

OPPORTUNITY CORRIDOR DEVELOPMENT: ON-SITE STORMWATER MANAGEMENT STRATEGY

SUMMARY REPORT

FEBRUARY 2018



About the Northeast Ohio Regional Sewer District

The Northeast Ohio Regional Sewer District protects public health and the environment by leading effective wastewater and stormwater management for 62 communities and one million residents. The District is completing Project Clean Lake, a multi-year, multi-billion-dollar capital program that includes gray infrastructure – such as wastewater treatment plant and pump station upgrades, deep tunnel systems, and relief sewers – and a comprehensive green infrastructure program.

More information about the District's investments in clean water is available at: www.neorsd.org

A MESSAGE FROM THE CEO

The Opportunity Corridor is a 3.5-mile roadway project, led by the City of Cleveland and the Ohio Department of Transportation, that will connect Interstate 490 at East 55th Street to East 105th Street in Fairfax and University Circle. When complete, the roadway will link residents and visitors with some of Northeast Ohio's most important institutional, educational, employment, and cultural resources.

A roadway project is no small undertaking, especially when it is woven into the fabric of six of the city's neighborhoods. The City of Cleveland, recognizing the potential impacts on surrounding communities, worked with residents, community development corporations, and other stakeholders to understand the challenges and opportunities from a project of this scale. The master plans, strategic and comprehensive plans, and site development plans resulting from years' of collaboration established a shared vision for future land use, urban design, and economic development.

The desired land uses and development projects represented in these plans come at a time when the Northeast Ohio Regional Sewer District is upgrading an overburdened combined sewer system, including in the neighborhoods adjacent to the roadway project. Much of the existing sewer infrastructure is outdated and unable to handle the large volumes of surface runoff that are generated during heavy rain events, which results in combined sewer overflows and impacts on water quality. The existing sewer system and the District's planned infrastructure improvements are not designed to fully manage stormwater runoff generated from redevelopment projects like those anticipated around the Opportunity Corridor. Instead, each development must manage volumes and peak flows on-site to comply with local and state regulations and to reduce downstream impacts like combined sewer overflows.

Plans for redevelopment surrounding the Opportunity Corridor identified a need for a comprehensive approach to stormwater management, which led to the **Opportunity** Corridor Development: On-Site Stormwater **Management Strategy** project. The goals of the study were to identify future development represented in existing plans, to assess the sewer system, and to evaluate potential impacts from stormwater runoff. Additionally, the District considered on-site stormwater management requirements from the perspective of the development community. The District clarified stormwater regulations, and created tools to assist with compliance and to encourage development projects to manage stormwater runoff as part of their development plans.

This report summarizes the results of this effort and is intended to serve as a go-to-resource for on-site stormwater management adjacent to the Opportunity Corridor and throughout the combined sewer system. It provides the City of Cleveland and the development community with helpful guidance for planning and designing stormwater control measures, and it supports the District's plan review process. This report also provides the tools necessary for innovative stormwater management that incorporates water into site design in new and exciting ways for Cleveland.

The District would like to thank our partners at the Cleveland City Planning Commission and the Greater Cleveland Partnership, as well as representatives from the District's External Advisory Committee, for the valuable input provided during this effort. We look forward to continuing our work together in making our Great Lake Great.

Sincerely,

Kyle Dreyfuss-Wells Chief Executive Officer, Northeast Ohio Regional Sewer District





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INTRODUCTION

This document summarizes the results from the Northeast Ohio Regional Sewer District's comprehensive planning study of anticipated development surrounding the Opportunity Corridor project. It provides the development community, neighborhood stakeholders, the City of Cleveland, and the District with resources to effectively plan and implement on-site stormwater management strategies.

The Northeast Ohio Regional Sewer District (District) led a comprehensive planning effort of on-site stormwater management strategies adjacent to the Opportunity Corridor roadway project. The Ohio Department of Transportation (ODOT) and the City of Cleveland are leading the design and construction of the Opportunity Corridor roadway (Figure 1) and associated infrastructure. The Cleveland City Planning Commission and the Greater Cleveland Partnership are leading planning efforts related to economic development and economic inclusion, future land use strategies, urban design, and neighborhood connectivity in the neighborhoods impacted by the roadway project.

On-site stormwater management is just one component of a long-term strategy for redevelopment adjacent to the Opportunity Corridor. The neighborhoods where redevelopment is anticipated to occur are served by combined sewers. Combined sewers carry both sanitary sewage and stormwater runoff in the same pipes. During wet weather events these sewers often become overburdened, which results in downstream combined sewer overflows (CSOs) and degradation of water quality in the Cuyahoga River and Lake Erie. Redevelopment in combined sewer areas present unique opportunities for integrating on-site stormwater management features that remove, reduce, or delay flows from entering combined sewers

In this context, the District, through interactions with its External Advisory Committee, identified a need to evaluate the potential impacts from future development on stormwater runoff volumes and existing sewer infrastructure. Through a comprehensive planning study of the Opportunity Corridor Study Area – more specifically, the anticipated development area – the District and partners were focused on the following goals:

- Identify desired future development types with the Opportunity Corridor Study Area;
- Develop recommendations for specific on-site stormwater management strategies that could be integrated, by land owners and developers, as part of future development within the Study Area and that reduce stormwater runoff entering the combined sewer system; and,
- Provide planning-level guidance for meeting the requirements of the District's Code of Regulations (Title IV) and other local and state stormwater management codes.

This report summarizes results from the District's comprehensive planning study and contains the following sections:

1: Introduction

This section introduces the City of Cleveland's Opportunity Corridor Target Areas and defines the basis for the Study Area boundary. It also contains results of the inventory of planning data and analysis of existing and future land use and land cover types.

2: Regulatory Context

This section describes the basis for stormwater management policy and the specific regulations that apply to development projects within the combined sewer system.

3: Stormwater Control Measures

This section serves as a "toolkit" identifying a range of on-site stormwater control measures (SCMs) that are often used for stormwater management in urban areas. For each SCM, important information, considerations, and resources are included.

4: Implementation

This section summarizes stormwater-related information and data for the Study Area and the City's Opportunity Corridor Target Areas. It also includes several detailed examples of potential approaches to integrating on-site stormwater management for compliance with applicable regulations.

FIGURE 1 **ROADWAY PROJECT**



PLANNING OVERVIEW



PLANNING OVERVIEW

The construction of the Opportunity Corridor represents the culmination of years' worth of coordination and planning among state and local agencies and community stakeholders.

