory & Analysis Criteria

Inventory and mapping in Geographic Information System (GIS) was instrumental in determining the effectiveness of GI for the forty-two (42) subsheds and prioritizing areas. Data was collected from known sources including Cuyahoga County, the District, Cleveland City Planning Commission, Cleveland Engineering Department, Cuyahoga County Auditor, Cuyahoga County Engineer, Cuyahoga County Planning Commission, Cleveland Metroparks, Ohio Department of Transportation, Ohio Department of Natural Resources, Federal Emergency Management Agency, the U.S. Geological Survey, the U.S. Department of Agriculture, and digitized information created for this study. These data sets were compiled into inventory categories to determine GI feasibility and their ability to reach the District's goals. Subject categories were analyzed by subshed areas and weighted with a high (three (3) points), medium (two (2) points) or low (one (1) point) score. See Figure 2.22 for a detailed table of analysis scoring.

Inventory Categories are:

<u>Redevelopment Coordination</u>

Based on the Consent Decree with the U.S. EPA, the District will need to complete $42 million worth of GI projects in eight years. To meet this goal the District will have to focus and integrate efforts within planned projects which can expedite construction, control costs and provide economic stimulus. Information about both private and public known redevelopment projects was collected.

<u>Vacant/Landbank Properties</u>

Utilizing the Cleveland and Cuyahoga County land banks could provide available space for GI while also strengthening neighborhoods and improving quality of life for residents. GI provides an opportunity to mitigate some of the negative impacts of Cleveland's vacant land problem by creating neighborhood amenities where possible.

<u>Impervious Areas</u>

A cost effective way of reducing CSO volume can be achieved by preventing stormwater from entering the combined sewers from large contiguous impervious areas that are directly connected to the sewer system. Commercial development has been a primary contributor to these large impervious areas. With proposed Regional Stormwater Management Program fees, which are based on square footage of impervious area, there are incentives for property owners to modify their approach in handling stormwater runoff. Additionally, these large impervious areas are often controlled by a single land owner, easing project coordination issues.

<u>Public Lands Adjacent to Vacant/Landbank Property</u>

Public lands adjacent to vacant/landbank property can be a partnering opportunity for GI implementation with other public agencies. These public agencies could provide additional GI educational opportunities, utilize GI sites for recreational purposes and other cooperative use programming as well as provide supplemental ecological monitoring.

<u>Minority & Poverty</u>

The District will give priority to neighborhoods with households that have low income or concentrated minority populations. Most of the entire study area meets this criteria, so this was not a significant variable on subshed selection.

<u>Soils</u>

In most urban settings, the soil profile has been affected by development. Over the course of Cleveland's history, some areas have been destroyed and rebuilt several times. Urban development often results in the displacement of clay soils and debris onto adjacent sites while compacting existing soils with the use of heavy equipment. All of which can effect estimating site specific stormwater infiltration capacity. The soil information in the study area is not detailed and is mainly classified as urban land. Historic soil data and soil borings from various sources have assisted with soil analysis for this project.

Redevelopment Coordination

Information on private and public development projects, underway or planned, was collected and scored based upon GI implementation coordination opportunity. Data for the public redevelopment map was collected from Northeast Ohio Areawide Coordinating Agency's (NOACA) Transportation Improvement Plan, Cleveland's Capital Improvement Plan, and Cleveland's 2020 Plan. The private redevelopment map information was collected from the Cleveland's 2020 Plan as well as through conversations with the Cleveland Planning Commission staff. As indicated in the private development plan, there is little immediate private development projected due to the current economic downturn.

Individual projects were given point values based upon probable construction dates - three (3) points for projects to be constructed within 0-5 years, two (2) points for projects planned at 5-10 years and one (1) point for projects not scheduled for at least 10 years or for projects that are planned but have no immediate funding (Figure 2.1 & 2.2). These points were then attributed to subsheds they overlay. Many of the projects overlap multiple subsheds, creating the need to summarize scores and weight subsheds based upon the summarized scores - creating an analysis of the subsheds based upon their potential for GI to be coordinated with redevelopment.

Subsheds with a large number of development projects occurring within the near future (subsheds from 12 to 7 summarized points) were simplified to overall weighted high score, subsheds with a moderate amount of development projects occurring further into the future (subsheds from 6 to 4 summarized points) were simplified to an overall weighted medium score and subsheds with low or no development were simplified to a low weighted score (subsheds with less than 4 summarized points). This overall weighted scoring is shown on the following analysis map (Figure 2.3).

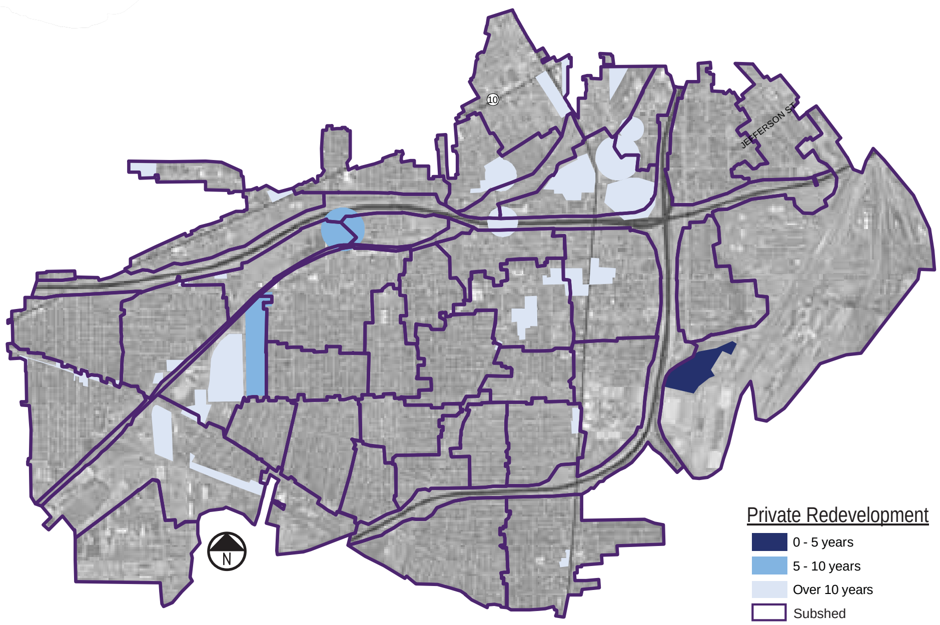

Figure 2.1: Private Redevelopment

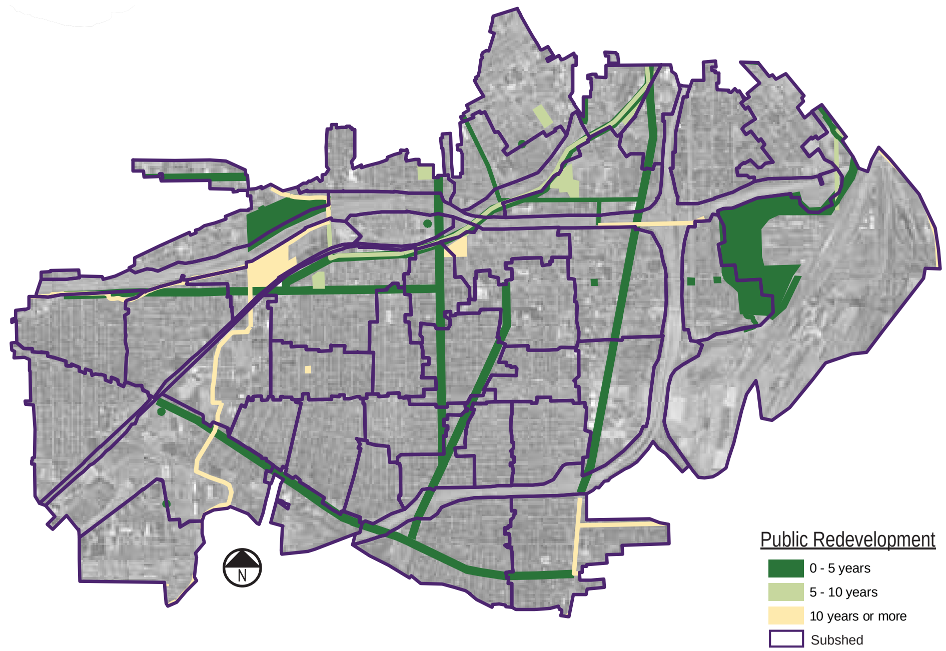

Figure 2.2: Public Redevelopment

Redevelopment Coordination Analysis Map

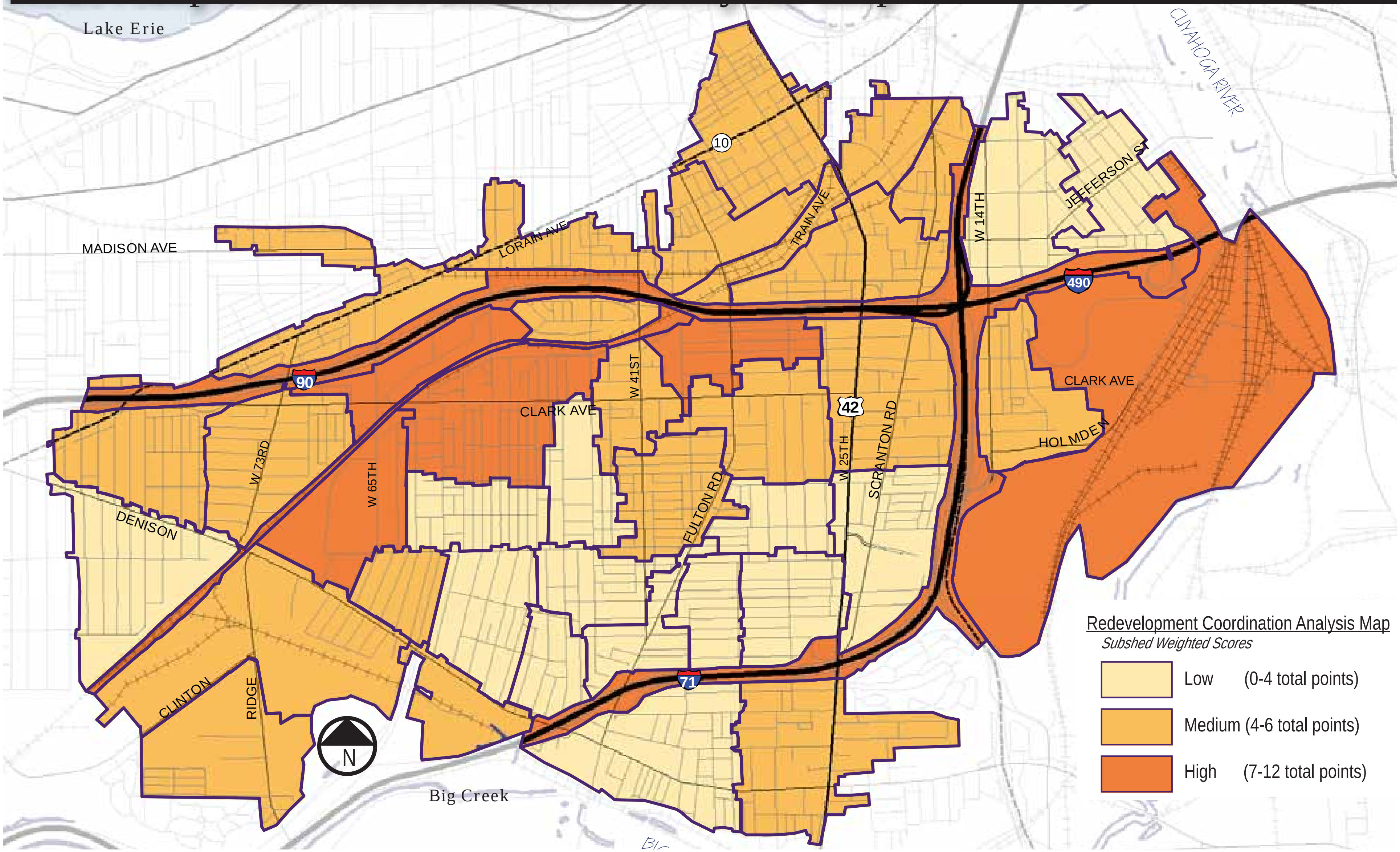

Figure 2.3: Utilizing the scoring system described on the previous page, this map weights subsheds by redevelopment coordination opportunity.

Vacant/Landbank Properties

Data for vacant and landbank properties was collected from Cuyahoga County's GIS database in conjunction with Cleveland's Landbank and the Cuyahoga County Land Reutilization Corporation. All vacant and landbank properties within the sewershed present opportunities for improving neighborhoods and increasing land value, but areas with larger or contiguous vacant lots offer more flexibility in the approach for large GI projects. Subsheds with the higher number of larger sites will provide the best opportunity for this type of GI project. Points were assigned to each merged contiguous vacant/landbank area based upon their aggregated acreage. Areas above 2 acres in size were given three (3) points, areas larger than 3/4 acre but less than 2 acres were given two (2) points, and areas below 3/4 acre were given one (1) point. (Figure 2.6)

These points were then attributed to subsheds they overlay and summarized. Subsheds with the highest number of larger sites (subsheds from 19 to 10 summarized points) were simplified to an overall weighted high score, subsheds with modest number sites (subsheds from 9 to 4 summarized points) were simplified to an overall weighted medium score, and subsheds with minor sites (subsheds with less than 4 summarized points) were simplified to an overall weighted low score. This overall weighted scoring is shown on the following analysis map (Figure 2.7).

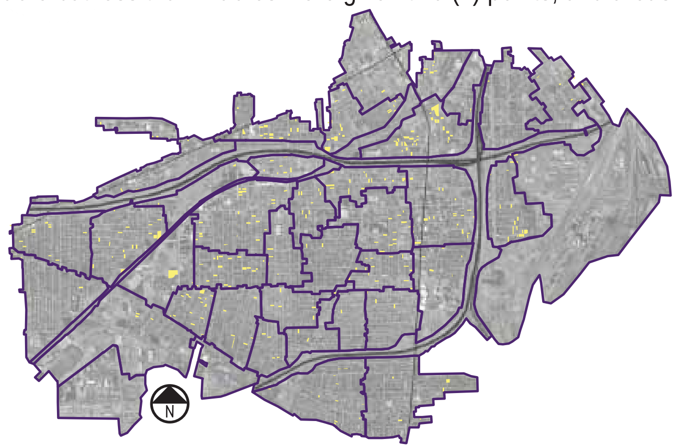

Figure 2.4: Landbank Properties in yellow

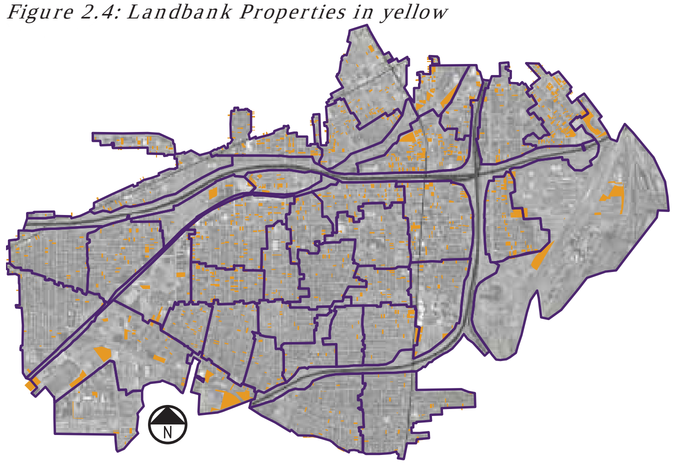

Figure 2.5: Vacant Properties in orange

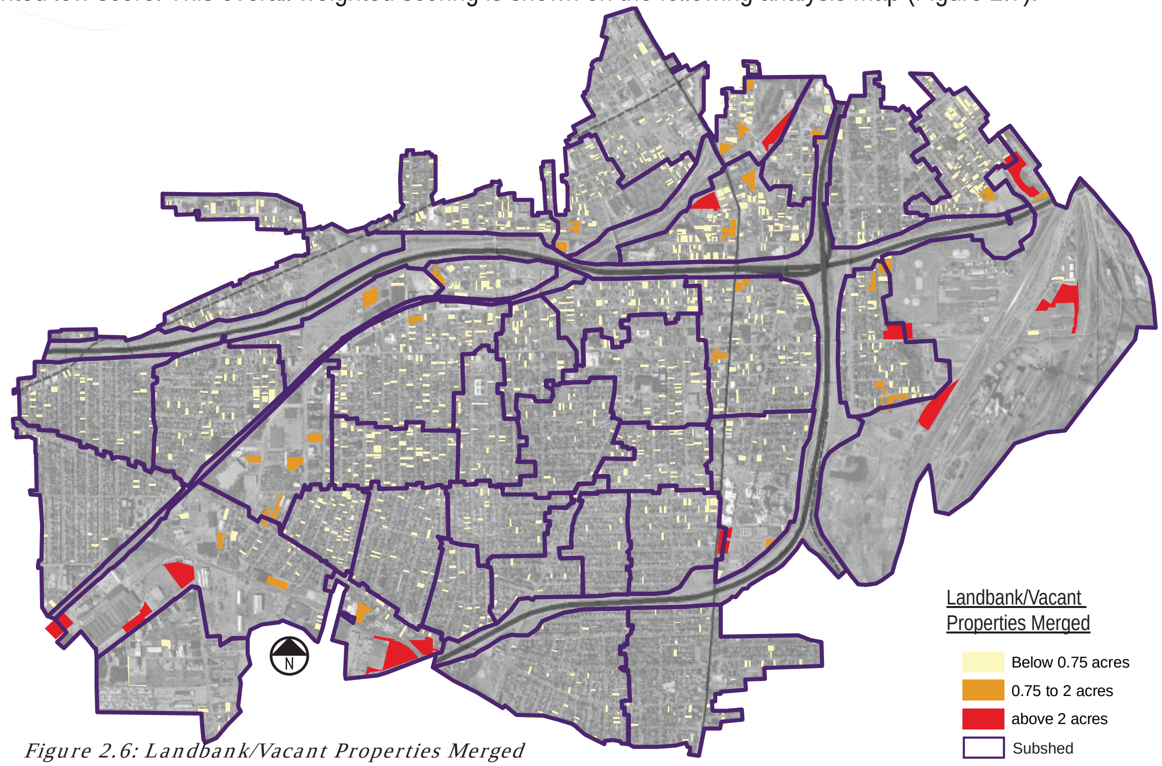

Figure 2.6: Landbank/Vacant Properties Merged

Vacant/Landbank Properties Analysis Map

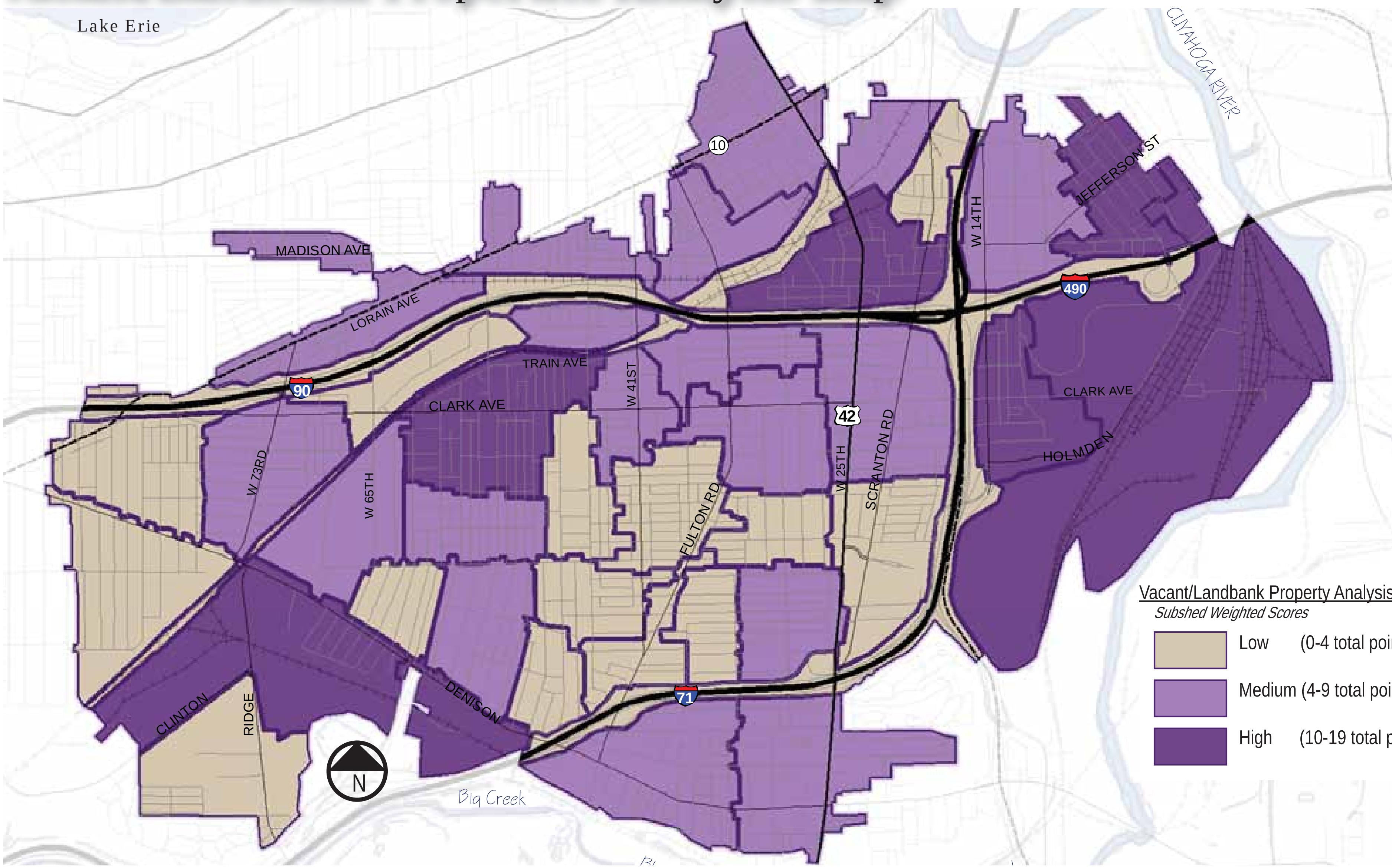

Figure 2.7: Utilizing the scoring system described on the previous page, this map weights subsheds by vacant and/or landbank abundance and size.

Impervious Areas

In Cleveland and most cities, exponential increase in impervious area has played a significant role in the increasing amount of CSO volume. Impervious areas may indirectly or directly connect to the sewer system. Indirectly connected stormwater enter sewers after allowing the water to run over pervious surfaces, such as lawns, detention basins and bioswales. This allows for infiltration, evapotranspiration and increases the time before stormwater enters the system. Directly connected impervious areas are directly attached to the sewer system via downspouts and catch basins where all of the stormwater falling on the impervious surface flows to the system.

Large parking lots above 20 spaces (digitized from 2008 Cuyahoga County GIS aerials) and large buildings above 2,000 SF (isolated from 2008 Cuyahoga County GIS) are typically directly connected impervious areas. These areas are shown in Figures 2.8 & 2.9. These types of large impervious areas are often controlled by a single land owner easing potential GI project coordination issues providing a greater potential for GI implementation. These two data sets were aggregated in GIS and their area calculated. The aggregated acreage was then compared to subshed acreage to determine the percent of large impervious area coverage per subshed. Subsheds with highest large impervious area coverage (10% or greater coverage) received an overall weighted high score, subsheds with moderate large impervious area coverage (less than 10% but greater than 5%) received an overall weighted medium score, and subsheds with lowest impervious area (less than 5%) received an overall weighted low score. This overall weighted scoring is shown on the following analysis map (Figure 2.10).

Example of large directly connected impervious area

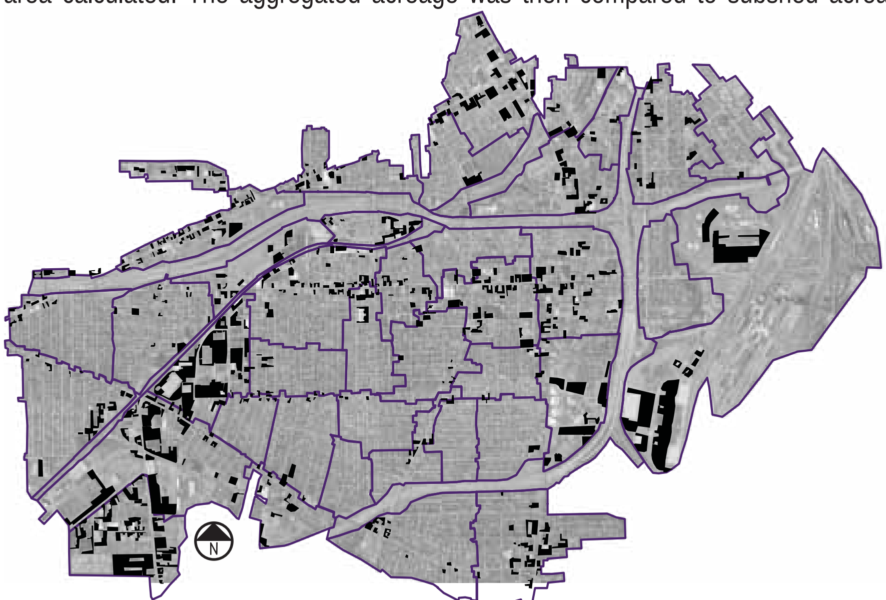

Figure 2.8: Large Parking Lots (above 20 spaces) in black

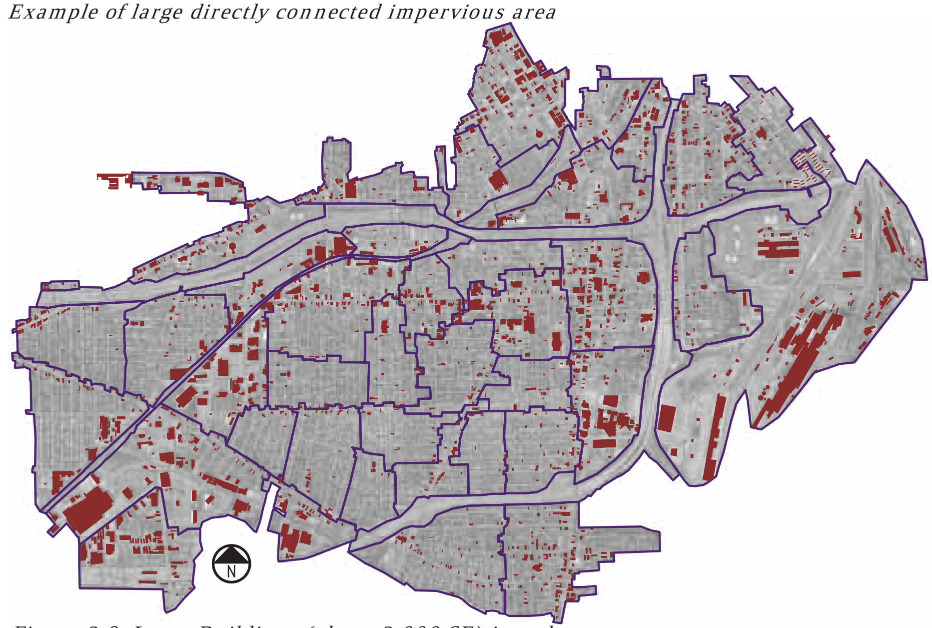

Figure 2.9: Large Buildings (above 2,000 SF) in red

Large Impervious Area Analysis Map

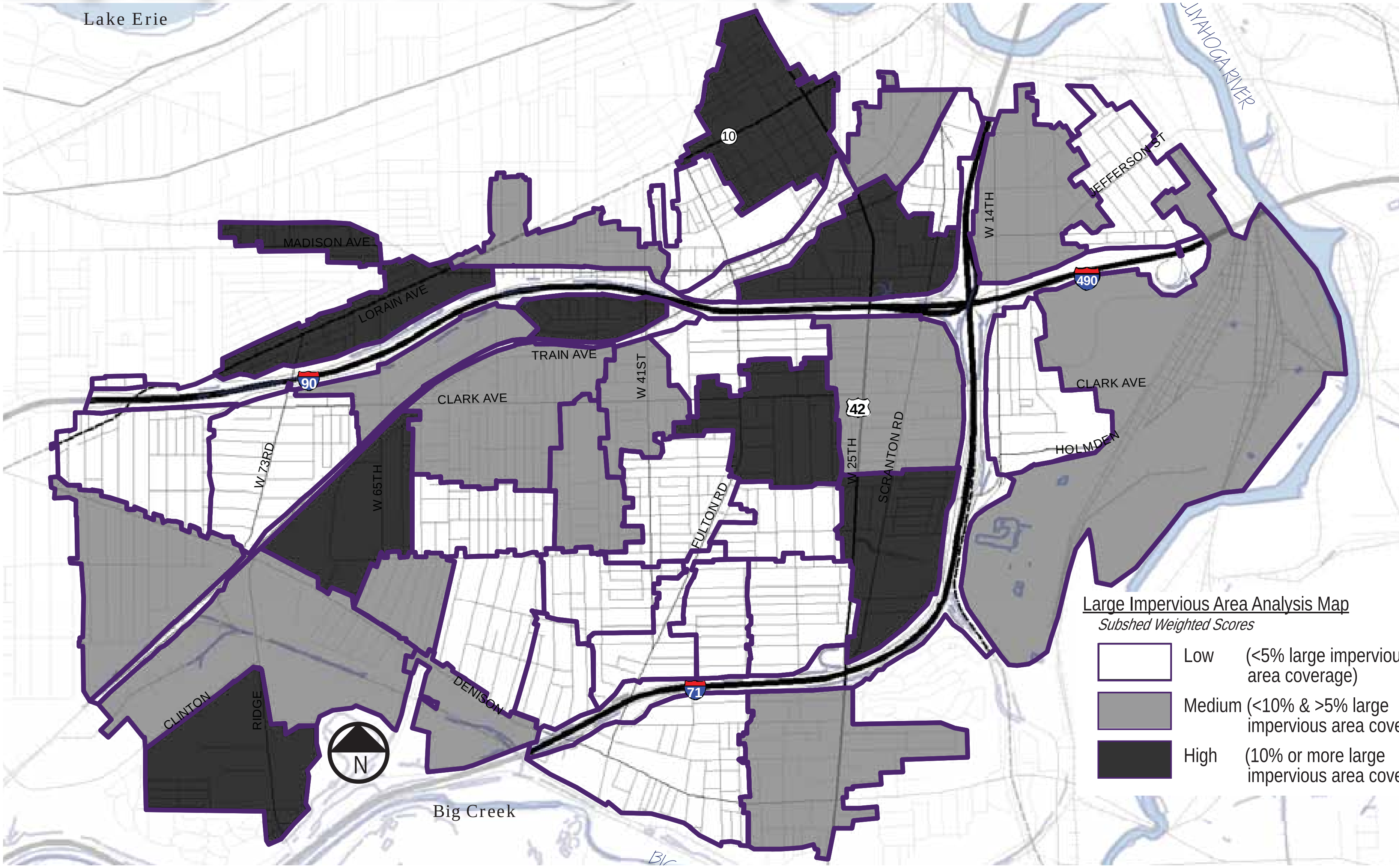

Figure 2.10: Utilizing the scoring system described on the previous page, this map weights subsheds by large impervious area capture opportunity.

Public Lands Adjacent to Vacant/Landbank Property

Identifying partners with missions consistent with the District's focus on clean water can provide opportunities for successful GI implementation. Private and public school properties, park land, and non-profit properties were identified as potential partners (Figures 2.14 & 2.16). These areas were juxtaposed with the vacant/landbank ranking created earlier (Figure 2.6 & 2.15).

Subsheds were then ranked based upon the size and location of the vacant/landbank property to partner properties. If the subshed had a partnership property with adjacent vacant/landbank property, the subshed received an overall weighted high score. If the subshed had vacant/landbank property within 500 feet of a partnership property, the subshed received an overall weighted medium score. If the subshed had vacant/landbank property beyond 500 feet from a partnership property, the subshed received an overall weighted low score. This overall weighted scoring is shown on the following analysis map (Figure 2.17).

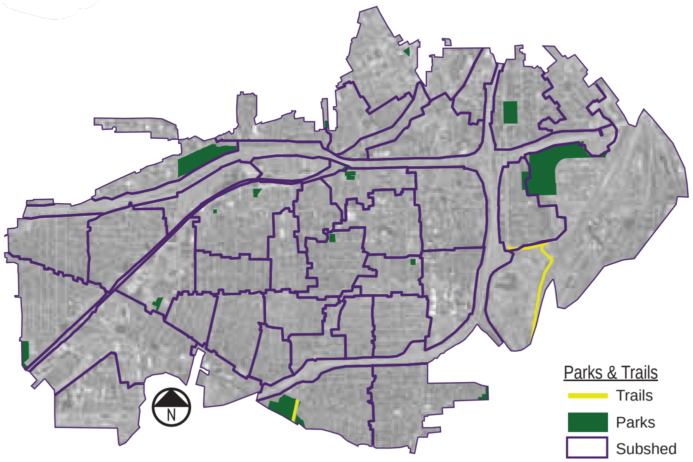

Figure 2.11: Parks/ Trails

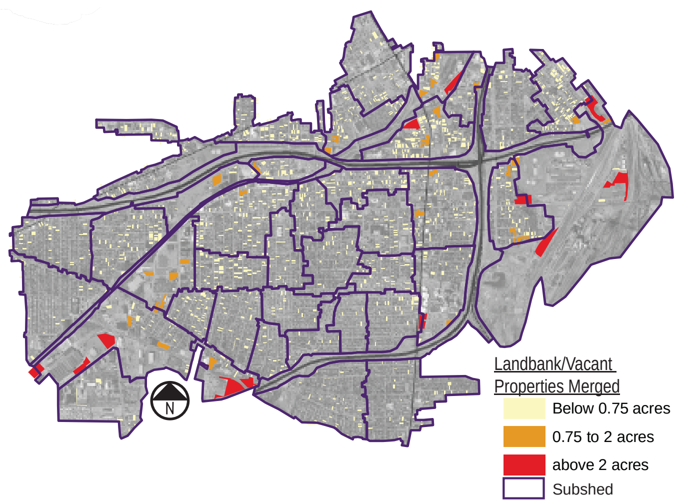

Figure 2.12: Landbank/Vacant Properties Merged

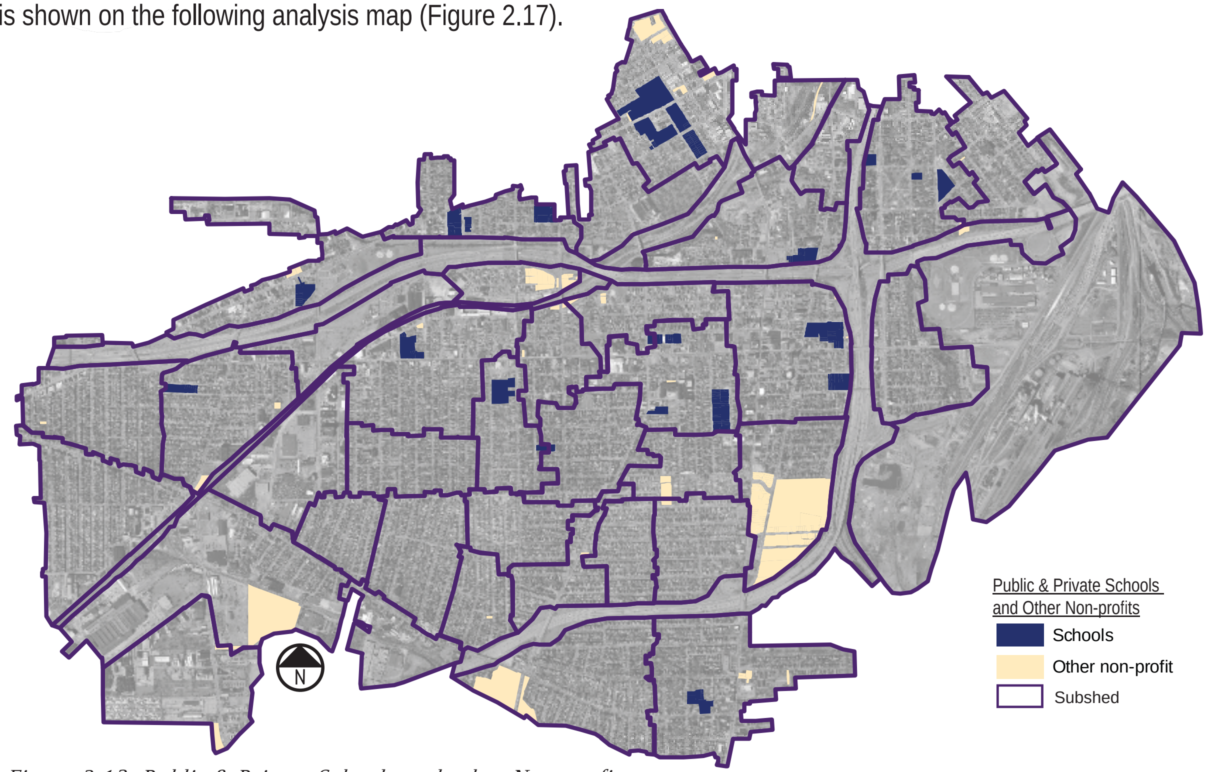

Figure 2.13: Public & Private Schools and other Non-profits

Public Lands Adjacent to Vacant/Landbank Property Analysis Map

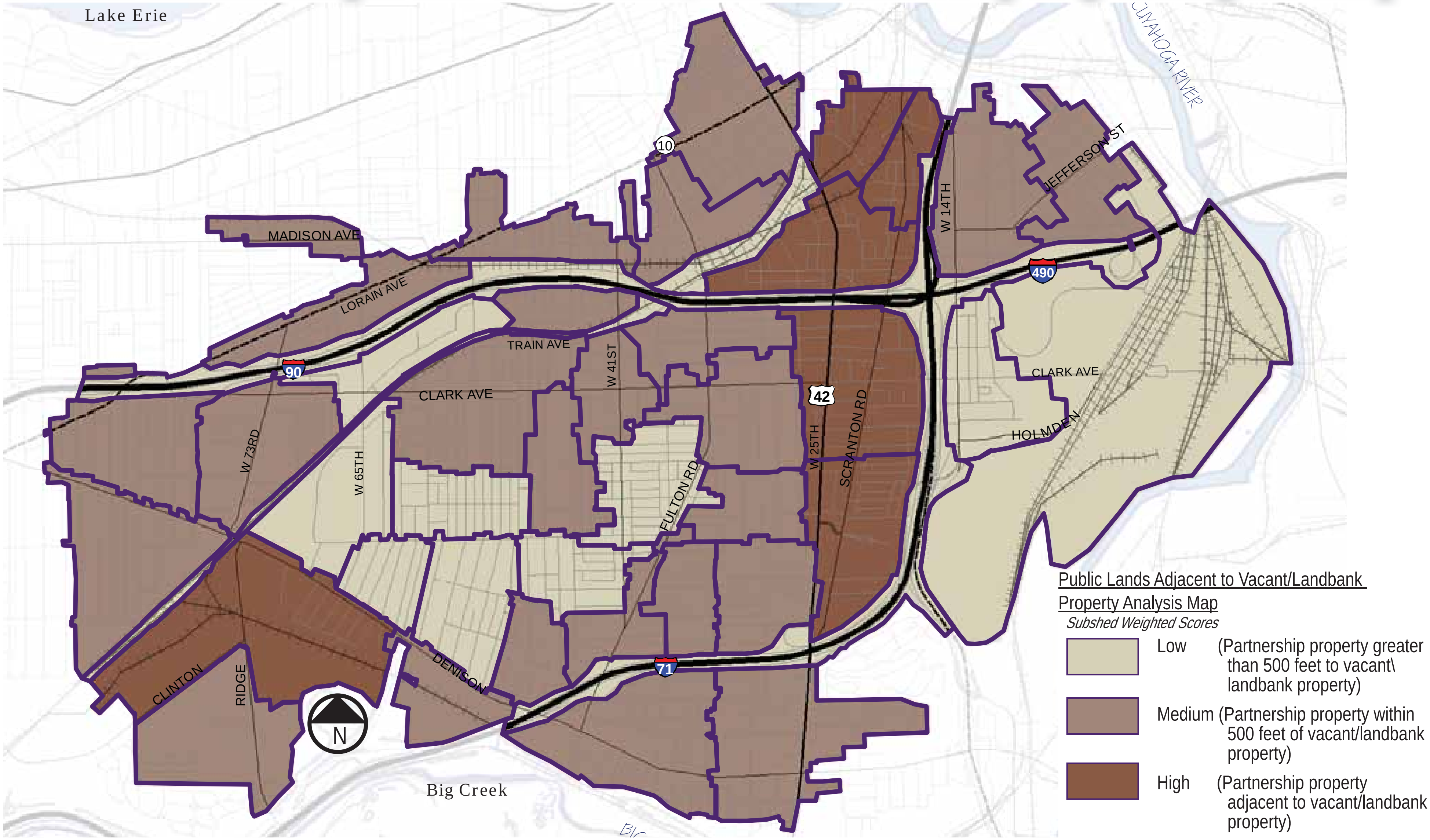

Figure 2.14: Utilizing the scoring system described on the previous page, this map weights subsheds by opportunity to create GI adjoining potential partners.

Minority & Poverty

According to the 2000 census data, the Walworth Run area has greater rates of poverty and minority populations as compared to those of Cuyahoga County. GI not only can reduce gray infrastructure (pipes, storage tanks, etc) costs but it can provide open space amenities for areas underserved by parks and green space. Green space in underserved communities can provide significant improvements in health, increases to property value, spur economic development, increase community involvement, and result in overall improvement to socioeconomic conditions.

Census blocks were identified in the Walworth Run area for rates above Cuyahoga County for minority populations and poverty rates (Figures 2.11 & 2.12). Subsheds received an overall weighted high score if the area was both above 13% poverty rate and 33% minority, subsheds received an overall weighted medium score if the area had one of the two categories present, and subsheds received an overall weighted low score if the area had neither category present. This overall weighted scoring is shown on the following analysis map (Figure 2.13).