According to the City of Cleveland, the Opportunity Corridor's overarching goal is to leverage investments in a dedicated connection from I-490 to East 105th Street to spur transformational change in areas of the City that need it most - specifically, neighborhoods that were subject to decades of disinvestment, land use challenges, and fragmented planning policies (Figure 1-1). Combining new approaches to land use planning, local economic development policy, and stakeholder engagement, the City and its partners are setting foundations for improving access to and from the neighborhoods along the roadway. According to the Greater Cleveland Partnership¹, the Opportunity Corridor will:

Enhance "roadway connections to the freeway system, improve Interstate mobility, support existing economic development activities, and promote economic redevelopment at the neighborhood level."

Encourage "private sector investment reliant upon transport facilities and services to export and import raw materials or access markets for products."

Create "an environment conducive to supporting existing and emerging development, raising the level of private sector activity and public engagement along the corridor which has the ability to foster sustainable economic growth in the area."



FIGURE 1-1 VACANT OR UNDERUTILIZED LAND ADJACENT TO THE OPPORTUNITY CORRIDOR

The District identified existing planning documents and reports for neighborhoods adjacent to the Opportunity Corridor. These resources – which include master plans, site development plans, strategic plans, and comprehensive plans – are summarized in Figure 1-2. They serve as the City's and/or neighborhoods' desired objectives for land development, and were created through extensive community engagement, one-on-one interaction, and stakeholder coordination. They establish an integrated framework to address existing challenges and build upon opportunities for land development, especially those resulting from the construction of a project the scale of the Opportunity Corridor.

The City's Connecting Cleveland 2020 Citywide Plan and the Fairfax Strategic Investment Plan, both completed in 2009, were the first documents to specifically mention the Opportunity Corridor project and its potential impacts to the future of the adjacent neighborhoods. The majority of available documents developed after 2009 also mention, at varying levels of detail, the Opportunity Corridor and acknowledge the desire to integrate the project with the neighborhood's land use and redevelopment goals and objectives.

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East 79th Street Corridor Study City of Cleveland, NOACA, City Architecture, WSP

Thrive 105-93 Corridor Study 🔴 City of Cleveland, AECOM

Innovation Square Fairfax 🛑 Neighborhood Plan

Fairfax Renaissance Development Corporation, City Architecture

2016 2017 201





OPPORTUNITY CORRIDOR TARGET AREAS

Because of anticipated development and changes in land use adjacent to the Opportunity Corridor, the Cleveland City Planning Commission identified five Target Areas that represent a focus for future redevelopment strategies. The Target Areas include:

- Core Job Zone
- New Economy Neighborhood
- East 79th Development Zone
- Urban Ag Zone
- Slavic Village TOD

Together, the Target Areas cover approximately 405 acres of existing land, much of which is vacant, abandoned, or otherwise underutilized. Areas of the individual Target Areas are summarized in Figure 1-3. Future, proposed development in these areas will be subject to the City's plan review process, which is intended to protect existing context, ensure high-quality development and appropriate placement of new facilities, enhance walkability, and increase the use of green infrastructure. Figure 1-4 shows a plan view of the City's Opportunity Corridor Target Areas.

FIGURE 1-3

TOTAL AREA OF THE CITY OF CLEVELAND'S OPPORTUNITY CORRIDOR TARGET AREA BOUNDARIES Local community development corporations collaborating with the City, land owners, and developers in these areas include:

- Buckeye Shaker Square Development Corporation
- Broadway Slavic Village Development Corporation
- Burten, Bell, Carr Development Corporation
- Fairfax Renaissance Development Corporation
- University Circle, Inc.







FUTURE OPPORTUNITY CORRIDOR ROADWAY



The District defined a unique Study Area Boundary (Figure 1-5) to help guide subsequent phases of planning analysis, and to help organize future recommendations for on-site stormwater management strategies in areas outside of the Opportunity Corridor roadway. The Study Area Boundary was based on locations of the City's Opportunity Corridor Target Areas, the alignment of the future roadway, and extents of areas represented in existing planning documents. The northern extent of the Study Area is defined by Quincy Avenue, East 93rd Street, Cedar Avenue, and Fairhill Road. The eastern boundary is defined by the Norfolk Southern railroad. The southern boundary is defined by Bessemer Avenue. The western boundary is defined by Bower Avenue and East 55th Street.

The Study Area Boundary covers 1,820 acres. It represents an approximate area of influence in terms of potential, future development and redevelopment that could occur as a result of the connection from I-490 to East 105th Street.

Figure 1-6 summarizes stakeholders and their relation to boundaries associated with the Opportunity Corridor project.



3.1 MILES OPPORTUNITY CORRIDOR ROADWAY



cleveland city planning commission

405 ACRES

CITY OF CLEVELAND OPPORTUNITY CORRIDOR TARGET AREAS





1,820 ACRES

OPPORTUNITY CORRIDOR DEVELOPMENT: ON-SITE STORMWATER MANAGEMENT STUDY AREA

◄ FIGURE 1-5

STUDY AREA BOUNDARY FOR THE OPPORTUNITY CORRIDOR DEVELOPMENT: ON-SITE STORMWATER MANAGEMENT PROJECT

FIGURE 1-6 SUMMARY OF STAKEHOLDERS AND THEIR RELATION TO PLANNING BOUNDARIES ASSOCIATED WITH THE OPPORTUNITY CORRIDOR









STUDY AREA INVENTORY

The District conducted an inventory of key variables related to natural systems and built systems within the Study Area boundary. Natural systems form the structure of the regional landscape and include topography, the hydrologic network, and geology. Built systems represent the existing development framework and include land use, land cover, and transportation. Built systems also include the sewer collections system – the network of combined, sanitary, and separate storm sewers that manages sanitary sewage, overland flow, and stormwater runoff.

An assessment of these variables provides foundations for identifying opportunities and constraints for a range of on-site stormwater management strategies at future development sites in the Study Area. Sources of GIS-level data included the following:

- Northeast Ohio Regional Sewer District
- Cleveland City Planning Commission
- Ohio Department of Natural Resources (ODNR)
- Cuyahoga County
- Ohio Department of Transportation (ODOT)

Topography

Topography in the Study Area (Figure 1-7) is generally flat with notable exceptions being the eastern edge of the boundary, areas adjacent to the railroad corridor, and a branch of the Kingsbury Run stream south of Kinsman Road. In these locations, existing topography can vary as much as 80 feet. The generally flat topography can limit opportunities for large-scale separation of stormwater runoff. FIGURE 1-7 ► TOPOGRAPHY IN THE STUDY AREA



Geology

The variability in topography from east to west is reflected in the underlying geology – specifically, the sediments between surface soils and bedrock. Geology is shown in Figure 1-8. The eastern third of the Study Area contains deposits of lacustrine silt, while the remainder of the Study Area is underlain by lacustrine sand. There is also a large deposit of grained materials (i.e., sand and gravel) north of Woodland Avenue. Well log information available from state data sources confirmed the presence of sand and gravel in many areas with lacustrine sand. The presence of sand and/or grained materials may increase the potential for infiltration of stormwater runoff. FIGURE 1-8 GEOLOGY IN THE STUDY AREA









◄ FIGURE 1-9 WATERSHEDS IN THE STUDY AREA

Watersheds

The Study Area crosses multiple watershed boundaries (Figure 1-9), including the Kingsbury Run watershed that drains into the Cuyahoga River and the Doan Brook and Lake Erie Direct Tributary East of the Cuyahoga River that both drain to Lake Erie. The majority (65 percent) of the Study Area is located within the Kingsbury Run, followed by 32 percent in the Lake Erie Direct Tributaries East of the Cuyahoga River, and three percent in Doan Brook. The Study Area boundary represents approximately 26 percent and 8.5 percent, respectively, of the total Kingsbury Run and Lake Erie Direct Tributaries East of the Cuyahoga River watershed areas.



Hydrologic Network

Within the Study Area, the historical stream network (Figure 1-10) included Kingsbury Run and Giddings Brook. Both streams carried natural drainage and stormwater runoff from tributary drainage areas, with Kingsbury Run flowing east to west towards the Cuyahoga River, and Giddings Brook flowing southeast to northwest towards Lake Erie. The streams were modified over time to accommodate development and changes in adjacent land use. Today the Kingsbury Run is mostly buried within a system of culverts, and Giddings Brook is redistributed within the existing sewer network.



Land Use

Existing land use within the Study Area (Figure 1-11) is highly varied and includes industrial, residential, institutional, transportation, and commercial land uses. The top three existing land use types, in terms of total area, are heavy industry, right-of-way, and transportation/ public utilities. Vacant land uses, which include land bank properties, represent 12 percent of the Study Area. Land use types impact the volume of stormwater runoff generated and can influence the types of onsite stormwater management practices that may be appropriate or feasible for a future development site. FIGURE 1-11 EXISTING LAND USE IN THE STUDY AREA



Land Cover

Existing land cover can be classified as impervious and pervious. Impervious includes buildings, roadways, sidewalks, and any other type of pavement or constructed surface. Impervious land cover types (Figure 1-12) total 763 acres and represent 42 percent of the total Study Area. Pervious land cover types, which represent 58 percent of the total Study Area, include open space, grass, and tree canopy. Land cover has implications on the volumes of stormwater runoff generated on a site, and also plays a role in approaches to compliance with stormwater management regulations.

FIGURE 1-12 EXISTING IMPERVIOUS LAND COVER IN THE STUDY AREA











Roadway Network

The Study Area boundary overlaps a cmplex roadway network (Figure 1-13), consisting of roadways that can classified into one of four categories: Interstate, US highway, state highway, and local streets. Interstate 490 joins the Study Area boundary at East 55th Street. Kinsman Road, a designated US highway, crosses the southern third of the Study Area boundary. State highways include Woodland Avenue, East 79th Street, Buckeye Road, Holton Avenue, Quincy Avenue, and East 105th Street. The Opportunity Corridor roadway will provide a direct connection to I-490 and East 105th, and enhance connections to US and state highways, as well as local streets.



Rail Corridors

The Study Area is intersected by a series of railroad corridors (Figure 1-14). These include two Norfolk Southern rails running from north-to-south, the RTA rail running from east to west, and two Norfolk Southern rails running from east to west. These corridors are important links in the regional rail network - both for commerce and for public transportation - but they also present physical barriers in terms of overland flow and drainage patterns.



Sewer System

The Study Area is served by an extensive system of underground sewers within the Study Area (Figure 1-15). This network – which includes combined sewers, culverts, storm sewers, and sanitary sewers. These sewers convey wastewater and combined sewage to downstream treatment plants. During rain events, the network conveys stormwater runoff and combined sewer overflows to the environment. More detail about the existing sewer system – specifically, existing drainage facilities, is contained in subsequent sections of this report.

FIGURE 1-15 EXISTING SEWER SYS IN THE STUDY AREA



Sewer Catchments (flow type)

Sewer catchments in the Study Area (Figure 1-16) are primarily classified as combined, which means that the dry weather and wet weather flows are conveyed in the same pipes to the District's downstream wastewater treatment plants. During rain events, when the system is at capacity, excess flows are diverted directly to the environment.

FIGURE 1-16 SEWER CATCHMENTS. CATEGORIZED BY FLOW TYPE IN THE STUDY AREA







LAND USE ANALYSIS

The District completed an analysis of existing and future land uses within the Study Area boundary. Existing land uses (Figure 1-17) were based on data contained within county-wide parcel GIS data, and future land uses (Figure 1-18) were based on information contained in the City of Cleveland's Connecting Cleveland 2020 Citywide Plan report. The objective of the land use analysis was twofold:

 Identify anticipated changes in land use between the existing and future (i.e., year 2020) condition.

Anticipated changes in land use could have implications on a particular type of future on-site stormwater management strategy. For example, a parcel with an existing land use of light industry and a future land use of office would require a different approach to on-site stormwater management than if the parcel remained or redeveloped as light industry.

Estimate the potential change in the typical year stormwater runoff volume between the existing and future land use types.

Changes in stormwater runoff volumes may help to identify priority areas for on-site stormwater management and areas of the existing collections system that may require a higher level of control.

The land use analysis was completed through several steps:

First, the drainage area was defined as the total parcel area for a specific land use type within a particular zone (i.e., the City's Opportunity Corridor Target Area and the remainder of the Study Area boundary). The total parcel area included all parcels of a particular land use type that overlap the zone boundary. Portions of parcels that extend outside of a specific zone boundary or outside the Study Area boundary were excluded from the analysis.