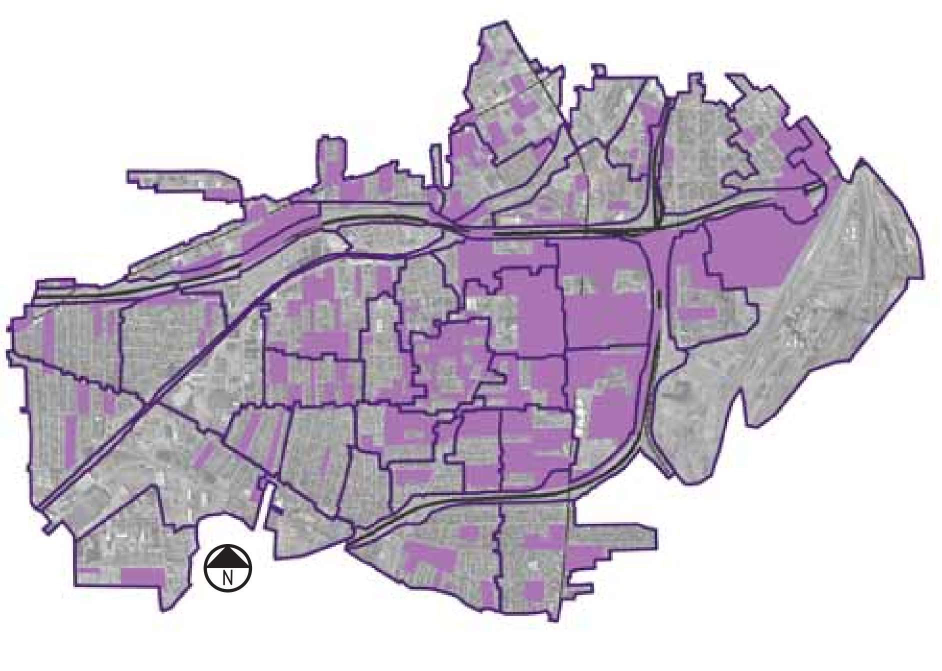

Figure 2.15: 2000 Census blocks above 33% minority population rate in purple

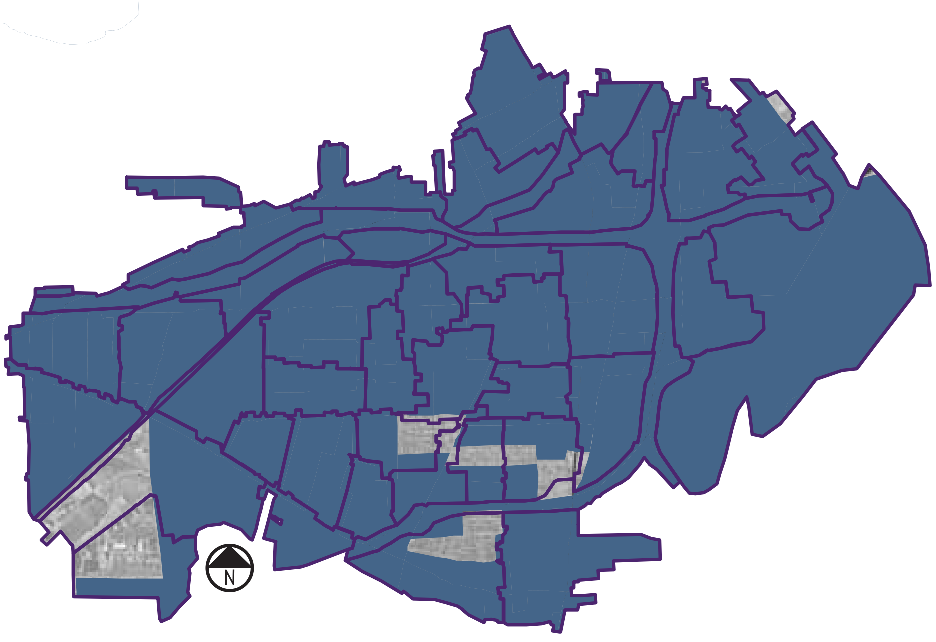

Figure 2.16: 2000 Census blocks above 13% poverty rate in blue

Minority & Poverty Analysis Map

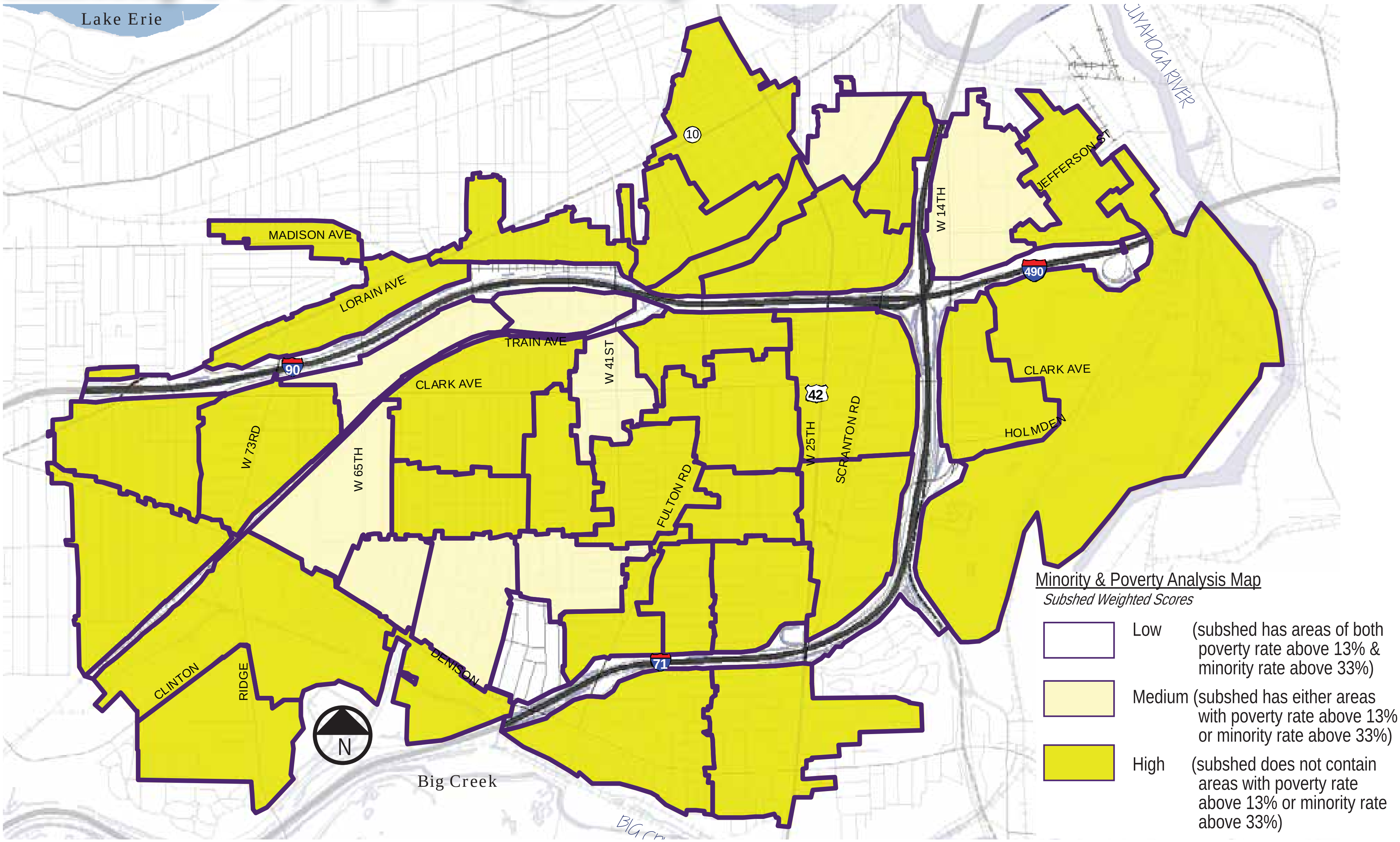

Figure 2.17: Utilizing the scoring system described on the previous page, this map weights subsheds by minority and poverty rates.

Soils

The National Resource Conservation Service (NRCS), a branch of the United States Department of Agriculture (USDA), has compiled soil data for the Cleveland region as well as most of the United States. In planning for GI where water infiltration is important, greater weight was given to those areas having sandy soils (Figure 2.19) and areas where steep slopes, escarpments, and shallow restrictive features were less desirable due to their low capacity for infiltration (Figure 2.18). Although the native soil of the Walworth Run area has high rates of infiltration, urban land development has concealed most of those conditions under sometimes deep layers of fill, pavement, demolished structures, and landfills.

Soil Infiltration Test:

One of the goals of the Feasibility Study was to model how much stormwater volume could be infiltrated by green infrastructure measures in the Walworth Run area. Soil percolation tests were originally proposed to be performed on selected sites in the study area to better identify soil infiltration characteristics. The percolation data is considered useful because the Walworth Run Watershed has gone through multiple phases of development where compaction and other factors could affect current soils hydrology at the site level. In 2010 the U.S. EPA, Office of Research and Development National Risk Management Research Laboratory (Cincinnati, OH) initiated a pilot research project in Cleveland to conduct soil taxonomic and hydraulic assessment (which included evaluation of soil compaction) on vacant lots in Cleveland (Shuster et al. 2011).

The objective of the pilot study was to develop a representative soil map and hydraulic assessment to provide a better understanding of soil characteristics of urban soils, and their utility in the arena of implementing GI (plant-soil systems) for enhanced stormwater management. The US EPA conducted soil investigations on 43 vacant lots and city park areas in the City of Cleveland. Soil cores were collected for taxonomic and fertility

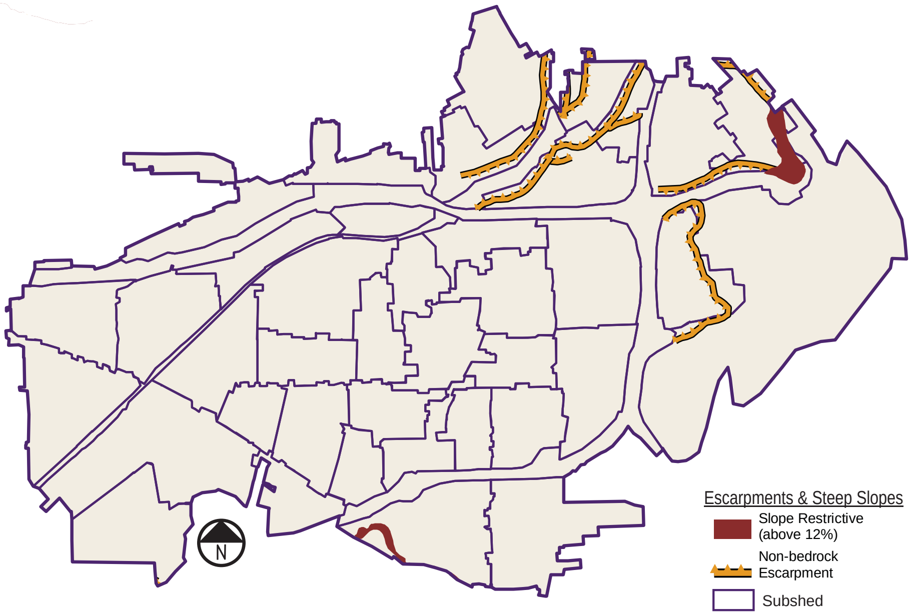

Figure 2.18: Escarpments & Steep Slopes

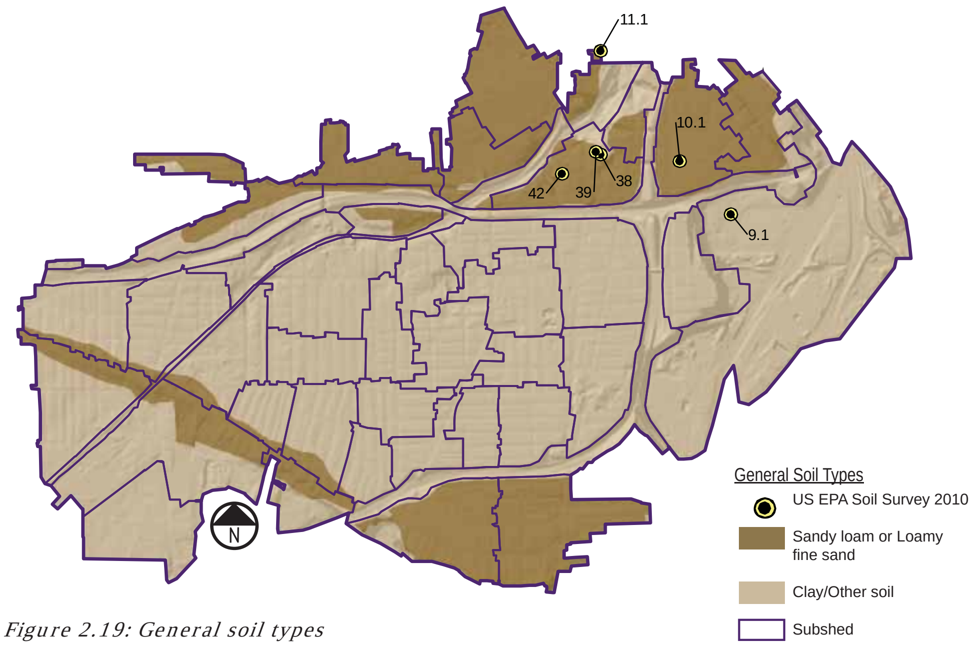

Figure 2.19: General soil types

Soils

analysis, and field data on saturated hydraulic conductivity at the soil surface and at depths ranging from 19 to 49 inches within the soil profile. A subset of six (6) sites were concentrated in or around the Walworth Run area (Figure 2.19). Three (3) of the six (6) sites were vacant lots that had homes demolished since 1996, with the other three (3) sites in local city parks.

For each vacant lot site, two (2) sub-areas were sampled: 1) within the fill sub-areas where demolition of the building occurred and 2) the relatively undisturbed native soil area of the property (backyard setback where less disturbance has occurred). The city park sites represent soils that have had limited impact from residential-urban activities. The results of this pilot study have not yet been published, but were presented as a poster at the Reclaiming Vacant Properties Conference (Cleveland, OH) in October 2010, and were made available to the District for review and inclusion into this study. For the purposes of this report the District reviewed the subsurface saturated hydraulic conductivity results from the six (6) sites in and around the Walworth Run area.

LIST OF USEPA SAMPLING SITES				
			CCHP*	
			NATIVE SOIL	
Site Number	Approximate Address	Type	Ksat (Glover) (cm/hr)	Depth (cm)
38 - Vacant Lot	2524 W 19th Pl	lot	0.2	113
39 - Vacant Lot	W 20th and Moltke Ct	lot	0.03	114
42 - Vacant Lot	2714 Queen Ave	lot	0.85	90
9.1 - Tremont Valley Playfield	W. 11th and Castle Ave	park	1.56	94
10.1 - Lincoln Park	W. 14th & Starkweather Ave	park	15.45	115
11.1 - Abbey Park	W. 19th & Smith Ct	park	1.39	162

*CCHP - saturated hydraulic conductivity calculated with Glover equation; depth indicates at which depth the conductivity was measured.

Soil hydraulic conductivity quantifies the ease with which water can move through pore spaces or fractures. Saturated hydraulic conductivity describes water movement through saturated soil media.

Figure 2.20: List of USEPA sampling sites

Soil hydraulic conductivity quantifies the ease with which water can move through pore spaces or fractures. Saturated hydraulic conductivity describes water movement through saturated soil media.Saturated hydraulic conductivity for native subsoils from three (3) vacant lot sample sites was less than 1 cm hr^{-1}. The saturated hydraulic conductivity was higher at the park sites, which have typically, underwent less disturbance, maintained vegetative cover, and thereby retained soil structure conducive to infiltration. These results also may illustrate the impact of development and disturbance (esp. as demolition, which can affect the whole parcel) on developed residential areas in the Walworth run area, and that these characteristics are highly variable from property to property, and within a lot. For conceptual planning of GI projects, the NRCS regional soil data and previous site activity are useful tools. If a GI project is to move beyond the conceptual phase each proposed project site will need more specific subsurface geotechnical investigation to determine the infiltration capacity of subsurface soils (as a limiting factor in the drainage of infiltration-type SCMs), scope soil management needs, and confirm the utility and projected effectiveness of each site SCM.

Due to the urban conditions and site specific unknowns of the soils, the subsheds were only categorized into an overall weighted high score where soils maps eluded to historic sandy conditions and an overall weighted low score where soil maps indicated potential soil restrictions. This overall weighted scoring is shown on the following analysis map (Figure 2.21).

References

Moving beyond the udorthent – a proposed protocol for surveying urban soils to service data needs for contemporary urban ecosystem management. WD Shuster*, A Barkasi, P Clark, S Dadio, P Drohan, B Furio, T Gerber, T Houser, A Kelty, R Losco, K Reinbold, J Shaffer, J Wander, and M Wigington. Soil Survey Horizons. Spring 2011

Invited poster – Vacant lots, soils, and the sustainable management of stormwater. Conference: Reclaiming Vacant Properties – The intersection of sustainability, revitalization, and policy reform. WD Shuster, B Furio. October 13-15 2010, Cleveland OH.

Soils Analysis Map

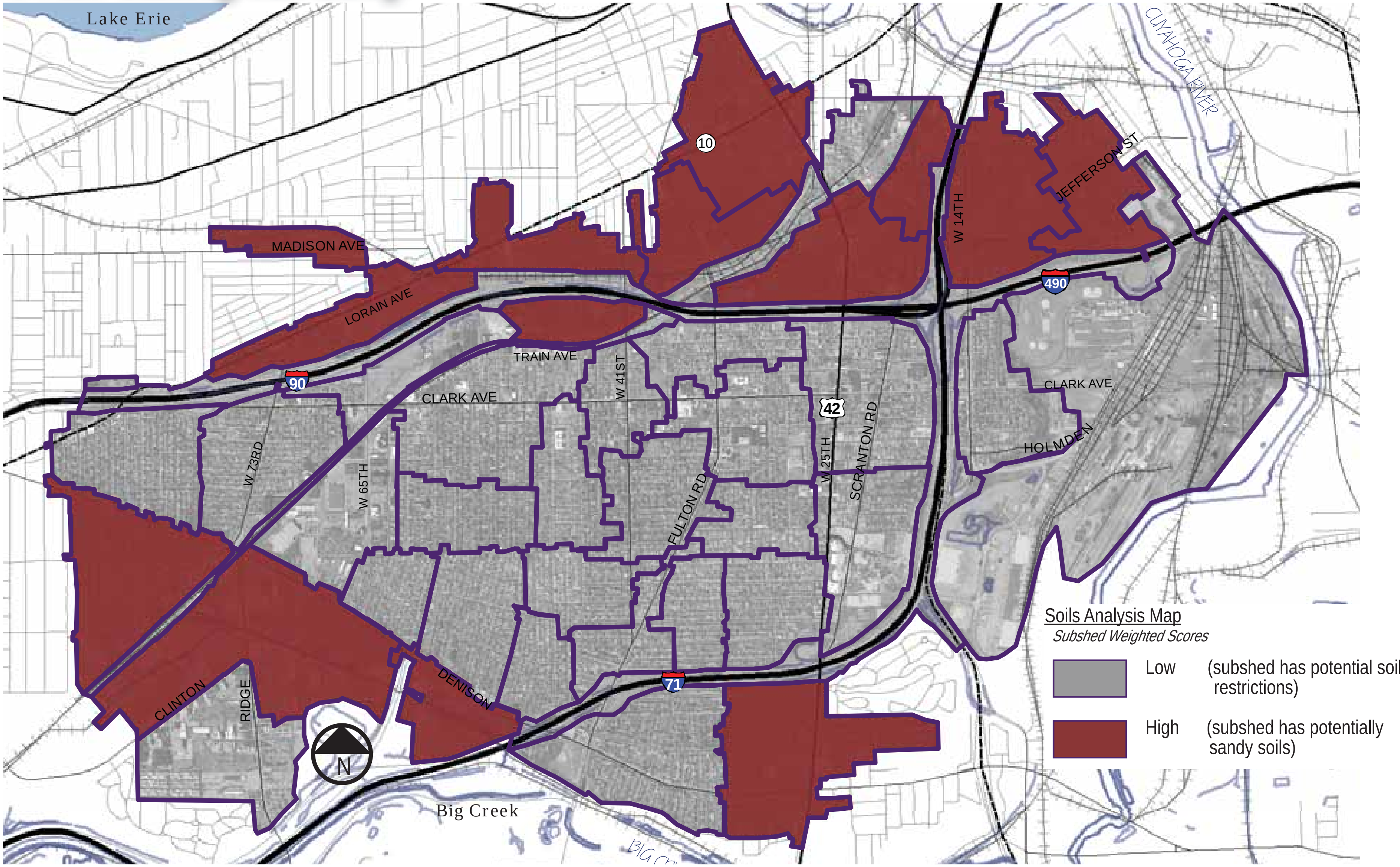

Figure 2.21: Utilizing the scoring system described on the previous page, this map weights subsheds by sandy soil opportunities and restrictions.

Analysis Scoring Summery

Walworth Run Analysis Scoring

Inventory Category	Summarized Points	Weighted Score
Redevelopment Coordination	Multiple projects & fastest time (21-7 points)	High (3 score)
	Some projects &/or a few fast project (6-4 points)	Medium (2 score)
	Few to no projects (4-0 points)	Low (1 score)
Vacant/Landbank Properties	Highest number of larger sites (19-10 total points)	High (3 score)
	Modest number sites (9-4 total points)	Medium (2 score)
	Minor sites (0-4 points)	Low (1 score)
Impervious Area	10% or more large impervious surface area coverage	High (3 score)
	10% but greater than 5% large impervious area coverage	Medium (2 score)
	Less than 5% large impervious area coverage	Low (1 score)
Public Lands Adjacent to Vacant/Landbank Property	Partnership property with adjacent vacant/landbank property	High (3 score)
	Vacant/landbank property within 500' of a partnership property	Medium (2 score)
	Vacant/landbank property beyond 500' of a partnership property	Low (1 score)
Minority & Poverty	Both above 13% poverty rate and 33% minority	High (3 score)
	One of the two categories present	Medium (2 score)
	Neither categories present	Low (1 score)
Soils	Historic sandy conditions	High (3 score)
	Soil maps indicated potential soil restrictions	Low (1 score)

Figure 2.22: Table of Analysis Scoring. Each subshed was given a weighted score of high, medium, or low for each inventory category based upon their summarized points.