Second, the existing condition impervious land cover was calculated for each existing land use type within a particular zone. Data for impervious land cover was based on the District's 2012 impervious surface layer, which included right-of-way. The pervious land cover was determined by subtracting the impervious land cover from the total drainage area.

Third, the estimated typical year runoff volume, expressed in millions of gallons, was calculated based on existing land cover types within the existing land use drainage area. The typical year rainfall was based on an assumed total depth of 38.71 inches. For impervious surfaces, 80 percent of the volume generated by the typical year

rainfall depth was assumed to be runoff, while 20 percent was assumed for pervious surfaces.

Fourth, for the future land use scenario, the drainage area was defined as the total parcel area for a specific land use type within a particular zone. Once again, portions of parcels that extend outside of a specific zone boundary or outside the Study Area boundary were excluded from the analysis.

Next, the impervious land cover for future land uses was estimated by multiplying a planning-level ratio for each land use type by the future condition drainage area for each land use. The ratio, expressed as impervious area per acre, was calculated by dividing the existing condition impervious area for a specific land use type by the corresponding total drainage area (i.e., parcel area). This ratio was calculated for each land use within a particular zone, and then an average was taken to determine the composite ratio for a particular land use within the entire Study Area.

Finally, the estimated typical year runoff volume for the future land use scenario was calculated by multiplying the planning-level ratio for each land use type by the future condition drainage area for each land use.





STUDY AREA BOUNDARY

LAND USE CATEGORY per City of Cleveland's Connecting Cleveland 2020 Citywide Plan

RETAIL

HEAVY INDUSTRY

PUBLIC UTILITY

COMMERCIAL SERVICES

RECREATION/OPEN SPACE

OFFICE

Results of the analysis of existing and future land use within the Study Area are summarized in Table 1-1 and Figure 1-29. Based on this analysis, impervious cover in the Study Area boundary under the future scenario increases by 38 acres, while pervious land cover decreases by the same amount. Additionally, the stormwater runoff volume is estimated to increase by 24 million gallons.

When reviewing the results for the individual Target Areas, the Urban Ag Zone is expected to have increases in impervious surfaces and stormwater runoff volumes. Decreases are expected in the four other Target Area boundaries. The remaining Study Area outside of the Target Areas is anticipated to add 57 acres of impervious surfaces, which results in an additional 36 million gallons of stormwater runoff. Per the City's Connecting Cleveland 2020 Citywide Plan, many vacant properties are converted to land uses with a higher impervious ratio with increased stormwater runoff volumes.

Figure 1-19 summarizes the total areas of existing and future land use types within the Study Area. The future land use condition shows a significant reduction in heavy industry and a complete conversion of land bank and vacant land parcels to other land use types. Light industry, institutional, single- and two-family, mixed use, and office land uses are all expected to increase in the Study Area.

		DRAINAGE AREA (ACRES)	IMPERVIOUS COVER (ACRES)			PERVIOUS COVER (ACRES)			RUNOFF VOLUME (MILLION GALLONS)	
	Zone		Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Proposed
eas	Core Job Zone	182	78	67	-10	105	115	10	87	81
arget Ar	Slavic Village TOD	70	45	35	-10	26	36	10	43	37
eland Tá	Urban Ag. Zone	51	12	23	11	39	28	-11	18	25
/ of Clev	E. 79th Development Zone	43	23	21	-2	20	22	2	24	22
£	New Economy Neighborhood	41	19	12	-7	22	29	7	21	16
	Remaining Study Area	1,432	586	643	57	846	789	-57	671	707
	Total	1,820	762	800	38	1,058	1,020	-38	863	887

TABLE 1-1

SUMMARY OF THE ANALYSIS OF LAND COVER AND STORMWATER RUNOFF VOLUMES IN THE STUDY AREA, BASED ON EXISTING LAND USE TYPES AND FUTURE LAND USE TYPES REPRESENTED IN THE CITY'S CONNECTING CLEVELAND 2020 CITYWIDE PLAN



LIGHT INDUSTRY

SUMMARY OF TOTAL AREAS OF EXISTING AND FUTURE LAND USE TYPES WITHIN THE STUDY AREA





1-18

The impervious-per-acre ratio (Figure 1-20) was calculated by dividing the existing condition impervious area for a specific land use type by the corresponding parcel area. Ratios for key land uses are summarized in the adjacent graphic. Right-of-way and heavy industry land uses have the highest impervious-per-acre ratio: 0.70 and 0.63, respectively. Right-of-way includes all areas located outside of parcel boundaries - for example, street pavement, curb, sidewalk, and tree lawn - and can provide opportunities for integrating stormwater management strategies as part of future capital improvement projects or adjacent development. Office has the lowest impervious-per-acre ratio at 0.17; however, this is attributed to the fact that the few parcels with an office land use designation are primarily open space (i.e., limited impervious surface cover) under the existing condition.

The estimated typical year stormwater runoff volume per acre was calculated by dividing the total runoff volume for a specific land use type by the corresponding parcel area. These ratios, summarized in the blue box on the adjacent graphic, include runoff from impervious and pervious surfaces. Both categories of ratios are unique to the Study Area boundary and to Cleveland. They likely differ from values reported in other data sources or in other areas of the City.



FIGURE 1-20 A

SUMMARY OF IMPERVIOUS PER ACRE AND STORMWATER RUNOFF VOLUME PER ACRE RATIOS FOR KEY LAND USES IN THE STUDY AREA

LAND COVER ANALYSIS

STORMWATER RUNOFF VOLUME (MILLION GALLONS PER ACRE)

0.32 0.47 0.48 0.48 0.51 0.51 0.61 0.65

Similarly to what was completed for existing and future land use, the District completed an analysis of existing and future land cover within the Study Area boundary. Existing land cover (Figure 1-21) was based on available GIS data and future land cover (Figure 1-22) was based on the desired development scenarios represented in the existing city and neighborhood plans described in Section 1. The objective of the land cover analysis was twofold:

• Identify the desired future development types within the Study Area.

Anticipated changes in land cover can influence the range of stormwater management strategies that would be appropriate based on site constraints and development conditions.

Estimate the potential change in the typical year stormwater runoff volume between the existing and future land cover types.

Changes in stormwater runoff volumes may help to identify priority areas for on-site stormwater management and areas of the existing collections system that may require a higher level of control. Additionally, changes in land cover resulting from redevelopment will require compliance with the District's Title IV Code of Regulations, as well as Ohio EPA and City of Cleveland requirements. The land cover analysis was completed through several steps:

First, the drainage areas were defined as the total areas of each of the City's Opportunity Corridor Target Areas and the remainder of the Study Area boundary.

Next, the impervious land cover was quantified within each drainage area. Data was based on the District's 2012 impervious surface layer, which includes right-ofway, and on the 2015 impervious surface layer, which excluded right-of-way. Comparing the two datasets allowed for extracting what portion of impervious surface is contained within right-of-way areas, separate from parcel areas.

Third, pervious land cover within each drainage area was calculated as the total drainage area minus the corresponding impervious land cover within a specific drainage area.

Fourth, the estimated typical year runoff volume, expressed in millions of gallons, was calculated based on existing land cover types within the drainage area. The typical year rainfall was based on an assumed depth of 38.71 inches. For impervious surfaces, 80 percent of the volume generated by the typical year rainfall depth was assumed to be runoff, while 20 percent was assumed for pervious surfaces.

Fifth, future impervious land cover types were identified for the entire Study Area boundary. Land cover represented in existing city and neighborhood plans - which included proposed buildings, parking areas, sidewalks or other pavement, and roadways - was digitized. In areas where existing planning documents did not shows a desired future land use, the existing impervious cover from the District's 2015 dataset was assumed.

Next, impervious and pervious land cover were quantified within each drainage area.

Finally, the estimated typical year runoff volume was calculated for the future land cover scenario and compared to the runoff volumes for the existing land cover scenario.









STUDY AREA BOUNDARY

LAND COVER TYPE*

- EXISTING IMPERVIOUS
- WALKWAY
- PARKING/DRIVEWAY
- ROADWAY
- PROPOSED BUILDING

RAILROAD CORRIDOR

FUTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CITY OF CLEVELAND, NEIGHBORHOOD COMMUNITY DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS Results of the analysis of existing and future land cover within the Study Area are summarized in the adjacent table and accompanying graphic. Based on this analysis, impervious land cover and estimated typical year runoff volume are expected to increase by 81 acres and 51 million gallons, respectively.

Development scenarios proposed in existing planning documents for the City's Core Job Zone are anticipated to add approximately 24 acres of impervious surface and increase stormwater runoff volume by 15 million gallons. Desired development in the Urban Ag Zone and East 79th Development Zone has the potential to add an additional three acres of impervious. Development scenarios proposed for the Slavic Village TOD and New Economy Neighborhood are anticipated to decrease impervious land cover and typical year stormwater runoff volumes.

Figure 1-23 shows the distribution of future impervious land cover types for each Target Area and the remainder of the Study Area boundary. This representation shows that new buildings, parking lots, and roadways are the largest contributors to impervious surface cover. This observation will help to influence the types of on-site stormwater management strategies that may be feasible for future development projects.

		DRAINAGE AREA (ACRES)	IMPERVIOUS COVER (ACRES)			PERVIOUS COVER (ACRES)			RUNO (MILLI	
	Zone		Existing	Proposed	Difference	Existing	Proposed	Difference	Existing	Pr
sas	Core Job Zone	182	78	102	24	105	80	-24	87	
Irget Are	Slavic Village TOD	70	45	39	-6	26	32	6	43	
of Cleveland Ta	Urban Ag. Zone	51	12	14	2	39	37	-2	18	
	E. 79th Development Zone	43	23	24	1	20	19	-1	24	
Ē	New Economy Neighborhood	41	19	18	-1	22	23	1	21	
	Remaining Study Area	1,432	586	647	61	846	785	-61	671	
	Total	1,820	762	844	81	1,058	976	-81	863	

TABLE 1-2

SUMMARY OF THE ANALYSIS OF LAND COVER AND STORMWATER RUNOFF VOLUMES IN THE STUDY AREA, BASED ON EXISTING IMPERVIOUS SURFACE DATA AND FUTURE DEVELOPMENT REPRESENTED IN EXISTING PLANNING DOCUMENTS

Note that Tables 1-1 and 1-2 both summarize land cover types and estimated typical year runoff volumes for existing and proposed scenarios; however, Table 1-1 is based on estimates of future land cover associated with changes in land use represented in the City's Connecting Cleveland 2020 Citywide Plan. Table 1-2 is based on changes in future land cover represented in existing city and neighborhood planning documents.

DISTRIBUTION OF FUTURE IMPERVIOUS LAND COVER TYPES WITHIN THE STUDY AREA BOUNDARY







REGULATORY CONTEXT



REGULATORY CONTEXT

Combined sewer overflows demonstrate how decisions made over one hundred years ago can impact how we develop land in our urban areas today. Combining sanitary sewage and stormwater in the same pipe greatly improved public health, but during rain events this infrastructure cannot adequately manage runoff generated from highly-impervious urban areas. For this reason, there are regulations that aim to minimize the impacts that land development has on urban hydrology.

Similar to more than 700 urban areas in the United States, greater Cleveland has a combined sewer system. Combined sewers were designed in the nineteenth century to transport sanitary sewage, industrial waste, and stormwater runoff in a single pipe and discharge to local streams, rivers, and Lake Erie. At the time, this technology greatly improved public health by removing wastewater and stormwater from streets and neighborhoods where it caused a range of problems, including sickness, disease, odors, and flooding.

Starting in the early 20th century, Cleveland's combined sewer system was upgraded with large interceptor sewers. The interceptors captured flows from the combined sewer system and conveyed them to one of three wastewater treatment plants rather than directly to the environment.

The network of new sewers greatly reduced untreated discharges to the environment; however, it was not perfect. During rain events, the network was designed to prevent basement backups, urban flooding, and damages to infrastructure and treatment plants by allowing a portion of flows to discharge directly to streams, rivers, and Lake Erie. Locations where these discharges of untreated combined wastewater occur, as well as the discharge events themselves, are known as combined sewer overflows (CSOs). CSOs are located along major waterways throughout Cleveland. Figure 2-1 shows the approximate extent of the combined sewer service area.

Because CSO discharges are a mixture of stormwater runoff and sanitary sewage, a range of pollutants is discharged to area waterways during overflow events. Floating material and debris are a highly visible problem that CSOs can cause. A more significant problem is the bacteria present in CSOs. High bacteria counts in area waterways impact public health, recreational opportunities, aquatic life, and wildlife that relies on clean water for food and habitat.