Opportunities and Constraints

Ranking Criteria

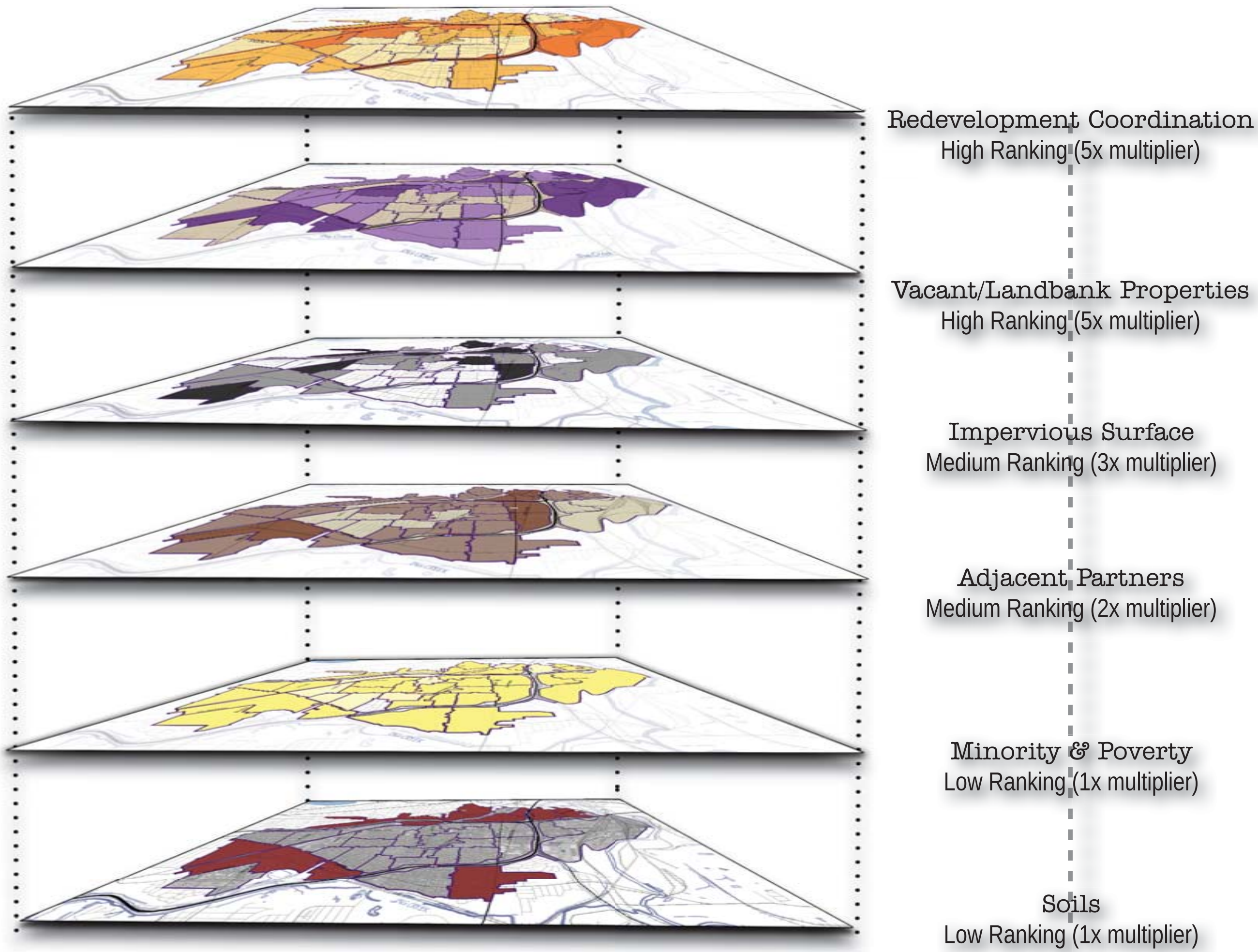

Figure 3.1: Inventory Category Ranking Criteria Overlay

Each subshed was given a weighted score for each inventory category (Figure 2.21). The categories were then ranked and given a multiplier number based on its ability to meet the project goals (Figure 3.1). Multipliers were applied to each subshed's inventory category scores to determine an overall ranking for prioritization of subsheds for GI implementation.

Redevelopment coordination and vacant/landbank properties inventory categories can best assist the District with their goal to achieve an additional 44MG of additional CSO volume reduction within eight years with GI. As these categories are most important for this goal, they were given a high ranking multiplier of five (5).

Impervious surfaces can provide the opportunity to capture and remove large amounts of stormwater from the combined sewer while minimizing property owner coordination. This category was given a medium ranking multiplier of three (3).

Adjacent Partners to vacant/landbank properties provide the potential to improve other public agency mandates and increase environmental education. This category was given a medium ranking multiplier of two (2).

Minority and Poverty information was determined to have little effect on the ranking of subsheds as a majority of the Walworth Run neighborhoods have significant poverty and minority rates. This category was given a low ranking multiplier of one (1).

Soils were determined to have little effect on the ranking of subsheds based on the lack of solid soil science in the urban lands and the inability to confirm infiltration capacity. This category was given a low ranking multiplier of one (1).

Subshed Ranking Matrix

All forty-two (42) subsheds inventory scores were multiplied by the ranking criteria. The chart below illustrates those multiplied ranking inventory categories.

Subshed Ranking Matrix (Numeric Order)

Subshed	Redevelopment	Vacant/ Landbank	Impervious Areas	Minority & Poverty	Public Lands Adjacent to Vacant/ Landbank	Soils	Ranked Score
1	Low	Medium	Low	High	Medium	Low	27
2	Low	Medium	Low	High	Medium	Low	27
3	Low	Low	Low	High	Medium	Low	22
4	Medium	High	Low	High	Low	Low	36
5	Low	Low	Low	High	Medium	Low	22
6	Low	Low	Low	Medium	Low	Low	19
7	Medium	Low	Low	High	Low	Low	26
8	Low	Low	Medium	High	Medium	Low	25
9	Medium	Medium	Medium	High	Medium	Low	38
10	Medium	Medium	Medium	Medium	Medium	Low	33
11	Medium	Medium	High	High	Medium	Low	38
12	Medium	High	Low	High	High	High	40
13	Low	Medium	Low	Medium	Low	Low	24
14	Medium	Low	Medium	Medium	Low	Low	27
15	High	High	Medium	High	Medium	Low	45
16	Low	Medium	Low	High	Low	Low	26
17	High	Medium	High	Medium	Low	Low	40
18	Low	Medium	Medium	Medium	Medium	High	30
19	Low	Low	Medium	High	Medium	High	27
20	Medium	Medium	Low	High	Medium	Low	32
21	High	Low	Medium	Medium	Low	Low	32
22	Medium	High	High	High	High	High	46
23	Medium	Medium	High	High	High	High	41
24	Medium	Medium	High	High	Medium	High	40
25	Medium	Medium	Medium	High	High	Low	36
26	High	High	Medium	High	Low	Low	44
27	Low	Low	Low	High	Medium	Low	22
28	Low	Low	Low	Low	Medium	Low	19
29	Medium	Medium	High	Medium	Medium	Low	38
30	Medium	Low	Low	High	Medium	Low	27
31	Medium	Medium	Medium	High	Medium	High	37
32	Medium	Medium	Medium	Medium	High	Low	34
33	Medium	Medium	Low	High	Medium	High	34
34	Low	High	Low	High	Medium	High	34
35	Medium	Low	Low	High	High	High	30
36	Low	Low	High	High	High	Low	29
37	Medium	Low	High	High	Medium	Low	33
38	Medium	High	Low	High	Medium	High	39
39	Medium	Medium	Medium	Medium	Medium	High	35
40	High	Low	Low	High	Low	Low	31
41	High	Low	Low	High	Low	Low	31
42	Medium	Low	Low	High	Low	Low	26

Figure 3.2: Ranking Matrix

High Medium Low

High Ranked Subsheds

The map below illustrates the ranked subsheds (Figure 3.3). The top six (6) subsheds have scores of 40 and above and are ranked as high, scores between 39 and 33 are ranked medium and below 32 are ranked low. As illustrated in Figure 3.4, the high ranking subsheds are mainly due to a combination of high potential of vacant/landbank potential, redevelopment coordination potential and impervious area capture potential. Utilizing this ranking system effectively focuses the study to the areas which have the highest potential to fulfill the project goals.

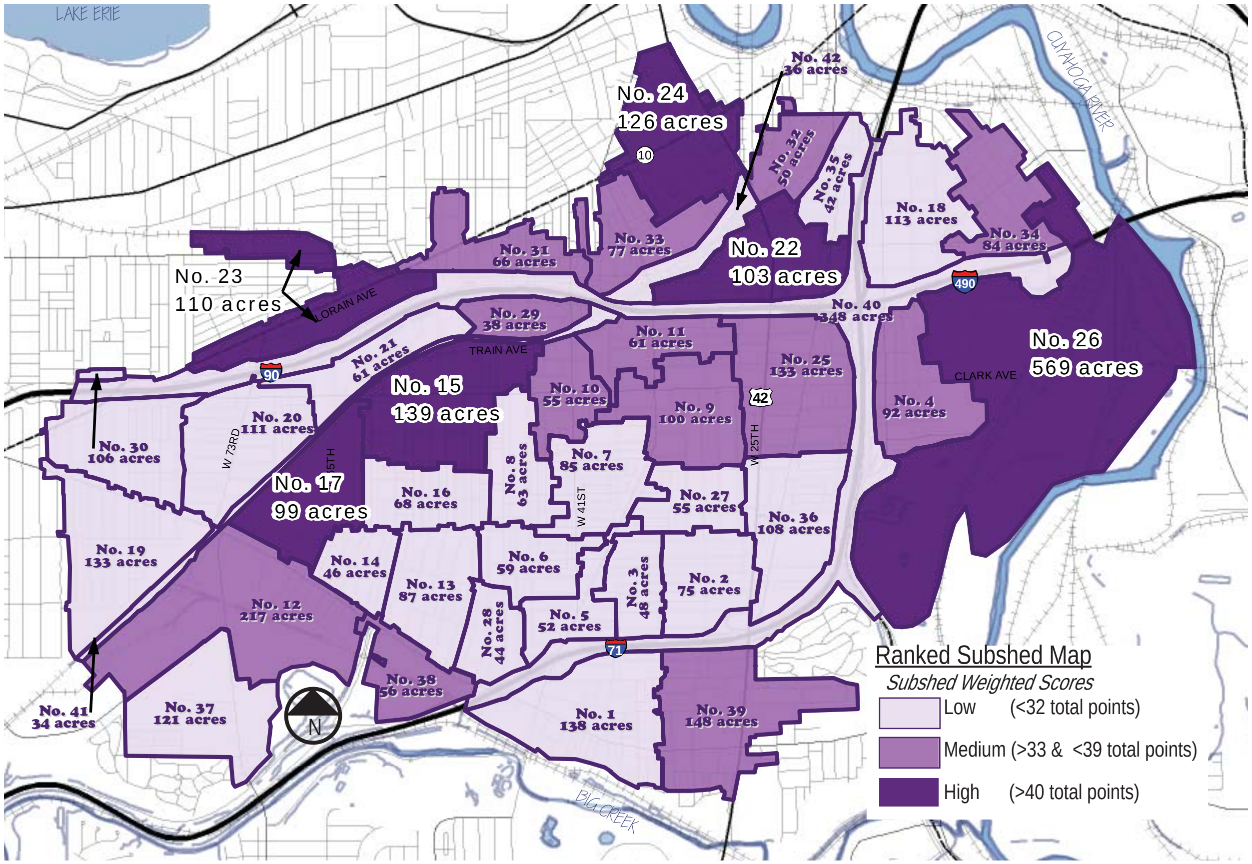

Figure 3.3: Ranked subsheds

Priority Subshed Ranking Matrix

Subshed	Redevelopment	Vacant/ Landbank	Impervious Area	Minority & Poverty	Public Lands Adjacent to Vacant/Landbank	Soils	Ranked Score
22	Medium	High	High	High	High	High	46
15	High	High	Medium	High	Medium	Low	45
26	High	High	Medium	High	Low	Low	44
17	High	Medium	High	Medium	Low	Low	41
23	Medium	Medium	High	High	Medium	High	40
24	Medium	Medium	High	High	High	High	40

High Medium Low

Figure 3.4: High ranking subsheds

Integration with overall Green Infrastructure Feasibility Study

This grant funded study has spurred the District to perform a GI analysis of the entire combined sewer system (Figure 3.5). This overall Green Infrastructure Feasibility Study will provide expanded, more in-depth engineering results of the sewer system's responsiveness to GI implementation. The study's goals outline specific CSO control measures, reduction quantities, performance goals and construction and monitoring time lines along which the District will perform for GI. The Walworth Run Green Infrastructure Feasibility Study will be considered under the overall Green Infrastructure Feasiblity Study and Green Infrastructure Plan for the District, but will remain a separate document for the neighborhood and stakeholders. Figure 3.7 illustrates the ranked Walworth Run subsheds (high, medium, and low) overlaid with the overall Green Infrastructure Feasibility Study draft high scoring areas.

During the integration of the Walworth Run GI Feasibility Study with the overall Green Infrastructure Feasibility study, it was found that the final CSO Long Term Control Plan separates subshed areas 1, 2, 3, 4, 9, 25, 26, 27, 34, 36, 39 and parts of 5, 7, and 11 from entering the Walworth Run CSO, therefore, excluding these areas from site specific consideration and the remainder of this study. The analysis of the excluded areas will be a part of the overall GI feasibility study.

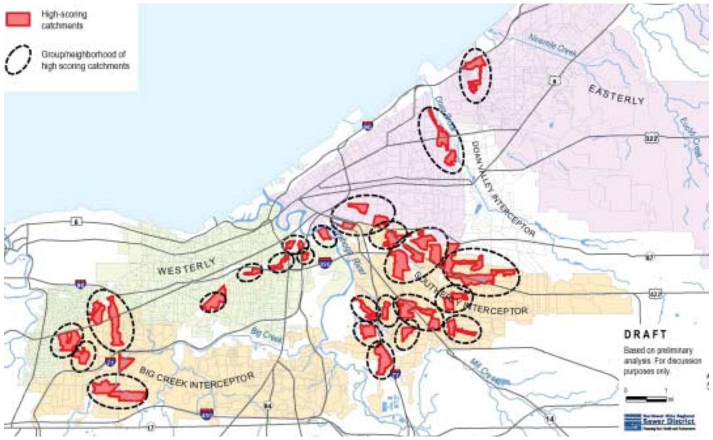

Figure 3.5: Overall GI Feasibility Study draft high ranked catchments (red) & draft high scoring areas (circles) (URS, Limnotech, WRCE, AECOM)

Based upon these two studies, subsheds listed in the table in figure 3.6 were selected for site specific analysis. These nine subsheds were analyzed on a site scale to see what GI measures could fit into the urban fabric, collect the most stormwater, work with redevelopment opportunities and enhance the neighborhoods based upon the positive utilization of vacant/landbank properties.

Subsheds Advanced for Site Specific Analysis	
Subshed #	**Area Name**
15	Train Park Area
17	Stock yards Area
18	Starkweather and West 10th
22	West 25th and Barber Ave.
23	Zone Recreation and Madison
24	Lorain Ave. and West 25th
29	Cleveland Public Power
33	Monroe Cemetery
35	Scranton Rd. and Kenilworth Ave.

Figure 3.6: Table of nine (9) subsheds analyzed on a site scale

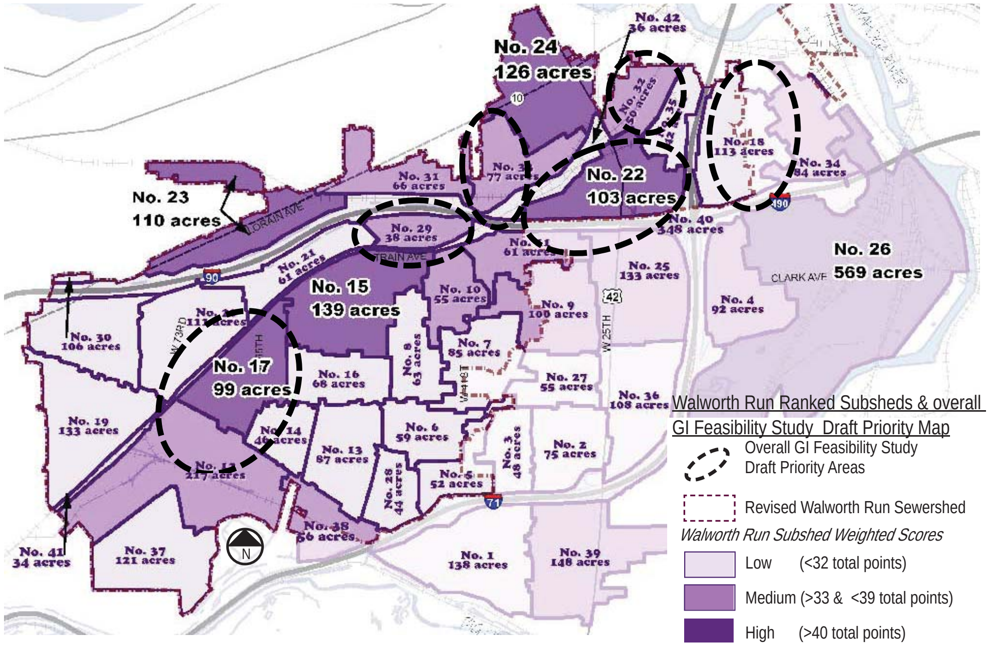

Figure 3.7: Overlay of Walworth Run ranked subsheds with overall GI study draft high scoring areas

CONCEPTUAL PLANS

Site Scale Analysis

Based upon the combination of the Walworth Run subshed rankings and the overall Green Infrastructure (GI) Feasibility Study draft ranking, nine (9) subsheds were selected for site scale analysis - 15,17,18, 22, 23, 24, 29, 33, and 35. Of these nine (9) subsheds, four (4) were directly eliminated from further analysis.

Despite having identified areas of sandy soils, redevelopment opportunities, land availability and impervious area disconnection within the inventory ranking, subshed 23 was not selected due to lack of available land for stormwater control measure (SCM) when analyzed at the site scale. The Michael J. Zone Recreation Center, which occupies a large portion of the subshed and was identified as a potential partnership opportunity, is currently being reconstructed and the new design utilizes all parts of the property, eliminating the potential to incorporate large SCMs. Subsheds 18 and 35 are in the heart of Tremont and were not selected due to the lack of available land. Subshed 33 was not selected due to lack of available space for large stormwater capture and the presence of two cemeteries.

GI can reduce CSO volume by preventing stormwater from entering the combined sewers from impervious surfaces. To simulate the effects of GI and rank the remaining five (5) subsheds for reduction potential, a 50% impervious surface runoff reduction hypothesis was modeled within the existing Westerly Interceptor sewer model for each subshed (Figure 4.1 & Appendix B). These subsheds were further studied on a detailed site scale basis to review their viability to implement SCMs, determine the largest drainage capture area and more accurately estimate their CSO volume reduction potential. Each subshed analysis examined topography, existing manholes/catch basins, the sewer system, property ownership, soils, and field reconnaissance to determine the largest drainage capture area and potential SCM solutions. Furthermore, the team met with the steering committee to review these analyses to determine the preferred SCM for each subshed. Utilizing the most preferred SCM for each subshed and its drainage capture area, CSO volume reductions were calculated (see Appendix B).

Based upon the scope of this project, four (4) sites were developed into conceptual plans. To increase this study's integration into the overall GI Feasibility Study, the top four (4) subsheds were selected that could best achieve that project's goals of reducing CSO volume. Based on the criteria, subshed 22 was not selected to develop into a conceptual plan. Compared to the other subsheds, this area provided the least amount of CSO volume reduction (0.58MG), due to lack of impervious surface capture. When redevelopment does occur in this subshed, SCMs should be incorporated to project plans to retain and infiltrate new impervious surfaces.

Final conceptual site plans were created for the top four (4) sites – 15, 17, 24and 29. These conceptual designs illustrate drainage area capture, conceptual sewer connections, and preferred SCM. The conceptual plans also address the ancillary benefits such as building strong neighborhoods, reduction of heat island effects, spurring redevelopment, providing space for alternative transportation and providing open space amenities where little exists. Site plans include a conceptual rendering to illustrate the potential aesthetics of the SCM, estimated costs for the construction of the SCM, and infrastructure needed to capture and redirect stormwater runoff to the proposed site and SCM. The plans are on the following pages in order of their CSO reduction potential.

Volume Reductions Based upon Potential Capture Area		
Subshed #	Area Name	Estimated CSO Volume Reduction
Subshed 17	Stock yards Area	3.3 MG
Subshed 15	Train Park Area	0.9 MG
Subshed 24	Lorain Ave. and West 25^{th}	0.7 MG
Subshed 29	Cleveland Public Power	0.6 MG
Subshed 22	West 25^{th} and Barber Ave.	0.58 MG

Figure 4.1: Modeling summary

STOCKYARDS AREA - SUBSHED 17

Conceptual Plan

Of all the priority sites, subshed 17 – Stockyards Area, has the greatest ability to reduce CSO overflows. The subshed naturally drains from the high point of Denison Avenue to the low point at the intersection of W. 65th Street and the railroad tracks/Stock Avenue. Over 55 acres of large paved parking lots, roads and roofs can theoretically be captured and stored in a stormwater wetland required to be at least four (4) acres in size and at least three (3) feet in depth. This will require separating stormwater from the combined pipe system at the roadway, and working with large and small property owners within the dark blue areas bound by Denison Avenue, Norfolk and Western Railroad, W. 65th street and the vacant Kmart site shown in figure 4.2 to disconnect downspouts and private directly connected impervious areas from the combined sewer.

During the planning process, this site was identified by the Walworth GI Steering Committee as an area lacking in green space. In neighborhoods with dense urban housing, a properly designed stormwater wetland can become a vital green space with the potential to act as a catalyst for increased property values, economic development, habitat and overall quality of life. Aside from its functional benefits, other features can be incorporated into the space such as a loop trail, gazebo and interpretive signage.

The conceptually designed stormwater wetland has the potential to reduce 3.3 MG of CSO volume per year, roughly a reduction of 43% runoff volume within subshed 17. The design has a conceptual cost range of $1,870,000 to $3,040,000 which includes sewer separation and SCM costs. Modeling and SCM sizing results for this concept, cost estimates and potential funding sources can be found in the Appendices B, C & D respectively.