CITY OF CLEVELAND BOUNDARY

APPROXIMATE COMBINED SEWER SERVICE AREA

OPPORTUNITY CORRIDOR ROADWAY ALIGNMENT One of the primary causes of combined sewer overflows is the change in upstream hydrology from land development. Stated simply, installation of impervious surfaces (e.g., pavements, sidewalks, streets, and rooftops) and underground drainage networks has changed the way rainfall interacts with the landscape. Rather than slowly soak into the ground or run over land to natural waterways, rainfall hits developed land, becomes stormwater runoff, and flows at a higher volume and faster rate to the existing sewer system.

During a rain event, the maximum rate at which flow through the sewer is the highest is called the peak flow rate. It occurs after the period of maximum rainfall intensity and when most of the tributary watershed is generating runoff. Figure 2-2 shows hypothetical hydrographs comparing peak flows in a watershed for pre-development and post-development scenarios.

Increasing both the volume of surface runoff generated and the rate at which runoff accumulates reduces the time at which a peak flow rate is reached during a rain event. This inundates the existing combined sewer system and can result in combined sewer overflows.



▲ FIGURE 2-2 HYPOTHETICAL HYDROGRAPHS COMPARING PRE- AND POST-DEVELOPMENT PEAK FLOWS IN A WATERSHED





Project Clean Lake is a \$3 billion, 25-year program that will reduce the total volume of raw sewage discharges from 4.5 billion gallons to 494 million gallons annually. At the heart of Project Clean Lake is the construction of seven large-scale storage tunnels, enhancements at the Sewer District's three treatment plants, and several regional green infrastructure projects. The green infrastructure projects include new, separate storm sewers that collect stormwater runoff and direct it to large-scale stormwater control measures before slowly releasing it back to the combined sewer system or discharging directly to the environment. Once Project Clean Lake is complete, over 98% of wet weather flows in the combined sewer system will receive treatment.

The Sewer District is not alone in reducing the volume and frequency of combined sewer overflows. Land owners and developers also play a role through compliance with local stormwater management regulations.

In Cleveland there are two entities responsible for developing and enforcing stormwater management regulations: the Northeast Ohio Regional Sewer District and the City of Cleveland. The regulations fall under two general goals:

1. To manage peak flow rates in the combined sewer system

The Title IV Combined Sewer Code provides the Northeast Ohio Regional Sewer District with the authority to control peak flows from development to ensure that stormwater runoff generated on a site does not negatively impact downstream sewer systems and the environment. Additionally, Chapter 541 of the Codified Ordinances of the City of Cleveland provides the City with the authority to require on-site detention.

2. To improve the quality of runoff that is collected and managed on-site

Chapter 3116 of the Codified Ordinances of the City of Cleveland provides the City with the authority to require on-site stormwater management controls that reduce pollutant and sediment loadings to downstream sewer systems and the environment.





TITLE IV

The Title IV Combined Sewer Code is part of the District's Code of Regulations. It provides the District with the authority to control combined sewer overflows from the combined sewer system and to regulate peak flows from local combined sewer systems at the point of connection into sewers owned by the District or member community (e.g., City of Cleveland). The Sewer District has the authority to review all requests for connection approval within the combined sewer system.

The purpose of Title IV is, "to provide a procedure by which the District and each Community ... can cooperate to control combined sewer overflows in their sewer systems and control peak flows from Community combined sewer systems at the point of connection into sewers owned by the District or another Community."

Title IV focuses on one key variable:



At new developments and redevelopments in the combined sewer system, the District will not authorize increases in post-development peak flows, CSO volumes, or typical year activations; therefore, any development project must incorporate on-site stormwater control measures that reduce peak flow discharges when compared to existing condition peak flows.

CODE OF REGULATIONS OF THE NORTHEAST OHIO REGIONAL SEWER DISTRICT

> TITLE IV COMBINED SEWER CODE



TITLE IV IS AVAILABLE FOR DOWNLOAD AT: http://www.neorsd.org

Title IV applies to all development within the Opportunity Corridor Study Area boundary. In fact, it is applicable to all projects within the District's service area that are served by combined sewers, have separate sanitary and/or storm sewers directly tributary to a combined sewer or, as determined by the District, are significantly contributing to a combined sewer overflow.

The District implements Title IV by reviewing development and redevelopment plans and supporting documentation in order to verify peak flows that will be discharged from a given connection point into a combined sewer or a storm sewer connected to a combined sewer.

To assist land owners and developers with developing an application for review, the District provides a guidance manual: Submittal Requirements for Connections to the Combined Sewer System. The manual identifies the following general components of a complete application for Title IV review:

Stormwater Management Report A report detailing the basis of design and including all pertinent pre- and post-development stormwater management design information, hydrologic and hydraulic calculations, assumptions, and parameters used.

Northeast Ohio **Regional Sewer District**

Submittal Requirements for Connections to the Combined Sewer System

Guidelines for Review and Approval

Requests for connection approval are required for all new development and redevelopment projects within the NEORSD service area seeking to connect to a combined server, combined server overflow (CSO) pipe, or separated storm server tributary to a combined server or CSO pipe.



Version 1.2

THE MOST CURRENT VERSION OF THE GUIDANCE MANUAL IS AVAILABLE FOR DOWNLOAD AT: http://www.neorsd.org

Site Maps and Project Plans

Site maps and project plans must accompany the Stormwater Management Report and clearly show the following: project location; drainage areas/ sewersheds; existing and proposed land cover types; longest flow paths for existing and proposed conditions; existing topography and proposed grades; locations, sizes, and types of all existing and proposed storm sewers, channels, and stormwater structures; plans and details for all stormwater control measures; predominant soil type from USDA soil surveys or soil borings from the site.

Operations & Maintenance Plan

A long-term operation and maintenance plan must be included. The plan shall identify the entity responsible for inspections, operation, and maintenance and describe a planned maintenance schedule. If a maintenance agreement is in place, it must be included with the application.

The most current guidance document, available on the District's website, should be referenced for a full description of the items required for a Title IV application.

The manual also defines minimum design standards, which are separated into two categories based on the size of the development or redevelopment project: projects from 0.5 acres up to one acre, and projects greater than or equal to one acre.

For both categories, the pre-development condition is defined as the current site condition at the time of submission to the District.

Regardless of the size of the project, the District will review Title IV applications to ensure that the proposed stormwater drainage system, which includes the on-site stormwater control measures, has the capacity to handle all contributing flow without negatively impacting the existing level of service in the combined sewer system.