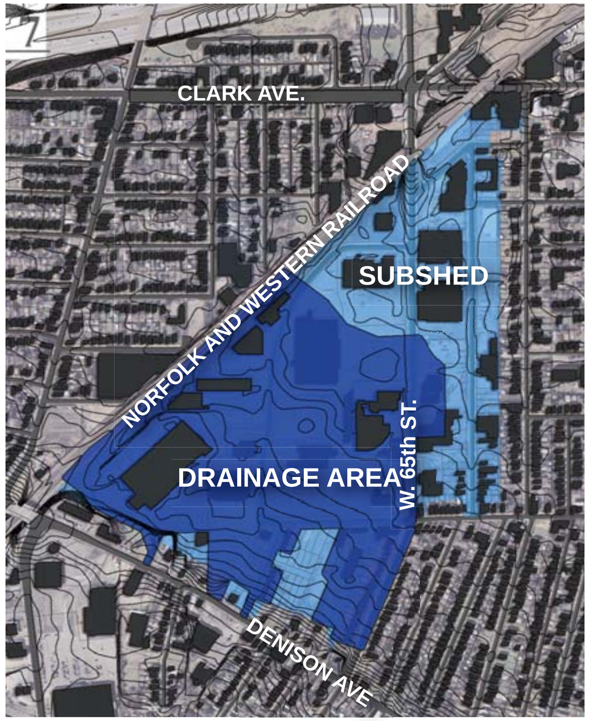

Figure 4.2: Subshed (light blue) and proposed drainage area (dark blue)

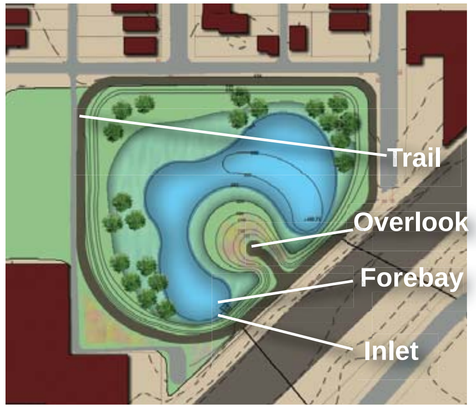

Figure 4.3: Conceptual plan of wetland

Figure 4.4: Conceptual view looking across the stormwater wetlands

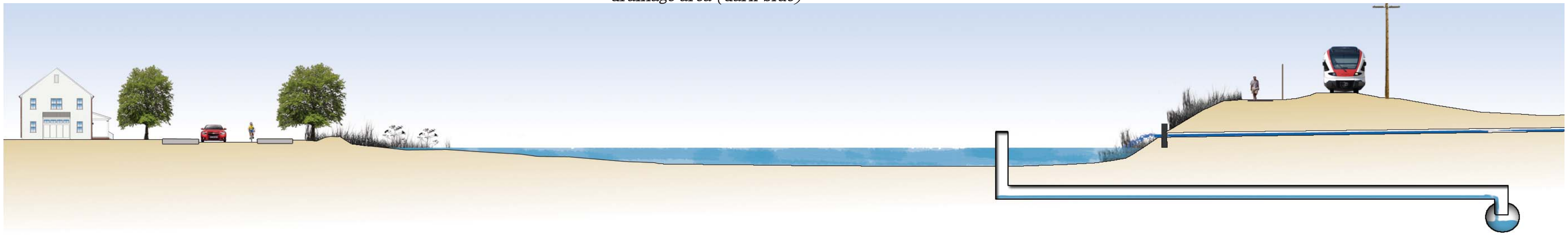

Figure 4.5: Conceptual section looking north though the stormwater wetland

LORAIN AVE. AND WEST 25TH ST. - SUBSHED 24

Conceptual Plan

The Ohio City neighborhood has implemented a successful urban farm that is supplying locally grown food for nearby restaurants. In partnership with this effort, this plan conceptualizes an irrigation pond for use by the farm. The SCM has the ability to remove significant amounts of CSO volume through water use and stormwater separation discharge to the Cuyahoga River, plus provides an economic benefit to the farmers by enabling the use of free stormwater for irrigation rather than utilizing city water.

Over 37 acres of stormwater could be conveyed into a one (1) acre pond through sewer separation along the high point of Lorain Avenue through the West Side Market to the RTA tracks and along W. 25th from Lorain Avenue to Franklin Boulevard, capturing private and public impervious areas on both sides of these streets (shown in dark blue). A concrete forebay will allow for sediment removal and increased quality of irrigation water prior to use. The irrigation pond would include a pump that will distribute water to the crops allowing for evapotranspiration, evaporation and groundwater recharge.

The proposed irrigation pond can reduce CSO volumes by 0.7 MG. A reduction of 27% runoff volume within subshed 24. The design has a conceptual cost range of $1,690,000 to $2,740,000 which includes sewer separation, irrigation pumps & pipes, and overflow connection to the Cuyahoga River. Modeling and SCM sizing results for this concept, cost estimates and potential funding sources can be found in the Appendices B, C & D respectively.

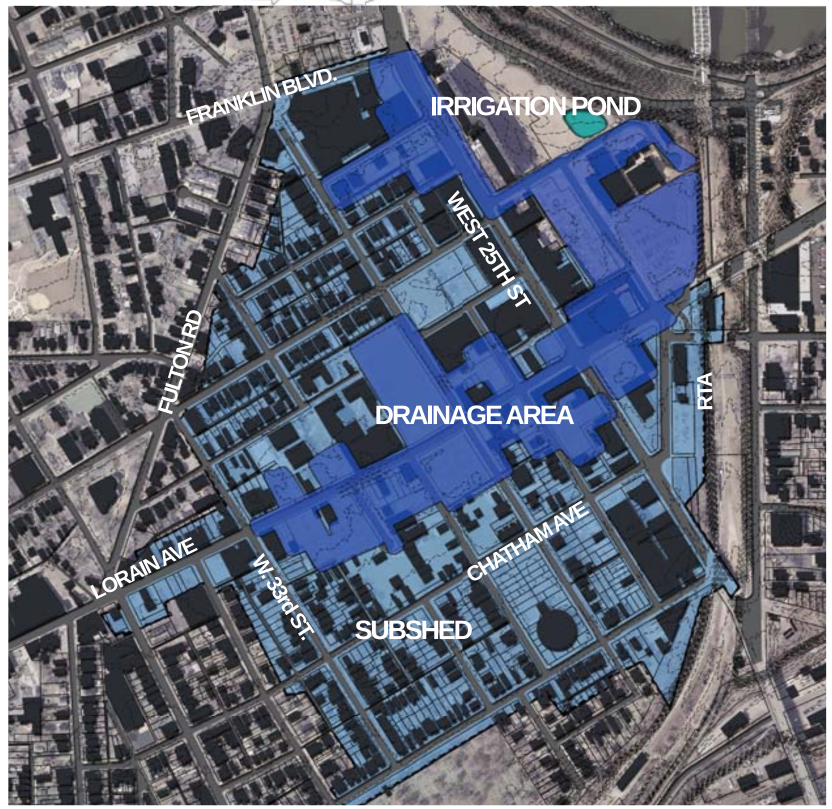

Figure 4.6: Subshed (light blue), proposed drainage area (dark blue) and proposed irrigation pond (green)

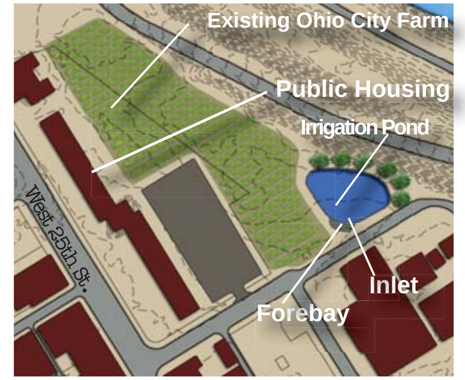

Figure 4.7: Conceptual plan of irrigation pond

Figure 4.8: Conceptual view looking across the proposed irrigation pond

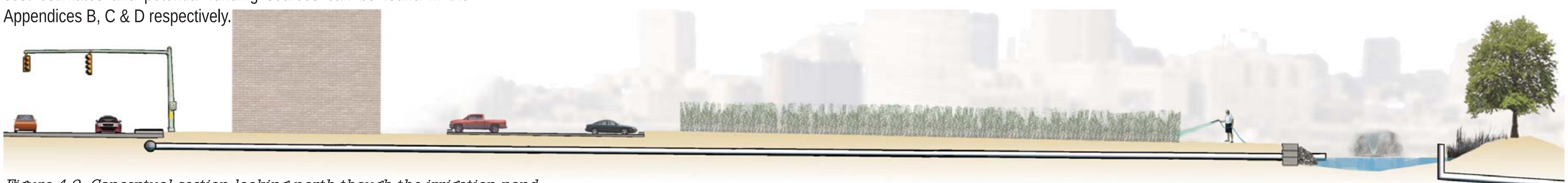

Figure 4.9: Conceptual section looking north though the irrigation pond

TRAIN PARK AREA - SUBSHED 15

Conceptual Plan

The Cleveland epidemic of home foreclosures presents a unique opportunity for reuse of vacant urban lots. Subshed 15 – Train Park Area represents this potential with multiple vacancies along Train Avenue. In this subshed, Clark Avenue represents a topographic division with points north draining towards Train Avenue and south draining flatly east and west making impervious area capture to a single area difficult. Through sewer separation and downspout disconnection, the area north of Clark Avenue from Train Avenue to W. 51st Street is able to capture approximately 24 acres of stormwater (shown in dark blue) within a one (1) acre infiltration basin located on Train Avenue. Soil data identifies sandy soils in this area enabling infiltration SCMs. Additionally, a demonstration site is proposed at the Clark Elementary school where the installation of a bioswale would present an educational partnership opportunity.

This infiltration basin will temporarily hold stormwater allowing the sandy soils and aggregate substrate to slowly infiltrate back into the groundwater table while filtering it for silt and other compounds picked up along the way.

The infiltration basin has the potential to capture 0.9 MG of CSO volume, a reduction of 16% runoff volume within subshed 15. The design has an estimated conceptual cost range of $1,780,000 to $2,900,000 which includes sewer separation, downspout disconnection and SCM installation. Modeling and SCM sizing results for this concept, cost estimates and potential funding sources can be found in the Appendices B, C & D respectively.

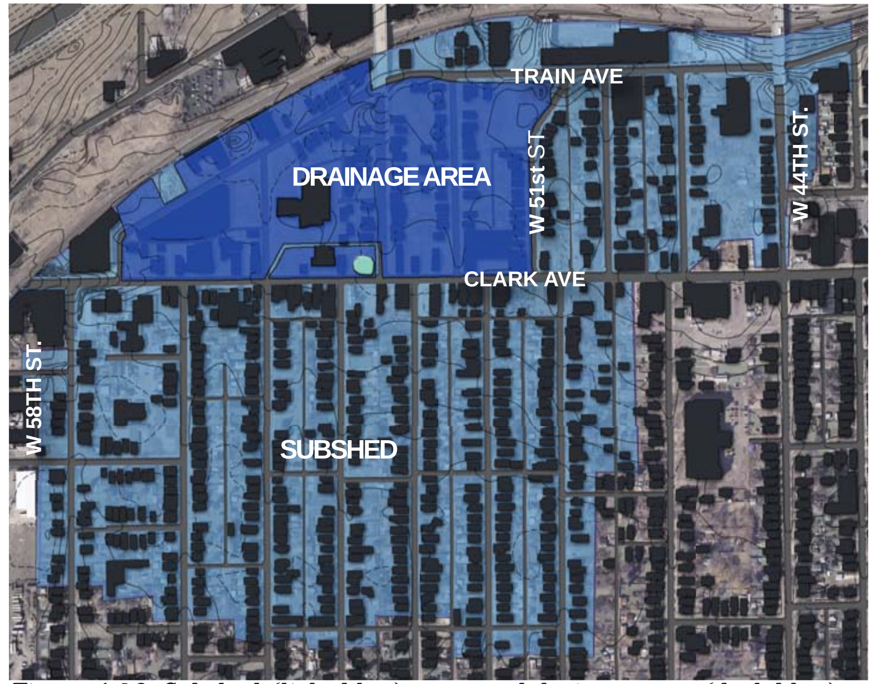

Figure 4.10: Subshed (light blue), proposed drainage area (dark blue) and proposed Clark Elementary bioswale (green)

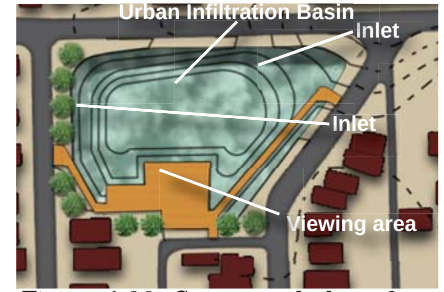

Figure 4.11: Conceptual plan of infiltration basin

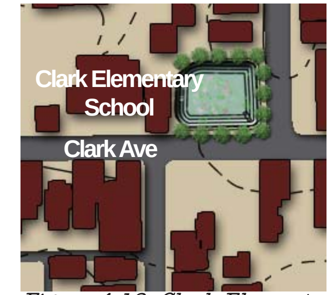

Figure 4.12: Clark Elementary proposed bioswale

Figure 4.13: Conceptual view looking across the infiltration basin

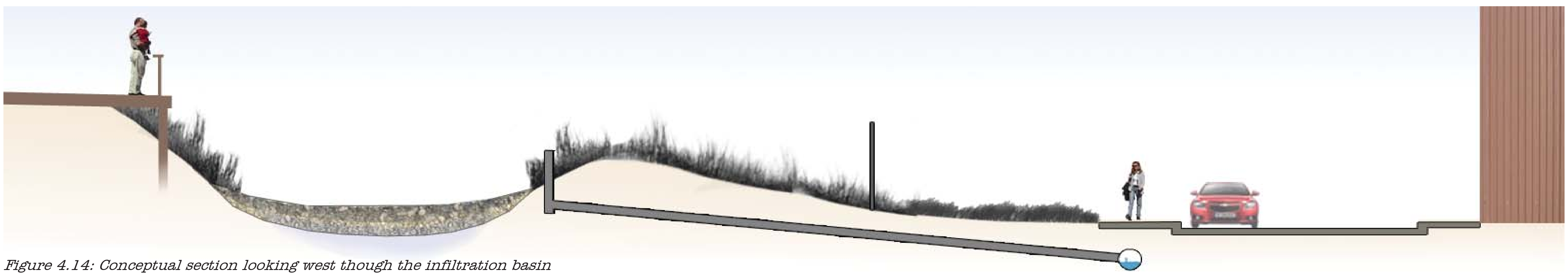

Figure 4.14: Conceptual section looking west though the infiltration basin

CLEVELAND PUBLIC POWER - SUBSHED 29

Conceptual Plan

With the natural borders of I-90 to the north and Norfolk and Western Railroad to the south, this subshed can utilize the low lying valley and the identified sandy soils around the low point at the Cleveland Public Power (CPP) facility. The 3/4 acre infiltration basin has the potential to capture and infiltrate approximately 20 acres of adjacent stormwater runoff through a sewer separation and surface flow capture bound by Junction Road, W. 47th Street, I-90, and Norfolk and Western Railroad (shown in dark blue). Other areas of the subshed drain away from this low point making stormwater capture difficult and costly.

Placing the basin on the CPP property could provide an opportunity for partnership with the City of Cleveland. An infiltration basin offers a low maintenance, economically efficient SCM option while enabling the capture of significant amounts of stormwater.

The infiltration basin has the potential to capture 0.6 MG of CSO volume, a reduction of 47% runoff volume within subshed 29. The design has an estimated conceptual cost range of $490,000 to $790,000 which includes sewer separation and SCM. Modeling and SCM sizing results for this concept, conceptual cost estimates and potential funding sources can be found in the Appendices B, C & D respectively.

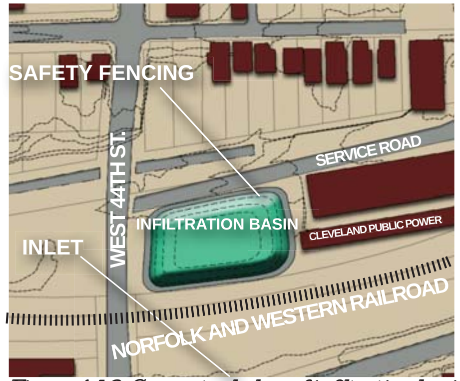

Figure 4.16: Conceptual plan of infiltration basin

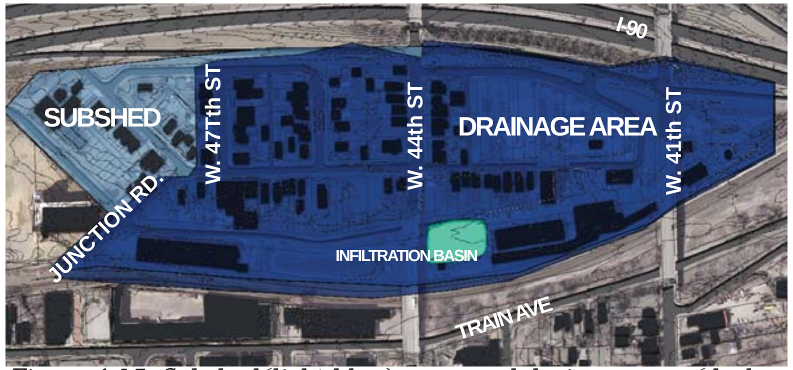

Figure 4.15: Subshed(light blue), proposed drainage area (dark blue) and proposed infiltration basin (green)

Figure 4.17: Conceptual view of infiltration basin

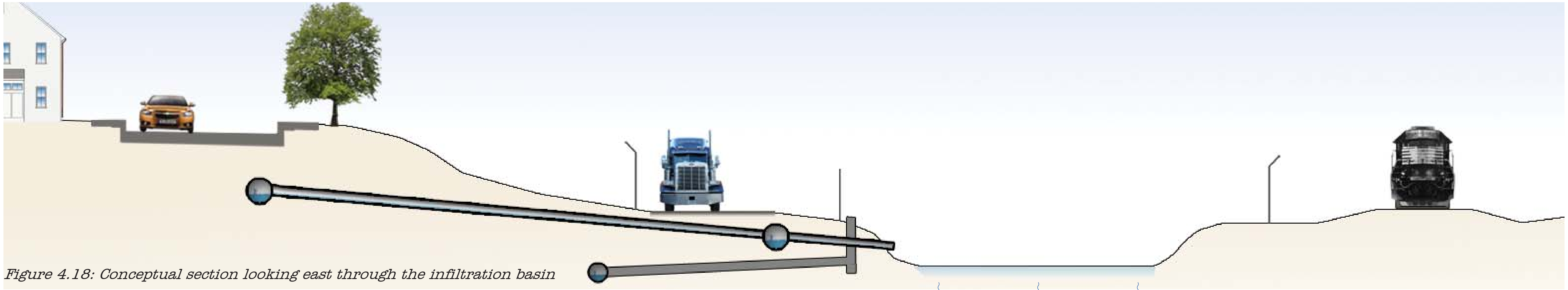

Figure 4.18: Conceptual section looking east through the infiltration basin

Stormwater Control Measure Matrix

Stormwater control measures (SCMs) were categorized for this study into three categories based upon how they best fit the goals of the project.

Within eight years the District must spend at least $42 million towards Green Infrastructure (GI) practices that will reduce 44 million gallons of CSO volume. Additionally, the goals of this project states the GI should function as a neighborhood enhancement and try to integrate with redevelopment opportunities.

The table to the right lists common SCMs considered for this study. The SCMs were analyzed for how they best fit the primary study goals and what additional benefits they provide. These SCMs were then broken into three categories based upon those criteria:

- District Lead - Type of SCM where the District would control, or be heavily involved in, the design, construction, operation and maintenance. District Lead SCMs must specifically meet District consent decree requirements.
- Partnership - Type of SCM the District can partner with other entities to capture significant amounts of stormwater.
- Support - Type of SCM the District would support through some financial support or technical guidance, but that capture small amounts of stormwater when compared to other projects under the GI program.

The following pages illustrate examples of District Lead and Partnership SCM's.

		Primary Goals			Additional Benefits				
	SCM	Stormwater Control Goals	Operation + Maintenance	Ownership/ Control	open space	recre-ation	environ-mental educa-tion	carbon sequestra-tion/ air quality	economic growth
District Lead	Reforestation	High	High	High	High	High	High	High	Low
	Stormwater Wetlands	High	High	High	High	High	High	Medium	High
	Wet Ponds	High	High	High	High	High	Medium	Low	High
	Dry Detention Basins	High	High	High	High	High	Medium	Low	Medium
	Infiltration Basins	High	High	High	High	Medium	Medium	Low	Medium
	Irrigation Ponds	High	Medium	High	High	High	Medium	Low	High
Partnership	Bio Retention Basins	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Pervious Pavements	Medium	Medium	Medium	Low	Medium	Medium	Low	High
	Green Streets	Medium	Low	Medium	Low	Medium	Medium	Medium	High
	Green Parking Lots	Medium	Low	Medium	Medium	Low	Medium	Medium	High
	Bioswales	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium
	Green Roofs	Medium	Low	Medium	Medium	Low	Low	Medium	Medium
Support	Raingardens	Low	Low	Low	Medium	Low	Medium	Medium	Medium
	Infiltration Planters	Low	Low	Low	Medium	Low	Medium	Medium	Low
	Cisterns	Low	Low	Low	Low	Low	Medium	Low	Medium
	Rain Barrels	Low	Low	Low	Low	Low	Medium	Low	Low
	Vegetated Swales	Low	Low	Low	Medium	Low	Low	Low	Low

High Medium Low

District Lead SCMs

Reforestation

Mature reforested area

Existing large empty parking lot that could be reforested

Reforestation is a process that involves the transformation of a large impervious area into a pervious area by reestablishing a forest habitat. Reforestation decreases the amount of stormwater runoff, and increasea habitat in the urban environment. With the reestablishment of naturally forested areas, a contiguous path of habitat can be recreated for migrating birds.

Reforested areas decrease runoff, improve air quality, create open space, reduce heat island effect, provide habitat, perform carbon sequestration and prevent soil erosion. As a stormwater control measure, reforestation is low-maintenance and has low operational costs.

Reforested area 3 years after planting large trees

District Lead SCMs

Stormwater Wetlands


Stormwater wetland in a suburban setting (Mayfield Villiage, Ohio)


Stormwater wetland in an urban setting


Stormwater wetland in a park setting


Stormwater wetland in an urban setting

Stormwater wetlands can be a cost effective way to capture and treat stormwater runoff. Wetlands improve stormwater quality through biological uptake and settling. During heavy rain events in the spring and fall, there can be standing water and over extended periods of dry weather a stormwater wetland can become dry. These areas are designed with plants and soils that are suited to wet and dry times. Stormwater wetlands control both stormwater quantity and quality over extended periods of time.

These habitats can offer unique educational opportunities for schools and park educational programs as they become refuges for many species not often found in the urban environment. In an urban setting, stormwater wetlands can be incorporated into park space and provide recreational opportunities with trails built upon their retaining structures (berms).

Wet Ponds

Small wet pond in a park

Wet ponds are stormwater control structures providing both retention and treatment of stormwater runoff. The pond consists of a permanent pool of deep water where runoff from each rain event is detained and slowly released from the outlet structure at pre-development flow rates. Wet ponds control both stormwater quantity and quality over extended periods of time. Prior to the water entering the pond, sedimentation removal is handled in a forebay. A forebay is a structure that allows the removal of particulates and heavy pollutants before they reach the pond. These sediments are regularly removed from the forebay allowing the pond depth and storage capacity to remain stable. In general, a higher level of nutrient removal and better stormwater quantity control can be achieved in wet detention ponds than can be achieved with other GI practices. Shallow ledges can be used to establish aquatic plants and provide additional habitat along the pond's edge.

Small wet pond in a park with overflow structure

A series of wet ponds can be linked together to proved for maximum storage such as this urban wet pond

District Lead SCMs

Dry Detention Basin

Small dry detention basin

Large dry detention basin with decorative plantings

Small dry detention basin alongside a roadway

Dry detention basins are an impoundment or excavated basin for short term detention of stormwater runoff from an impervious area, with a controlled slow release from the outlet structure at pre-development flow rates. These structures are engineered to detain the water, not to provide permanent storage. Dry detention basins can be mowed and utilized for open areas because of the limited amount of time when it will hold water. Once vegetation has been established, maintenance is minimal. The aesthetic value of a basin can be enhanced and be ascetically interesting through increased plantings.

Infiltration Basins

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater into the soil. The gravel media and sediment collectors allow for filtration of the stormwater prior to entering into the ground water system. Infiltration basins have a high pollutant removal efficiency and can recharge groundwater sources. To be effective, this measure should only be installed in an area with sandy sub soils. Additionally, regular maintenance is critical to the success of this SCM. To assist with maintenance, a forebay should be included in the design and construction to reduce clogging due to sediment.

Small infiltration basin with sediment collector pit and vegetation

These small basins are linked to collect water from the adjoining road

Urban infiltration basin with sediment trap

Irrigation Ponds

An irrigation pond is an impoundment designed to retain stormwater to be used to irrigate fields or gardens between rain events. Similar to a wet pond, runoff is detained in a permanent pool with the ability to pump water for surrounding heavy irrigation areas such as golf courses, sports fields, farming, and urban parks. Reusing stormwater for irrigation allows the water to infiltrate into the ground, be absorbed by vegetation. This SCM has the ability to reduce large amounts of stormwater from the combined sewer system.

Irrigation ponds are often used in agriculture and farming

Irrigation ponds are typically used in golf courses and other sports requiring large amounts of mown lawn

Large irrigation ponds can also function as a neighborhood amenity and recreation

Partnership SCM's

Porous Paving

Permeable concrete pavers used in parking stalls

Permeable concrete used as a sidewalk

Porous paving allows stormwater to filter through a drivable or walkable surface and be either infiltrated into existing ground or piped slowly back to the existing sewer system. In addition to the runoff benefits, porous pavement reduces the amount of roadway salt required in the winter and has lower heat retention during the summer - reducing the heat island effect. Porous pavements can be used to replace existing impervious surfaces and is ADA accessible.

Bioretention Ponds

Biorention pond collecting stormwater from the parking lot

Biorention pond collecting stormwater from the street

Bioretention ponds provide for greater storage capacity than a bioswale and can be more readily integrated into existing development than wetlands or detention ponds due to their smaller footprint. Surface runoff is directed into these medium sized depressions and allowed to pond. The water gradually infiltrates through a prepared soil substrate where the filtered runoff then is collected in a perforated underdrain and slowly returned to the storm system.

Partnership SCM's

Green Streets

Bioswale bumpouts and pervious paver parking stalls (Ohiopyle, PA)

Pervious paver on street parking stalls

Green streets utilize the area of a street's right of way to collect and convey stormwater through linked SCM features. Some examples include landscape bumpouts, bioswales, pervious pavements, parking stalls, and/or permeable pavement bike lanes. These measures often provide more economic benefits than a typical streetscape project and can reduce the cost of grey infrastructure used on the street.

Green Parking Lots

Pervious concrete parking stalls (Louisville, KY)

Bioswale with pervious paver handicap aisle (Cleveland, OH)

GI can be utilized to turn existing impervious surface parking lots into green parking lots through the use of linked SCMs, similar to green streets. By incorporating these green features, a parking lot can capture and filter stormwater runoff, reduce urban heat island effect and provide carbon sequestration with the planting of trees.

Partnership SCM's

Green Roof

Large green roof used as a plaza

Tray green roof installed by volunteers (Cleveland, OH)

Green roofs are mainly flat roof areas of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. Green roofs absorb rainwater, provide insulation, create a habitat for wildlife, help to lower urban air temperatures and combat the heat island effect. Green roofs can be depths from 4" thick to 6' thick. These roofs often increase the insulation factor and life span of a roof.

Bioswales

Bioswale collecting roadway stormwater

Bioswale collecting parking lot stormwater

Bioswales intercept runoff from impervious surfaces to slow and filter stormwater through engineered soil substrate and selected plant material. The stormwater is generally retained for 24 to 48 hours and only for a 6" - 9" ponding depth. They can be implemented into existing impervious surfaces such as parking lots where automobile pollutants can be collected and filtered through the soil substrate then slowly released to the sewer system.

Appendix B: Model Results

As discussed in Section 4: Conceptual Plans, the priority subsheds were modeled hydraulically to determine their ability to reduce CSO volume discharge and test the sewer system reactivity to green infrastructure (GI) implementation. The existing Westerly Interceptor system model (Info Works 10.5) includes a hydrology and hydraulic component. The hydrology models are developed to simulate runoff hydrograph generation based upon characteristics such as imperviousness and time of concentration. The hydraulic model is developed to route the hydrograph inputs from the system hydrology models. The routing utilizes storage volumes (pipes and tunnels) and system conveyance during storm events and computes system outflow discharges including CSO.

GI can reduce CSO volume by preventing stormwater from entering the combined sewers from impervious surfaces. To simulate the effects of GI and simplify the modeling, imperviousness quantities within the model were reduced by 50% in each priority subshed to quantify impacts on generated stormwater runoff and CSO discharge. Table B-1 (50% Imperviousness Reduction Simulation Results (InfoWorks)) indicates the total catchment area, runoff volumes and corresponding CSO reduction based upon the 50% imperviousness reduction. Values shown in this table are estimated based upon modeling runs performed with a uniform 50% imperviousness reduction for each subshed.

These subsheds were further studied on a detailed site scale basis to review their viability to implement stormwater control measures (SCM), determine the largest drainage capture area and more accurately estimate their CSO volume reduction potential. Each subshed analysis examined topography, existing manholes/catch basins, the sewer system, property ownership, soils, and field reconnaissance to determine the largest drainage capture area and potential SCM solutions. Furthermore, the team met with the steering committee to review these analyses to determine the preferred SCM for each subshed.

Selecting the most preferred SCM for each subshed and its drainage capture area, CSO volume reductions were calculated by correlating the imperviousness reduction hypothesis with the conceptual plan percentage of total captured area. Table B-1 (Conceptual Plan CSO Reduction Estimates) indicates the largest drainage capture area, estimated CSO reduction volume, and estimated basin storage.

The estimated basin storage capacity for each subshed was calculated using the industry standard "Urban Hydrology for Small Watersheds" TR-55 Manual. The TR-55 manual outlines simplified procedures to calculate storm runoff volume, peak runoff rate, hydrographs and storage volumes required for storm water storage. Prior to the completion of the overall Green Infrastructure Feasibility Study, the final concept plans will be fully modeled to determine the final CSO volume reductions.

Table B-1 –Modeling Results

50% Imperviousness Reduction Simulation Results (InfoWorks)					Conceptual Plan CSO Reduction Estimates			
Priority Subshed	Total Area (Acres)	Runoff Volume (MG) [Existing Conditions]	50% Imperviousness Reduction Runoff Volume (MG)	CSO Volume (MG) with 50% Imperviousness Reduction	Drainage Capture Area (Acres)	Percentage of Total Area Captured	Estimated CSO Volume Reduction (MG)	Estimated Basin Storage (Ac-Ft)
Subshed 15	139.20	5.12	2.56	2.56	23.90	17%	0.9	2.8
Subshed 17	99.44	5.85	2.93	2.92	55.80	56%	3.3	10.1
Subshed 24	125.73	2.35	1.18	1.18	37.11	30%	0.7	2.1
Subshed 29	21.25	0.62*	0.31*	0.31*	20.00	94%	0.6	1.8
Subshed 22	110.00	3.54	1.77	1.77	35.00	32%	1.1	3.4
Subshed 23	110.00	2.63	1.32	1.32	27.50	25%	0.7	2.1

* Estimated Based upon Drainage Area



Appendix C: Conceptual Costs

For each of the four conceptual plans, conceptual estimates were developed utilizing the Association for the Advancement of Cost Engineering (AACE) International Cost Estimate Classification System, Class 4 for Concept Study purposes. These costs will assist the District and partners with implementation options including phasing potential, coordination with other capital improvements and grant funding. Cost include the recommended SCM measure and materials necessary to direct stormwater to the SCM location. Additionally, estimates for proposed enhancements are included in each estimate.

Subshed 15: Train Park Area

5/24/2011

NEORSD Green Infrastructure

TABLE C.1 - Subshed 15 Train Park Area

Opinion of Probable Construction Costs

Currency: USD-United States-Q1 2011 Dollars

Item	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments
					Grand Total Price:	$ 2,900,000	
		Site Preparation/Demolition				$ 69,100	
1	P	Site Access/Staging	1	LS	$1,600.00	$ 1,600	General Site Prep
3	P	Demo	1	LS	$52,500.00	$ 52,500	General Site Demo including clearing
4	P	Erosion Control	1	LS	$15,000.00	$ 15,000	SW3P standard items
		SCM Construction				$ 487,500	
1	p	Excavation & Haul off	19,000	CY	$25.00	$ 475,000	Includes excavation and excess haul off
2	P	Topsoil	900	CY	$10.00	$ 9,000	assumes 6" of topsoil
3	P	Outlet Weir Structure	1	EA	$3,500.00	$ 3,500	4x4 outlet structure
4	P	Fencing	1,000	LF	$38.00	$ 38,000	Ornamental Fencing
5	P	Decidious Tree	3	EA	$250.00	$ 750	
6	P	Ornamental Tree	6	EA	$160.00	$ 960	
7	P	Evergreen Tree	5	EA	$200.00	$ 1,000	
8	P	Lawn Seed	8,000	SY	$1.00	$ 8,000	
		Sewer Separation Construction				$ 869,600	
1	P	Storm Sewers	5,000	LF	$85.00	$ 425,000	Assmed 30" and under RCP
2	P	Catch Basin, with Sump	25	EA	$2,500.00	$ 62,500	2x3 Cleveland Catch Basins
3	P	Downspout Disconnection	68	EA	$350.00	$ 23,800	Per home
4	P	Asphalt Repair (includes stone)	32,640	SF	$10.00	$ 326,400	Includes full depth repair
5	P	Concrete Sidewalk Repair	3,600	SF	$4.00	$ 14,400	4" concrete walk per 608
6	P	Concrete Curbing & Repair	300	LF	$25.00	$ 7,500	Concrete repair
7	P	Private Storm Sewers	1	LS	$10,000.00	$ 10,000	Tying in private sewer connections
		Enhancement Project				$ 393,284	
1	P	Plaza Space	12,595	SF	$6.00	$ 75,570	Plaza Area
2	P	Playground	1	LS	$2,500.00	$ 2,500	Equipemnt & Install
3	P	trash container	2.0	EA	$900.00	$ 1,800	
4	P	bench	3	EA	$1,500.00	$ 4,500	Standard Bneches
5	P	Interpretation sign	2	EA	$800.00	$ 1,600	
6	P	Elementary Bioswale	1	LS	$307,314.00	$ 307,314	Complete Demonstration Project
					Running Subtotal:	$ 1,819,480	
		Mobilization/Field Oversight Expenses				$ 90,974	
1	P	Contractor General Conditions (Prime)	1	LS	5%	$ 90,974	
		Parametric Contingency				$ 181,948	
1	P	Unlisted Items Allowance	1	LS	10%	$ 181,948	
					Running Subtotal:	$ 2,092,402	
		Markups				$ 133,391	
1	S	Subcontractor Markups	1	LS	0.0%	$ -	H/O Overheads, Job Fee & Risk (Included above)
2	P	Prime Contractor OH&P on Subs	1	LS	0.0%	$ -	ditto
3	P	Prime Contractor OH&P on Self-Perform	1	LS	0.0%	$ -	ditto
4	P	Contractor Insurance and Bonds	1	LS	2.5%	$ 52,310	Perform./Payments Bonds, Genl Liablty, & Bldr's Risk
5	P	State Sales Taxes	1	LS	7.75%	$ 81,081	Assume 50% of Running Total
6	P	Escalation	1	LS	0.0%	$ -	Excluded, pricing basis = Q1 2011
					Running Subtotal:	$ 2,230,000	Total Estimated Constr Costs w/o contingency
			MU Factor:	1.066			
		Project Administration & Management				$ 670,000	
1	--	Construction Oversight & Mgt	1	LS	0%	$ -	Excluded
2	--	Engineering	1	LS	0%	$ -	Excluded
3	--	Misc Owner's Soft Costs (All)	1	LS	0%	$ -	Excluded
4	--	Scope Contingency/Market Conditions	1	LS	30%	$ 670,000	Design definition/estimating/market allowance
5	--	Interest During Construction	1	LS	0%	$ -	Financing costs excluded
6	--	Owner's Construction Contingency/Mgt Reserve	1	LS	0%	$ -	Excluded, allowance for changed field conditions
			MU Factor:	1.5939			
					Grand Total:	$ 2,900,000	Total Estimated Constr Costs w/ Contingency
					Cost Range: $ 1,780,000	$ 2,900,000	Per AACE cost estimate guidelines

Notes:

1) This OPCC is classified as a Class 4 cost estimate per AACE guidelines. Stated accuracy range = -20% to + 30%.
2) Pricing basis = 3rd Qtr 2010, escalation to midpoint of construction is not included.
3) P=Prime, S=Subcontractor
4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Owner soft costs and project management expenses excluded.
6) Capital spare parts not included.
7) Land Acquisition Costs Not Included

OPCC Disclaimer

The client hereby acknowledges that URS has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that URS cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from URS's good faith Class 4 OPCC

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5/24/2011

NEORSD Green Infrastructure

TABLE C.2 - Subshed 17

Opinion of Probable Construction Costs

Currency: USD-United States-Q1 2011 Dollars

Item	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments
					Grand Total Price:	$ 3,040,000	
		Site Preparation/Demolition				$ 100,000	
1	P	Site Access/Staging	1	LS	$25,000.00	$ 25,000	Includes Filed Trailor
2	P	Clearing and Grubbing	1	LS	$5,000.00	$ 5,000	Tree Removal
3	P	Demo	1	LS	$40,000.00	$ 40,000	General Site Demo/House removal
4	P	Erosion Control	1	LS	$30,000.00	$ 30,000	SW3P standard items
		SCM Construction				$ 628,500	
1	p	Excavation & Haul off	30,000	CY	$20.00	$ 600,000	Includes excavation and excess haul off
2	P	Topsoil	2,500	CY	$10.00	$ 25,000	assumes 6" of topsoil
3	P	Outlet Weir Structure	1	EA	$3,500.00	$ 3,500	4x4 outlet structure
4	P	Soil test	10	EA	$50.00	$ 500	Standard Soil Tests
5	P	Trees	21	EA	$200.00	$ 4,200	
6	P	Habitat Seed	4,000	SY	$2.00	$ 8,000	
7	P	Lawn Seed	3,800	SY	$1.00	$ 3,800	
8	P	Whip Plantings	1,500	EA	$3.00	$ 4,500	
		Sewer Separation Construction				$ 1,104,900	
1	P	Storm Sewers	5,500	LF	$85.00	$ 467,500	Assmed 30" and under RCP
2	P	Bore & Jack Storm Sewer	240	EA	$400.00	$ 96,000	Not including Permits
3	P	Catch Basin, with Sump	31	EA	$2,500.00	$ 77,500	2x3 Cleveland Catch Basins
4	P	Manhole	17	EA	$3,500.00	$ 59,500	Standard Precast MH-1
5	P	Downspout Disconnection	30	EA	$350.00	$ 10,500	Per home
6	P	Asphalt Repair (includes stone)	33,440	SF	$10.00	$ 334,400	Includes full depth repair
7	P	Concrete Sidewalk Repair	5,500	SF	$4.00	$ 22,000	4" concrete walk per 608 & HC Ramps
8	P	Concrete Curbing & Repair	500	LF	$25.00	$ 12,500	Concrete repair
9	P	Private Storm Sewers	1	LS	$25,000.00	$ 25,000	Tying in private sewer connections
		Enhancement Project				$ 82,050	
1	P	Asphalt Trail (includes stone)	1,650	SY	$15.00	$ 24,750	Light Duty Trail
2	P	Light Poles	9	EA	$4,500.00	$ 40,500	Includes power source to site
3	P	bollards	9.0	EA	$500.00	$ 4,500	Includes power source to site
4	P	bench	5	EA	$1,500.00	$ 7,500	Standard Benches
5	P	trash container	3	EA	$800.00	$ 2,400	
6	P	interpretation sign	3	EA	$800.00	$ 2,400	
					Running Subtotal:	$ 1,915,450	
		Mobilization/Field Oversight Expenses				$ 95,773	
1	P	Contractor General Conditions (Prime)	1	LS	5%	$ 95,773	
		Parametric Contingency				$ 191,545	
1	P	Unlisted Items Allowance	1	LS	10%	$ 191,545	
					Running Subtotal:	$ 2,202,768	
		Markups				$ 140,426	
1	S	Subcontractor Markups	1	LS	0.0%	$ -	H/O Overheads, Job Fee & Risk (Included above)
2	P	Prime Contractor OH&P on Subs	1	LS	0.0%	$ -	ditto
3	P	Prime Contractor OH&P on Self-Perform	1	LS	0.0%	$ -	ditto
4	P	Contractor Insurance and Bonds	1	LS	2.5%	$ 55,069	Perform./Payments Bonds, Genl Liablty, & Bldr's Risk
5	P	State Sales Taxes	1	LS	7.75%	$ 85,357	Assume 50% of Running Total
6	P	Escalation	1	LS	0.0%	$ -	Excluded, pricing basis = Q1 2011
					Running Subtotal:	$ 2,340,000	Total Estimated Constr Costs w/o contingency
			MU Factor:	1.062			
		Project Administration & Management				$ 700,000	
1	--	Construction Oversight & Mgt	1	LS	0%	$ -	Excluded
2	--	Engineering	1	LS	0%	$ -	Excluded
3	--	Misc Owner's Soft Costs (All)	1	LS	0%	$ -	Excluded
4	--	Scope Contingency/Market Conditions	1	LS	30%	$ 700,000	Design definition/estimating/market allowance
5	--	Interest During Construction	1	LS	0%	$ -	Financing costs excluded
6	--	Owner's Construction Contingency/Mgt Reserve	1	LS	0%	$ -	Excluded, allowance for changed field conditions
			MU Factor:	1.5871			
					Grand Total:	$ 3,040,000	Total Estimated Constr Costs w/ Contingency
				Cost Range:	$ 1,870,000	$ 3,040,000	Per AACE cost estimate guidelines

Notes:

1) This OPCC is classified as a Class 4 cost estimate per AACE guidelines. Stated accuracy range = -20% to + 30%.
2) Pricing basis = 3rd Qtr 2010, escalation to midpoint of construction is not included.
3) P=Prime, S=Subcontractor
4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Owner soft costs and project management expenses excluded.
6) Capital spare parts not included.
7) Land Acquisition Costs Not Included

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Subshed 24: Lorain Avenue & W. 25th Avenue