- Projects from 0.5 acres up to one acre For storm events from the 6-month, 24-hour event up to and including the 25-year, 24-hour event, the post-development peak discharge rates shall not exceed the pre-development peak discharge rate for corresponding storm frequency.
- Projects greater than or equal to one acre For storm events from the 6-month, 24-hour event up to and including the 5-year, 24-hour event, the postdevelopment peak discharge rates shall not exceed the pre-development peak discharge rate for the 6-month, 24-hour storm event.

For storm events greater than the 5-year, 24-hour event, up to the 100-year, 24-hour event, the postdevelopment peak discharge rate shall not exceed the pre-development peak discharge rate for the corresponding storm frequency.

In the application, the performance of the proposed system shall be demonstrated for a range of stormwater events. The depths, in inches, and intensity, in inches per hour, for rainfall events applicable to Title IV compliance are summarized in Figure 2-3. These include the following rain events, each with a 24-hour duration:

· 6-month	· 10-year
· 1-year	· 25-year
· 2-year	· 50-year
· 5-year	· 100-year





At a minimum, the application for Title IV review must include a summary of pre- and post-development peak discharge rates for these specific events based on the two area categories.

Figures 2-4 and 2-5, respectively, compare predevelopment peak discharges to post-development peak discharges for a hypothetical project less than one acre and greater than or equal to one acre in size. For each event, the red portion of the post-development peak discharge represents the reduction that must be achieved to comply with the requirements of Title IV.

Additionally, for sites greater than or equal to one acre, construction site pollutant control and post-construction water quality shall be managed in accordance with Chapter 3116 of the City's Codified Ordinances or the most current version of the Ohio EPA's Construction General Permit. Both are described later in this section.

Note that in the combined sewer system area, Title IV also applies to separate storm infrastructure that discharges directly to the environment - for example, through a connection to an existing culvert, existing separate storm infrastructure, or a stormwater outfall (SWO). In these situations, the application must demonstrate that postconstruction water quality requirements required by the District and the City of Cleveland are met.

SUMMARY OF DEPTHS (TOP) AND INTENSITIES (BOTTOM) FOR RAINFALL EVENTS APPLICABLE TO TITLE IV COMPLIANCE



SHALL NOT EXCEED THE PRE-DEVELOPMENT PEAK DISCHARGE RATE FOR THE CORRESPONDING STORM FREQUENCY



FIGURE 2-4 HYPOTHETICAL GRAPH SHOWING TITLE IV COMPLIANCE REQUIREMENTS FOR A PARCEL BETWEEN 0.5 ACRES AND ONE ACRE IN SIZE

FIGURE 2-5 HYPOTHETICAL GRAPH SHOWING TITLE IV COMPLIANCE REQUIREMENTS FOR A PARCEL GREATER THAN OR EQUAL TO ONE ACRE IN SIZE



CHAPTER 541

Chapter 541 of the Codified Ordinances of the City of Cleveland provides the City's Division of Water Pollution Control (WPC) with the authority to regulate connections to sewers owned by the City.

Chapter 541 prohibits illegal and illicit discharges to the City's sewer system and establishes the process for dealing with those discharges. Additionally, sections 11 and 12 reference one key variable related to on-site stormwater management:



Section 11 defines unacceptable discharges, which include any wastewater flow rates that exceed the design capacity of and any water that increases the hydraulic loading on the downstream sewer system.

If flow rates are considered unacceptable, then per Section 12 WPC has the authority to require on-site modifications - for example, pretreatment or storage facilities - to reduce, eliminate, or equalize flows.

CHAPTER 541 - SEWER CONNECTIONS AND SEWER USE CODE

541.01 Definitions 541.02 Jurisdiction Over Sewer Connections 541.03 Responsibility for Installation and Maintenance of Sewer Connections 541.04 Sewer Builder's License and Bond 541.05 Sewer Connection Permits 541.06 Sewer Construction Requirements 541.07 Catch Basins 541.08 Clear Water Connections 541.09 Sewer Construction Inspection 541.10 Guarantee 541.11 Regulation of Discharges 541.12 Control of Unacceptable Discharges 541.13 Sewerage Test Tee Inspection, Installation and Snaking 541.97 Enforcement Procedures 541.98 Administration 541.99 Penalty Sewer, water and other connections, Charter § 163

Charter reference:

Cross-reference:

Rules and regulations for sewerage system, CO 543.08 Sewerage service charges; payment, CO Ch. 543 Tampering with or possessing manhole covers, CO 625.22, 625.23

Statutory reference: Compulsory sewer connections, RC 729.06 Interference with sewage flow, RC 4933.24 Management and control of sewerage system, RC 729.50 Power to construct sewerage system, RC 715.40, 717.01 Regulations to control house sewers and connections, RC 729.51

The type of stormwater management required by WPC is determined on a case-by-case basis and may consider one or more of the following factors:

- · Location and size of the property
- · Type of improvement/project
- · Location of adjacent sewers
- Type of adjacent sewers (e.g., combined, separate)
- · Downstream capacity

WPC's requirements for on-site stormwater management are in addition to those required by the Northeast Ohio Regional Sewer District under Title IV.

When pretreatment, equalization, or storage facilities are required, then WPC will review plans, specifications, and other pertinent data prior to implementation.

CHAPTER 541 IS AVAILABLE FOR DOWNLOAD AT: http://library.amlegal.com



WPC'S GUIDANCE DOCUMENT IS AVAILABLE FOR DOWNLOAD AT: http://www.clevelandwpc.com

WPC's Engineering Section provides a guidance document that summarizes many of the key requirements listed in Chapter 514, including the following:

Stormwater detention and drainage calculations may be required by WPC's Engineering Section.

Elimination or reduction of stormwater runoff into public sewers is highly recommended.

Prior to WPC's final approval for any sewer-related permits, the City's Department of Building and Housing must approve plans.



5 CHAPTER 3116

Through Chapter 3116 of the Codified Ordinances of the City of Cleveland, the City requires on-site stormwater management controls that reduce pollutant and sediment loadings to downstream sewer systems and the environment. The City has the authority to request the submittal of a Stormwater Pollution Prevention Plan (SWP3) for any construction activity in Cleveland that is equal to or greater than one acre.

The purpose of Chapter 3116 is to control construction and post-construction stormwater runoff. The City requires erosion and sediment controls and registration of permits for all construction projects within the City that disturb one or more acres of land.