5/24/2011

NEORSD Green Infrastructure

TABLE C.3 - Subshed 24

Opinion of Probable Construction Costs

Currency: USD-United States-Q1 2011 Dollars

Item	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments
					Grand Total Price:	$ 2,740,000	
		Site Preparation/Demolition				$ 16,500	
1	P	Site Access/Staging	1	LS	$5,000.00	$ 5,000	Includes Filed Trailor
2	P	Clearing and Grubbing	1	LS	$1,500.00	$ 1,500	Tree Removal
3	P	Erosion Control	1	LS	$10,000.00	$ 10,000	SW3P standard items
		SCM Construction				$ 97,000	
1	p	Excavation & Haul off	3,700	CY	$25.00	$ 92,500	Includes excavation and excess haul off
2	P	Topsoil	100	CY	$10.00	$ 1,000	assumes 6" of topsoil
3	P	Outlet Weir Structure	1	EA	$3,500.00	$ 3,500	4x4 outlet structure
4	P	Fencing	600	LF	$35.00	$ 21,000	Ornamental Fencing
5	P	Irrigation Pump	1	EA	$28,000.00	$ 28,000	Does not include irrigation system
6	P	Impermeable pond liner - 45 mil	43,560	SF	$1.50	$ 65,340	
7	P	Irrigation Pond Wall	1,000	SSF	$35.00	$ 35,000	
8	P	Lawn Seed	1,000	SY	$1.00	$ 1,000	
		Sewer Separation Construction				$ 1,599,500	
1	P	Storm Sewers	7,400	LF	$85.00	$ 629,000	Assmed 30" and under RCP
2	P	Storm Sewer Outlet	2,000	LF	$85.00	$ 170,000	Outlet to Cuy River
3	P	Catch Basin, with Sump	39	EA	$2,500.00	$ 97,500	2x3 Cleveland Catch Basins
4	P	Manhole	20	EA	$3,500.00	$ 70,000	Standard Precast MH-1
5	P	Downspout Disconnection	10	EA	$350.00	$ 3,500	Per home
6	P	Asphalt Repair (includes stone)	57,000	SF	$10.00	$ 570,000	Includes full depth repair
7	P	Concrete Sidewalk Repair	5,500	SF	$4.00	$ 22,000	4" concrete walk per 608 & HC Ramps
8	P	Concrete Curbing & Repair	500	LF	$25.00	$ 12,500	Concrete repair
9	P	Private Storm Sewers	1	LS	$25,000.00	$ 25,000	Tying in private sewer connections
		Enhancement Project				$ 8,000	
1	P	interpretation sign	1	EA	$8,000.00	$ 8,000	
					Running Subtotal:	$ 1,721,000	
		Mobilization/Field Oversight Expenses				$ 86,050	
1	P	Contractor General Conditions (Prime)	1	LS	5%	$ 86,050	
		Parametric Contingency				$ 172,100	
1	P	Unlisted Items Allowance	1	LS	10%	$ 172,100	
					Running Subtotal:	$ 1,979,150	
		Markups				$ 126,171	
1	S	Subcontractor Markups	1	LS	0.0%	$ -	H/O Overheads, Job Fee & Risk (Included above)
2	P	Prime Contractor OH&P on Subs	1	LS	0.0%	$ -	ditto
3	P	Prime Contractor OH&P on Self-Perform	1	LS	0.0%	$ -	ditto
4	P	Contractor Insurance and Bonds	1	LS	2.5%	$ 49,479	Perform./Payments Bonds, Genl Liablty, & Bldr's Risk
5	P	State Sales Taxes	1	LS	7.75%	$ 76,692	Assume 50% of Running Total
6	P	Escalation	1	LS	0.0%	$ -	Excluded, pricing basis = Q1 2011
					Running Subtotal:	$ 2,110,000	Total Estimated Constr Costs w/o contingency
			MU Factor:	1.066			
		Project Administration & Management				$ 630,000	
1	--	Construction Oversight & Mgt	1	LS	0%	$ -	Excluded
2	--	Engineering	1	LS	0%	$ -	Excluded
3	--	Misc Owner's Soft Costs (All)	1	LS	0%	$ -	Excluded
4	--	Scope Contingency/Market Conditions	1	LS	30%	$ 630,000	Design definition/estimating/market allowance
5	--	Interest During Construction	1	LS	0%	$ -	Financing costs excluded
6	--	Owner's Construction Contingency/Mgt Reserve	1	LS	0%	$ -	Excluded, allowance for changed field conditions
			MU Factor:	1.5921			
					Grand Total:	$ 2,740,000	Total Estimated Constr Costs w/ Contingency
				Cost Range:	$ 1,690,000	$ 2,740,000	Per AACE cost estimate guidelines

Notes:

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2) Pricing basis = 3rd Qtr 2010, escalation to midpoint of construction is not included.
3) P=Prime, S=Subcontractor
4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Owner soft costs and project management expenses excluded.
6) Capital spare parts not included.
7) Land Acquisition Costs Not Included

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Subshed 29: Cleveland Public Power

5/24/2011

NEORSD Green Infrastructure

TABLE C.4 - Subshed 29

Opinion of Probable Construction Costs

Currency: USD-United States-Q1 2011 Dollars

Item	GC	Description	Quantity	UOM	Unit Price	Total Price	Comments
					Grand Total Price:	$ 790,000	
		Site Preparation/Demolition				$ 20,800	
1	P	Site Access/Staging	1	LS	$5,000.00	$ 5,000	Includes Filed Trailor
2	P	Clearing and Grubbing	1	LS	$800.00	$ 800	Tree Removal
3	P	Erosion Control	1	LS	$15,000.00	$ 15,000	SW3P standard items
		SCM Construction				$ 97,460	
1	p	Excavation & Embankment	6,000	CY	$15.00	$ 90,000	Includes excavation and site mounding
2	P	Topsoil	396	CY	$10.00	$ 3,960	assumes 6" of topsoil
3	P	Outlet Weir Structure	1	EA	$3,500.00	$ 3,500	4x4 outlet structure
4	P	Fencing	700	LF	$35.00	$ 24,500	Ornamental Fencing
5	P	Infiltration basin substrate	1,000	SY	$60.00	$ 60,000	Does not include irrigation system
6	P	Lawn Seed	3,565	SY	$1.00	$ 3,565	
		Sewer Separation Construction				$ 371,700	
1	P	Storm Sewers	3,157	LF	$40.00	$ 126,280	Assmed 18" and under RCP
3	P	Catch Basin, with Sump	10	EA	$2,500.00	$ 25,000	2x3 Cleveland Catch Basins
4	P	Manhole	2	EA	$3,500.00	$ 7,000	Standard Precast MH-1
5	P	Downspout Disconnection	40	EA	$350.00	$ 14,000	Per home
6	P	Asphalt Repair (includes stone)	18,942	SF	$10.00	$ 189,420	Includes full depth repair
7	P	Private Storm Sewers	1	LS	$10,000.00	$ 10,000	Tying in private sewer connections
		Enhancement Project				$ 8,000	
1	P	interpretation sign	1	EA	$8,000.00	$ 8,000	
					Running Subtotal:	$ 497,960	
		Mobilization/Field Oversight Expenses				$ 24,898	
1	P	Contractor General Conditions (Prime)	1	LS	5%	$ 24,898	
		Parametric Contingency				$ 49,796	
1	P	Unlisted Items Allowance	1	LS	10%	$ 49,796	
					Running Subtotal:	$ 572,654	
		Markups				$ 36,507	
1	S	Subcontractor Markups	1	LS	0.0%	$ -	H/O Overheads, Job Fee & Risk (Included above)
2	P	Prime Contractor OH&P on Subs	1	LS	0.0%	$ -	ditto
3	P	Prime Contractor OH&P on Self-Perform	1	LS	0.0%	$ -	ditto
4	P	Contractor Insurance and Bonds	1	LS	2.5%	$ 14,316	Perform./Payments Bonds, Genl Liablty, & Bldr's Risk
5	P	State Sales Taxes	1	LS	7.75%	$ 22,190	Assume 50% of Running Total
6	P	Escalation	1	LS	0.0%	$ -	Excluded, pricing basis = Q1 2011
					Running Subtotal:	$ 610,000	Total Estimated Constr Costs w/o contingency
			MU Factor:	1.065			
		Project Administration & Management				$ 180,000	
1	--	Construction Oversight & Mgt	1	LS	0%	$ -	Excluded
2	--	Engineering	1	LS	0%	$ -	Excluded
3	--	Misc Owner's Soft Costs (All)	1	LS	0%	$ -	Excluded
4	--	Scope Contingency/Market Conditions	1	LS	30%	$ 180,000	Design definition/estimating/market allowance
5	--	Interest During Construction	1	LS	0%	$ -	Financing costs excluded
6	--	Owner's Construction Contingency/Mgt Reserve	1	LS	0%	$ -	Excluded, allowance for changed field conditions
			MU Factor:	1.5865			
					Grand Total:	$ 790,000	Total Estimated Constr Costs w/ Contingency
				Cost Range:	$ 490,000	$ 790,000	Per AACE cost estimate guidelines

Notes:

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4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Owner soft costs and project management expenses excluded.
6) Capital spare parts not included.
7) Land Acquisition Costs Not Included

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Appendix D: Funding Opportunities

Grant Opportunities, public/private partnerships as well as phasing projects to coincide with other agency work (Ohio Department of Transportation, Cuyahoga County, etc) are possible funding opportunities for the Walworth Run Green Infrastructure Feasibility Study. The effort to identify and secure grant funding from local, state, and federal sources should be continuous and on-going. Identified below are potential opportunities to fund specific project recommendations.

Grants administered by the Ohio Environmental Protection Agency (OEPA):

<u>EPA 319 Grant:</u> This federal grant is awarded through the Ohio EPA. Awards can be for stream restoration, wetland restoration, dam removal, riparian restoration, riparian and wetland protection or innovative stormwater management projects (i.e. bioswales, raingardens, pervious pavement and rain water collection systems). Section 319(h) implementation grant funding is targeted to Ohio waters where nonpoint source pollution is a significant cause of aquatic life impairments.

More information on the Ohio EPA 319 grant can be found at:
http://www.epa.gov/owow/nps/319/index.html

<u>Surface Water Improvement Fund (SWIF):</u> Administered by the Ohio EPA Division of Surface Water, this fund supports projects that restore or improve Ohio's impaired waters. Funding for this grant comes from supplemental environmental projects, alternative mitigation and payments and contributions from state agencies, corporate sponsors and others. Ohio municipalities, county and township governments, statewide conservation organizations and metro park districts may be eligible to receive grants. Watershed groups may also be eligible, with the support of a co-sponsoring local government.

Projects such as stream restorations, dam removals, wetland and riparian restoration and innovative storm water management projects (bioswales, raingardens, pervious pavement and rain water collection systems) are possibilities. The first round of this grant closed in February 2010. The next round for has yet to be announced.

More information on the Ohio EPA SWIF grant can be found at:
http://www.epa.state.oh.us/dsw/

<u>Green Project Reserve / Drinking Water State Resolving Fund (DWSRF):</u> The U.S. EPA requires Ohio EPA to use at least 20 percent of its capitalization grant funds for projects to address green infrastructure, water or energy efficiency improvements and other environmentally innovative activities. These four categories of projects comprise the Green Project Reserve (GPR).

All projects, whether whole of partial, must clearly advance the objectives articulated for each specific project category. Applications for this funding source are due in March.

More information on the Ohio EPA Green Project Reserve grant can be found at:
http://www.epa.state.oh.us/ddagw/financialassistance.aspx

Loans administered by the Ohio Department of Development (ODOD):

<u>Alternative Stormwater Infrastructure Loan Program:</u> The Alternative Stormwater Infrastructure Loan Program is a partnership between the Ohio Water Development Authority and the Ohio Department of Development. It provides below-market-rate loans for the construction of water development projects (including privately- or publicly-owned infrastructure) as part of economic development projects. The alternative stormwater infrastructure must utilize or incorporate sustainable practices such as bioswales, green roofs, constructed wetlands, and rain gardens.

The property must be located in currently or previously developed areas. The property must have a plan for redevelopment or improvement that will result in economic benefit and revitalization of the community, such as to create or retain jobs, new or rehabilitate housing, leverage investment, or expansion of community services.

Governmental Agencies are eligible to apply. Private entities partnering with a public entity can utilize the program for development projects. Borrowers must own or have access to the property and have the ability to repay.

Loans can be made up to $5 million, with a maximum repayment period of 10 years. Loans will be offered at below-market interest rates. The Ohio Department of Development will work with the applicant to establish the specific terms of the loan agreement.

Loans can be made up to $5 million, with a maximum repayment period of 10 years. Loans will be offered at below-market interest rates. The Ohio Department of Development and the applicant will work together to establish the specific terms of the loan agreement.

Applicants are encouraged to provide matching funds but are not required. Applications are accepted on an open cycle.

More information on the Alternative Stormwater Infrastructure Loan Program can be found at:
http://www.development.ohio.gov/Urban/ASILP.htm

Grants administered by the Northeast Ohio Regional Sewer District

Small Scale Stormwater Demonstration Projects (S3DP): The District recognizes the importance of local demonstrations of rain gardens, bioretention, and other site based stormwater management practices. The District wants to support the implementation of these demonstration projects by member communities. To that end, the District has developed a grant opportunity to support small-scale stormwater management projects. Small Scale Stormwater Demonstration Project (S3DP) funding is available for projects that meet the criteria described below:

Located on property within the Northeast Ohio Regional Sewer District's (the District) service area;

- Demonstrates on-site stormwater control measures.
- Request is of $10,000.00 or less.
- Long-term maintenance plan is in place.
- Supported by local member community.
- Completion by October 15, 2011.
- Qualified applicants must represent the local community or a non-profit 501(c)(3) organization working in partnership with the local member community.

This fund is expected to be reauthorized in 2012.

More information on the S3DP grant can be found at:
http://www.neorsd.org/watershedgrants.php

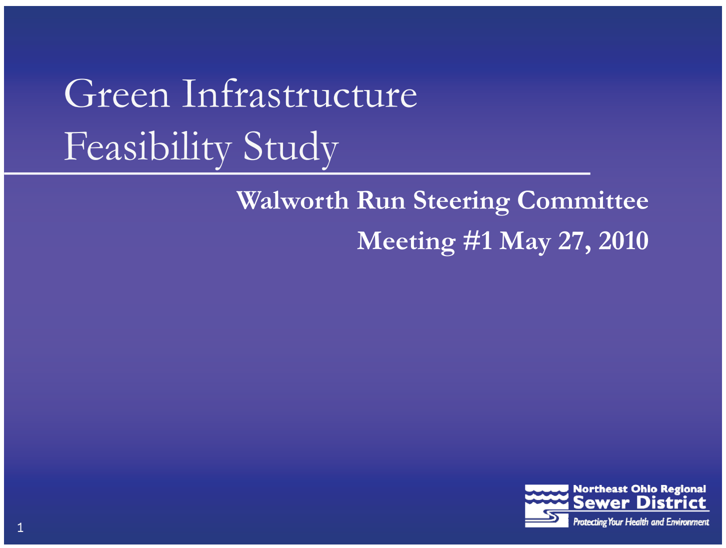
Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #1 - May 24, 2010

As this study builds on work completed in the Train Avenue Greenway Plan, a majority of the steering committee members were asked to be a part of this committee. The Walworth Run drainage area overlaps a number of Community Development Corporations (CDC's) and council wards, requiring coordination and cooperation with multiple non-profits, City council members, and business districts. This group is responsible for providing guidance on the strategic direction of the study and assisting with neighborhood input.

During this first meeting with the Steering Committee, the agenda was to:

1) Provide an update on Train Avenue Trail and Greenway Plan (City Planning Commission)
2) Provide an overview of District's green infrastructure work (District)
3) Timeline and potential deliverables from the Study (District & City)
4) Have open discussion

The sign in sheet is shown to the right.



WALWORTH RUN GREEN INFRASTRUCTURE MEETING - MAY 27, 2010

NAME	TITLE	AFFILIATION	SIGNATURE
Laszlo Horvath		Aries Industries	
David Radis		Blue Ribbon Meats	
Daryl Rush	Director	City of Cleveland, Department of Community Development	
Ben Stock	Chief Civil Engineer	City of Cleveland, Division of Engineering & Construction	
Rick Switalski	Administration Bureau Manager	City of Cleveland, Division of Engineering & Construction	
Rob Mavec		City of Cleveland, Division of Traffic Engineering	
Andrew Waterson	Chief	City of Cleveland, Office of Sustainability	
Brian Cummins	Councilman	Cleveland City Council - Ward 14	
Matt Zone	Councilman	Cleveland City Council - Ward 15	
Joe Cimperman	Councilman	Cleveland City Council - Ward 3	
George Cantor	Chief City Planner	Cleveland City Planning Commission	
Jim Danek	Assistant Director	Cleveland City Planning Commission	
Trevor Hunt	Assistant City Planner	Cleveland City Planning Commission	
Carla Regener	Associate Senior Planner	Cuyahoga County Planning Commission	
Paul Alsenas	Executive Director	Cuyahoga County Planning Commission	
Jeff Ramsey	Executive Director	Detroit-Shoreway Community Development Organization	
Jennifer Spencer	Project Manager	Detroit-Shoreway Community Development Organization	
Danielle Willis	Planning Team Leader/ Sustainability Coord.	Greater Cleveland Regional Transit Authority	
Maribeth Feke	Director of Planning	Greater Cleveland Regional Transit Authority	
Bob Drakem		Hydracrete Concrete Pumping	
Denis Zaharija	Project Manager	Northeast Ohio Regional Sewer District	DZ
Frank Greenland	Director of Watershed Programs	Northeast Ohio Regional Sewer District	FG
Kellie Rotunno	Director of Engineering and Construction	Northeast Ohio Regional Sewer District	KR
Kyle Dreyfuss-Wells	Manager Watershed Programs	Northeast Ohio Regional Sewer District	KDW
Linda Mayer-Mack	Environmental Specialist	Northeast Ohio Regional Sewer District	
Lita Laven	Watershed Team Leader	Northeast Ohio Regional Sewer District	
Tim Donovan	Executive Director	Ohio Canal Corridor	
Eric Wobser	Executive Director	Ohio City Near West Development Corporation	
Dean Comber		Shaker Valley Foods	
Alex Brazynetz	Executive Director	Stockyard Redevelopment Organization	
Matt Martin	Vacant Property Manager	Stockyard Redevelopment Organization	
Megan Meister	Director of Organizing & Outreach	Stockyard Redevelopment Organization	
Chris Garland	Executive Director	Tremont West Development Corporation	
Kristen Trolio	Community Organizer	Tremont West Development Corporation	
Michael Hoag	Vice-President of Redevelopment	WIRE-Net/CIRI	
Millie Caraballo	Industrial Development Manager, Region 4	WIRE-Net/CIRI	
[illegible]		NEORSD	

Appendix E: Meetings

Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

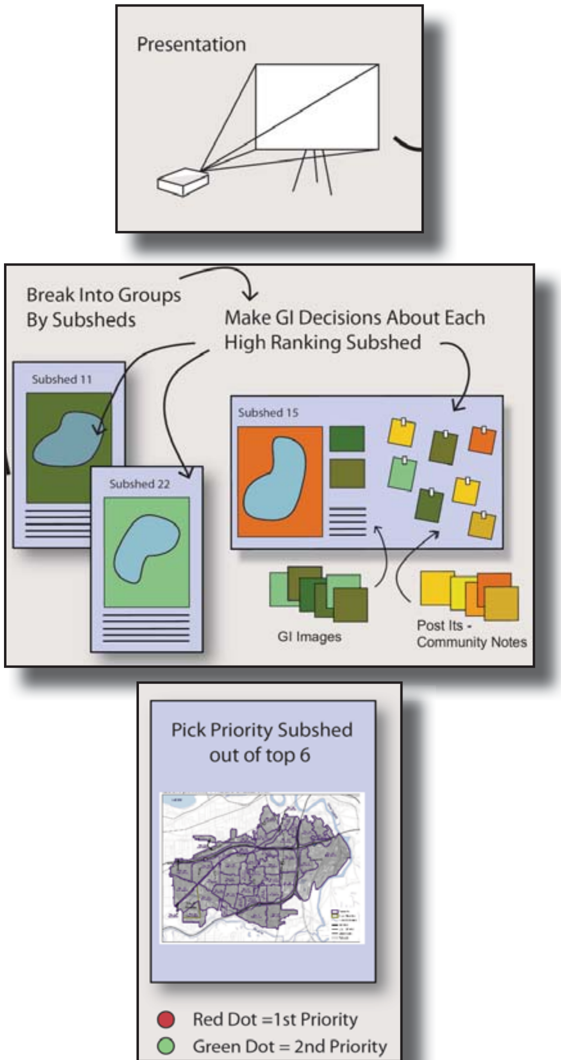
On the afternoon of September 30, 2010 from 1:30 to 3:30, the Steering Committee met and participated in a workshop. This workshop and presentation (agenda on the following page) was developed to:

1. Inform & gain input from the Steering Committee on the project's progress to date.
2. Gather input from the Committee on Stormwater Control Measure (SCM) visions for the top ranking subsheds.
3. Gain input from the Committee on identifying the top four priority subsheds.

A short presentation, that included project background, was followed by participants spending approximately 15 minutes at six stations around the room - one for each highly ranked subshed. Each station included a large map of the subshed, SCM example projects, identified redevelopment and vacant/landbank areas and note pads. Each had a station leader to engage participants, gather feedback and summarize feedback at the end of the workshop.

After this break out workshop & subshed SCM vision summaries, each participant was given one red & one green sticker to identify for their preferred priority subshed. A summary of the feedback received and results of the priority subshed preferences are included in the following pages.

Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010



Agenda

INTRODUCTORY POWER POINT - 30 MINUTES

1. Review Study Timeline
2. Review Study Process
3. Work Performed to date:
   i. Part 1 – Study Area determination
   ii. Part 2 – Subsheds determination
   iii. Part 3 – Ranking system based upon inventoried information
   iv. Part 4 – Identify high ranked subsheds – 6 subsheds
4. Meeting Process:
   i. Process for Steering Committee review & input

STEERING COMMITTEE REVIEW & INPUT – 60 MINUTES

1. Break into Groups to review the 6 High Ranked Subsheds.
2. Identify types of Green Infrastructure preferred in high ranked subsheds based upon example SCM (Stormwater Control Measure) Projects (Green Infrastructure Toolbox)
3. Identify Steering Committee's thoughts on top two Priority Subsheds

MEETING WRAP UP – 20 MINUTES

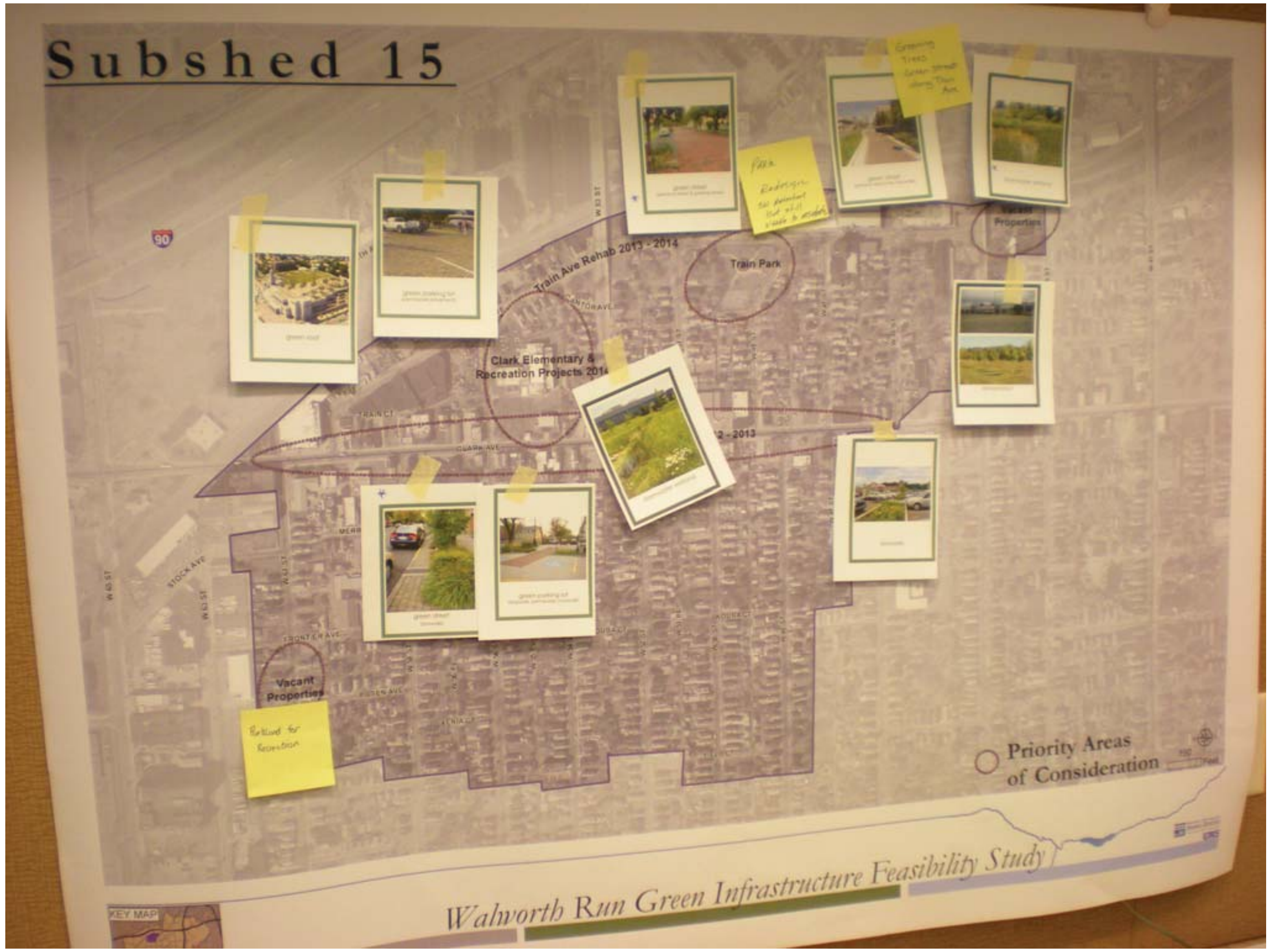
- Summarize visions and comments heard

Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Subshed 15

SCM Visions & Comments heard from the meeting discussion were:

- Infill in places where you can perform - Green streets, permeable parking (in conjunction with Clark and Train Avenues renovations).
- Not a lot of space in this area, especially green space and recreation spots.
- Keep Train Park recreational. Maybe add stormwater control at edges.
- Linear, reforestation, green, bioswales along Train and Clark Avenues.
- In vacant properties, create recreational wetland area.
- Train Avenue bike lane and trail system to be permeable.
- “Reforest” in streets and vacant lots.
- Green roof across from U-Haul & perhaps permeable parking for stormwater storage.
- Clark Elementary School just purchased lots next to the right – could these be teaching wetland & put bioswales and permeable parking in.
- Green Infrastructure as part of high school renovations at 65th street - Connect to Zone Rec Center.

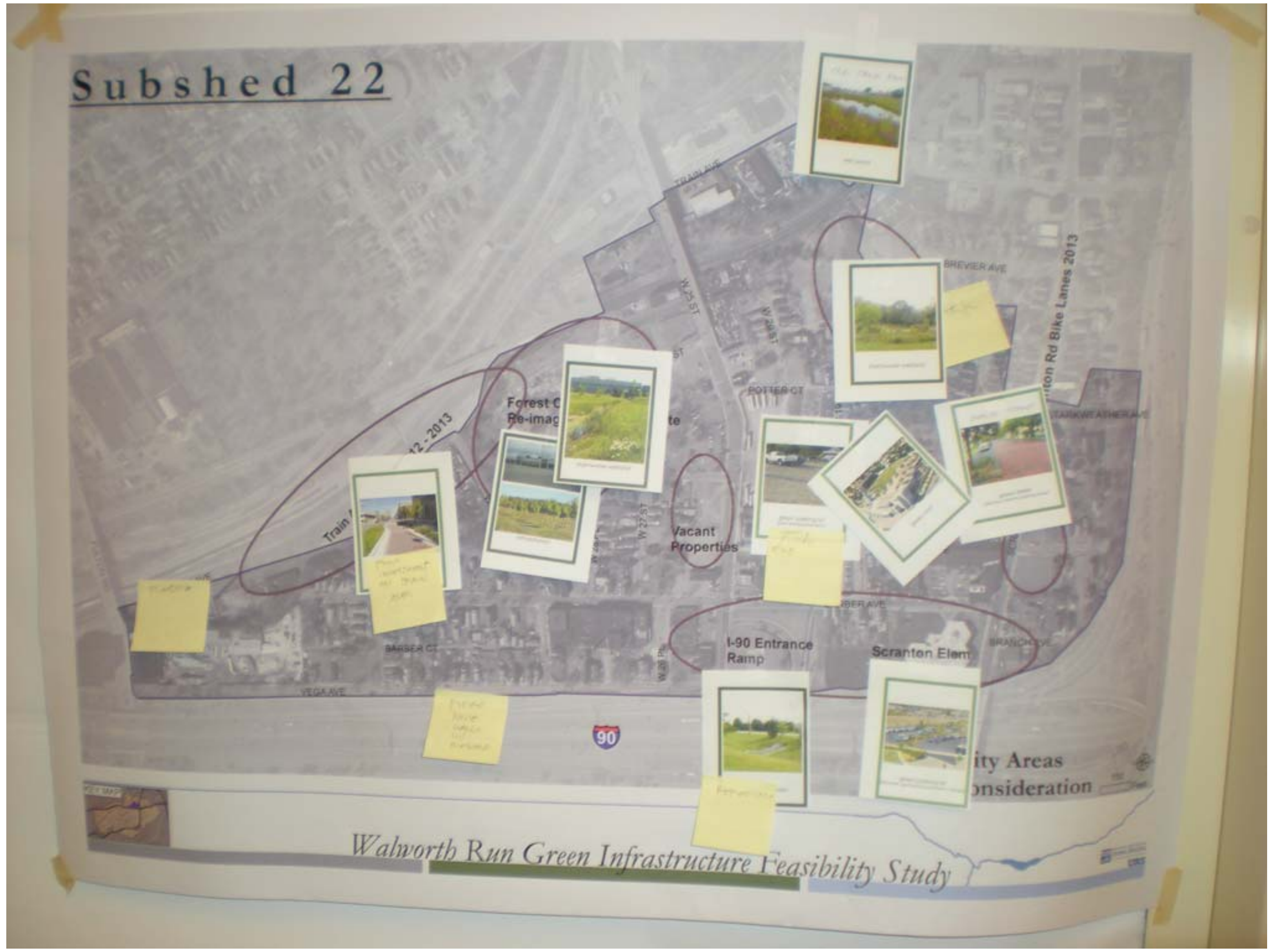


Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Subshed 22

SCM Visions & Comments heard from the meeting discussion were:

- Scranton Elementary School could have some form of green parking lot with bioswales, permeable pavements, and runnels.
- Dry detention basin could be within the I-90 entrance ramp with reforestation.
- Future I-90 noise walls could incorporate bioswales (I-90 and Vega Avenue sound walls).
- Flooding exists along Train Avenue and Fulton Road. Green street focus investment on Train Avenue with bioswales and pervious bike lanes.
- Forest City Foundry – Re-imaging Cleveland site could include reforestation, a wet pond (old tank farm), and stormwater wetland.
- Other vacant properties could include stormwater wetlands with a park.
- Residential areas could include green streets with pervious streets and parking lanes.
- With the future Nestle expansion (no knowledge on timeframe) there could be green parking lots, permeable pavements and a green roof.



Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Subshed 26

SCM Visions & Comments heard from the meeting discussion were:

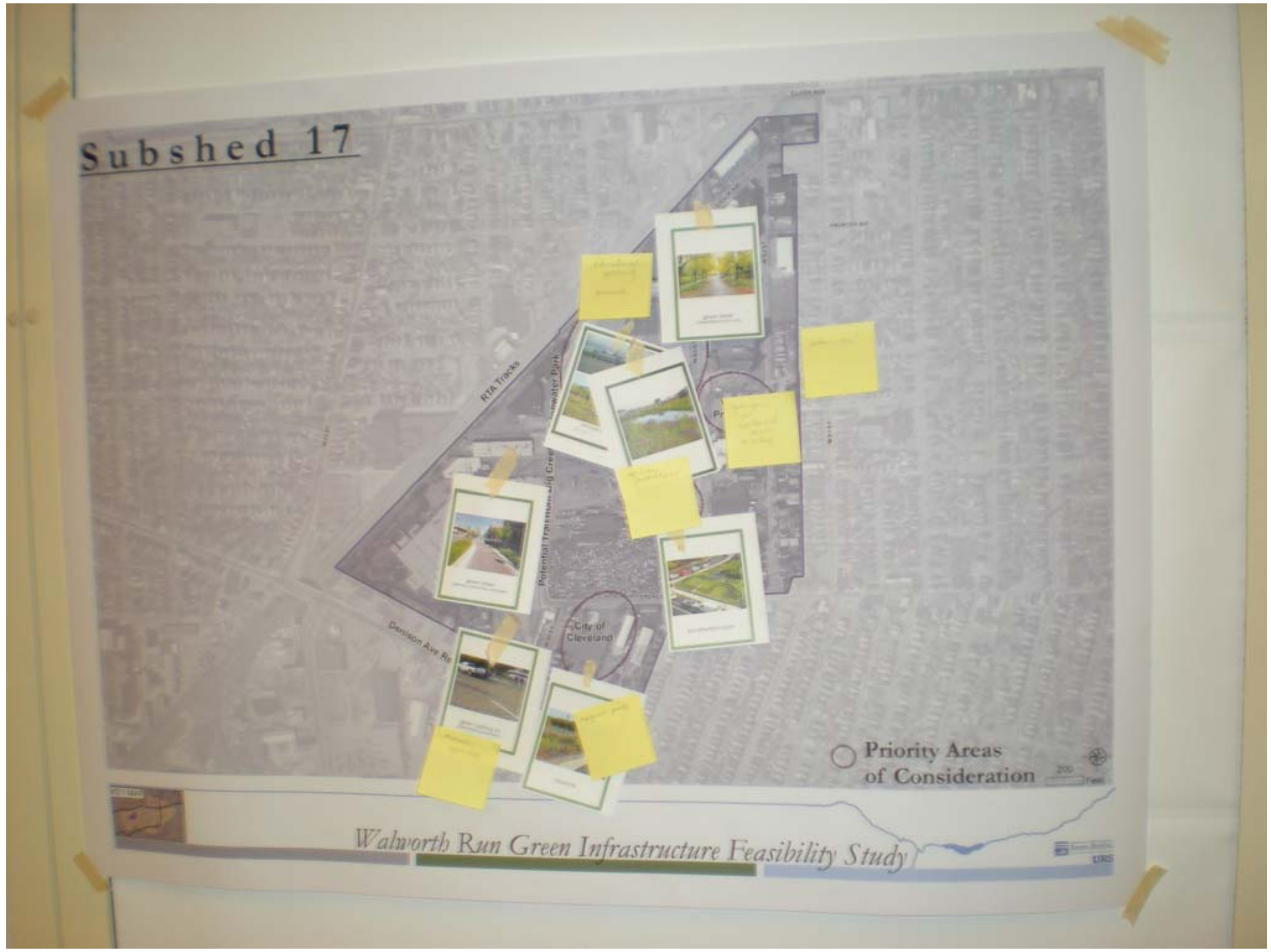
- Steelyard Commons – Future development could include green roofs, pervious pavement.
- Clark fields and Towpath construction could include an irrigation pond to catch southwest adjoining drainage subshed (City does not currently irrigate athletic fields), however, concern over open water near public access.
- An irrigation wetland system could be adjacent to towpath for irrigation of fields and vegetation.
- Parks and Recreation has developed master plan that includes future removal of road (unnamed). This plan could include: green parking lot, bioswale, permeable pavement, runnels and maybe a stormwater wetland. Wetland southwest flanking the Towpath near Mary CT. A new road aesthetic could tell a story of both the cultural and ecological benefits of capturing runoff.
- The I-490 swale could be expanded for stormwater collection. Try to catch flow from I-490. Wet pond catches flow from I-490 & landfill.
- Beachwood Packaging Corp., which sheet flows east to river, could include a southwest wetland flanking the Towpath Trail.
- A southwest wetland could be placed near Clark Avenue to capture existing runoff problem and provide benefits to towpath.

Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Subshed 17

SCM Visions & Comments heard from the meeting discussion were:

- General Note: Subshed 17 is industrial/former industrial opportunity for more available space through abandoned buildings. e.g. next to Kmart (southwest) and across street.
- General Note: Subshed is surrounded by residential area. Opportunity for green amenities for residents.
- City of Cleveland park could include bioswales & upgrades to the park.
- Park lot next to park (W. 67) is under used. Could remove impervious or create green park lot.
- Potential trail connecting Edgewater to Big Creek Trail could include bioswales, green bike lanes.
- Stockyard Elementary School triangle just west to do a swale towards school. Environmental education possible.
- Note: New high school being built just north of area.
- Vacant parcels could be used as green space for residential access to former Kmart site (redevelop or reforest) - Create a link to the residential neighborhood to a potential re-development of Kmart.
- Former Kmart - Reforest with pond on wetland not likely to be redeveloped. Don't know owner's plan.
- W. 65th – green street (flows north).
- Concerns with contamination.
- Land bank parcel could include bioretention basin.



Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Subshed 23

SCM Visions & Comments heard from the meeting discussion were:

- Reforestation.
- Green street with vegetated bump outs.
- Stormwater wetland could be urban here.
- Green parking lot with bioswales, permeable pavement, runnels.
- Bioswales in general.
- An irrigation pond for Zone Recreation & gardens that exist on Pearl Avenue.
- Bioretention basin.
- Green street for Madison Avenue including bioswales.
- Other green streets with pervious parking lane.
- Have green parking lots with bioswale, permeable pavement & permeable crosswalk.

Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Subshed 24

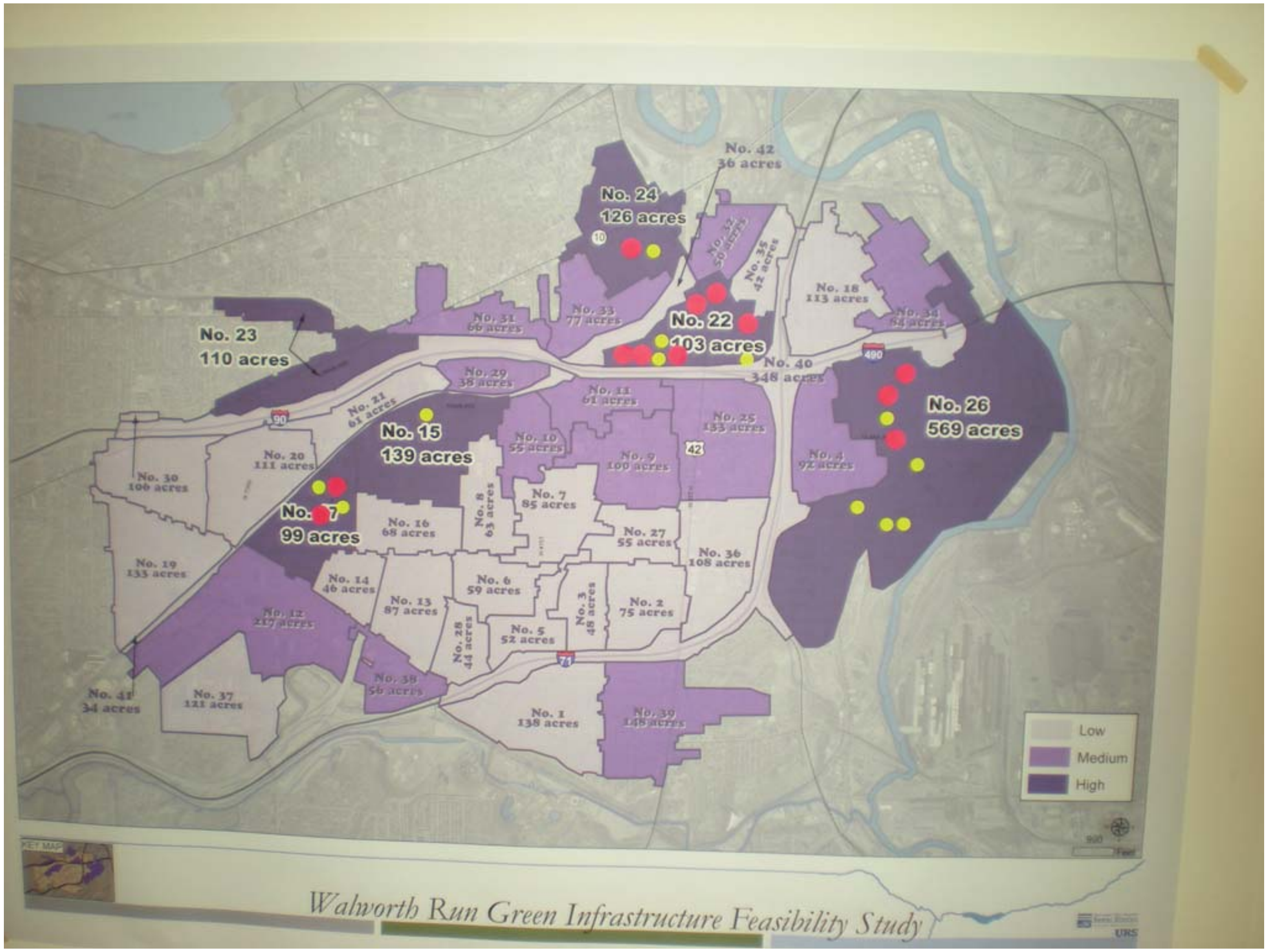
SCM Visions & Comments heard from the meeting discussion were:

- Lutheran Hospital could incorporate green parking lots with bioswale & pervious parking bays.
- St. Ignatius High School could utilize a stormwater wetland. Schools' track is an artificial surface.
- Keep Train Park recreational - maybe add stormwater at edges.

Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #2 - September 30, 2010

Overall Preference

After envisioning what types of SCMs the Steering Committee could see as part of the six high ranked subsheds, attendees were asked to select their top two priority subsheds. Red is first priority, yellow is second.



Walworth Run Green Infrastructure Feasibility Study Steering Committee Meeting #3 - May 6, 2011

This final steering committee meeting, attendees reviewed and provided comments upon the conceptual plans developed. A meeting agenda is shown to the right.

Walworth Run Green Infrastructure Feasibility Study
Third Steering Committee Meeting
May 6, 2011
10:30 AM to Noon
Northeast Ohio Regional Sewer District
3900 Euclid Ave

1. NEORSD Green Infrastructure (GI) Feasibility Study – 20 minutes

2. Walworth Run GI Feasibility Study – 20 minutes
    - Review study timeline and process
    - Work performed to date
        a. Review results from September 2010 meeting
        b. Review/re-assess high ranking subsheds
        c. Modeling results of subsheds
        d. Preliminary engineering/conceptual site design of potential projects in subsheds

3. Steering Committee review & input – 30 minutes
    - Break into groups to review conceptual projects. Each conceptual project will have a station with maps, conceptual design and layout, and costs.
        a. Ask questions on conceptual projects
        b. Provide feedback/comments on conceptual projects

4. Meeting wrap up – 20 minutes
    - Summarize comments
    - Review schedule for Walworth Run Feasibility Study
    - Outline funding sources for conceptual projects

Walworth Run Green Infrastructure Feasibility Study Advisory Committee Meeting - March 18, 2011

The Walworth Run Green Infrastructure Advisory Committee includes the members of the ReImagining Cleveland Vacant Land Use Steering Committee. This group is a long standing committee of the ReImagining a More Sustainable Cleveland effort, lead by the Cleveland Foundation, Neighborhood Progress Inc., ParkWorks, and the Cleveland Urban Design Collaborative of Kent State University. The Committee includes representatives from the City of Cleveland, Cuyahoga County, the District and local and regional non-profits leading the way to find opportunities to repurpose the growing vacant land properties in and around the City of Cleveland. This Committee has been meeting for approximately one year to discuss alternative and long term reuse options for these properties, including stormwater management. The use of the ReImagining Committee as a GI Advisory Committee is a great opportunity for the District to capitalize on an existing structure of local decision makers with a deep background in GI and vacant land reuse issues. This Committee will look beyond Walworth Run to the District's overall GI efforts.

During the study, the Advisory Committee met once. The sign in sheet is shown to the right.

Yetty	Alley
Dorothy	Baunach
Michele	Benko
Jim	Bissell
Renee	Boronka
Michael	Bosak
Bob	Brown
Marty	Cader
Fred	Collier
Jim	Danek
James	Downing
Kyle	Dreyfuss-Wells
Mark	Duluk
Kim	Foreman
Brooke	Furio
Frank	Greenland
Todd	Houser
Andy	Hudak
Trevor	Hunt
Marie	Kittredge
Jennifer	Kuzma
Kamla	Lewis
Dave	Lincheck
Stephen	Love
John	Mack
Devona	Marshall
Linda	Mayer-Mack
Dan	Meaney
Erika	Meschkat
Tori	Mills
Julia	Musson
Joe	Ratner
Bobbi	Reichtell
Kellie	Rotunno
Jan	Rybka
Derek	Schafer
Terry	Schwarz
Jennifer	Scofield
Morgan	Taggart
Carol	Thaler
Dave	Vasarhelyi
Andrew	Watterson
Rachel	Webb
Marlene	Weslian
Denis	Zaharija
Lilah	Zautner
Ann	Zoller
KAYLE	MORTELLELI
Danella	Robertson
Mardele	Cohen
Maribeth	Feke
Betsy	Yingling

Lora DiFranco

Kim Kimlin