Chapter 3116 falls under the City's Land Use Code specifically, Title XIII Building Code. It focuses on one key variable:



During construction activities (e.g., clearing, grading, excavating, filling), sediment runoff rates are typically greater than those of agricultural lands, and significantly greater than those of forested or stabilized land surfaces. In even short periods of time, construction sites can contribute more sediment to downstream sewers and streams than can be deposited naturally over several decades. The resulting siltation, and the contribution of other pollutants from construction sites, can negatively impact the performance of downstream sewer infrastructure and the natural processes within surface waters.

CHAPTER 3116 - CONSTRUCTION AND POST-CONSTRUCTION SITE STORM WATER RUNOFF CONTROL

116.01	Definitions
116.02	General Provisions
\$116.03	Permit Required
116.04	Plan Review, Inspections and Record Keeping; Contract Authority
116.05	Permit Application; Fee
116.06	Approval or Disapproval of Storm Water Pollution Prevention Plan
116.07	Issuance of Permit; Appeal
116.08	Periodic Inspections of Construction Activities
116.09	Amendment of Approved Plan
onstruc	Final Inspection, Certificate of Completion of Construction Activities and Post tion Management
116.11	Periodic and Final Inspection Fees
116.12	Waivers
3116.13	Severability

Statutory reference:

Construction and demolition debris, RC Ch. 3714

§ 3116.01 Definitions

The definitions contained in Ohio Environmental Protection Agency ("Ohio EPA") General Permit Number "OHC000003", entitled "Authorization for Storm Water Discharges Associated With Construction Activity under the National Pollutant Discharge Elimination System" in effect at the time a nermit is applied for under this chapter shall apply to this chapter, except the following definitions shall apply:

(a) "Construction activity" for numous of this chanter means any clearing erading excavating grubbing, trench dewatering, and/or filling activities that disturb one (1) or more acres of land. The threshold acrease includes the entire area disturbed in the larger common plan of development or sale.

(b) "Director" means the Director of Building and Housing or his or her designee

(c) "Ohio EPA Permit No. OHC000003" means the Ohio EPA's National Pollutant Discharge Elimination System construction general permit number OffC000003, effective April 21, 2008 and any subsequent generations of that permit issued by the Ohio EPA

(d) "Person" means any individual, partnership, firm, association, joint venture, public or private

CHAPTER 3116 IS AVAILABLE FOR DOWNLOAD AT: http://library.amlegal.com

In the combined sewer system, for example, sediment loadings can clog pipes and contribute to blockages, backups, and even overflows. In direct stormwater discharges to the environment, too much sediment can cloud the water and make it difficult or impossible for aquatic plants to receive adequate sunlight. Excess sediment also smothers aquatic habitat, clogs fish gills, and impedes navigation in waterways, which can lead to expensive dredging.

Following construction, stormwater runoff from the site collects pollutants like sediment, oil and grease, nitrogen and phosphorus, and other chemicals and transports them into downstream storm infrastructure or surface waters.

On-site stormwater management controls that prevent the contamination of stormwater are critically important during and after construction to manage pollutants and limit impacts on surface waters used for recreation and on sources of drinking water.

Chapter 3116 applies to all new and existing stormwater discharges associated with construction activity that enters surface waters of the State, or a storm drain leading to surface waters of the State, or to a public sewer drain. The City of Cleveland Department of Building and Housing administers Chapter 3116, and coordinates with the Cuyahoga Soil and Water Conservation District to review plans, conduct inspections, provide reports, and do field enforcement of this ordinance.

Chapter 3116 references the requirements prescribed in the Ohio Environmental Protection Agency's (Ohio EPA) General Permit Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System. This is also known as OHC000004, or the Construction General Permit (CGP).

The goal of the **Construction General Permit** is to ensure compliance with the federal Water Pollution Control Act, the Ohio Water Pollution Control Act (Ohio Revised Code Chapter 6111) and the Ohio Administrative Code Chapter 3745-1 (Water Quality Standards).

Note that the Oho EPA's CGP is frequently updated. The most current version of the CGP should be obtained directly from Ohio EPA's website.

Part II of the CGP identifies non-numeric effluent limitations for construction activities. These include general guidelines for erosion and sediment controls, soil stabilization, dewatering, pollution prevention measures, prohibited discharges, and surface outlets. Part III of the CGP describes specific design criteria for meeting nonnumeric effluent limitations, which include non-structural preservation methods, erosion control practices, runoff control practices, and sediment control practices. These are outlined in subsections G.2.a through G.2.e.

Part III also describes requirements for a SWP3, which must be submitted to and approved by the City of Cleveland prior to the start of construction. A SWP3 describes and ensures the implementation of best management practices, or stormwater control measures (SCMs), that reduce pollutants in stormwater discharges during construction and pollutants associated with postconstruction activities.

OHIO E.P.Á. Issuance APR 11, 200 Effective INTERIO DIRECTOR'S JOURNAL Expiration

OHIO ENVIRONMENTAL PROTECTION AGENCY

GENERAL PERMIT AUTHORIZATION FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the federal Water Pollution Control Act, as amended (33 J.S.C. Section 1251 et. seq. hereafter referred to as "the Act") and the Ohio Water Pollution Control Act [Ohio Revised Code ("ORC") Chapter 6111], dischargers of storm water from sites where construction activity is being conducted, as defined in Part I.B of this permit, are uthorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the outfalls at the sites and to the receiving surface waters of the state identified in their Notice of Intent ("NOI") application form on file with Ohio FPA in accordance with the conditions specified in Parts I through VII of this permit.

It has been determined that a lowering of water quality of various waters of the state associated with granting coverage under this permit is necessary to accommodate important social and conomic development in the state of Ohio. In accordance with OAC 3745-1-05, this decision was reached only after examining a series of technical alternatives, reviewing social and economic issues related to the degradation, and considering all public and intergovernmental comments received concerning the procesal

This permit is conditioned upon payment of applicable fees, submittal of a complete NOI application form and written approval of coverage from the director of Ohio EPA in accordance with Ohio Administrative Code ("OAC") Rule 3745-38-02.

> I certify this to be a true and accurate copy of the official documents as fied in the records of the Chil wental Protection Agency

THE MOST CURRENT VERSION OF THE GENERAL PERMIT IS AVAILABLE FOR DOWNLOAD AT: http://www.epa.ohio.gov/dsw/permits/GP ConstructionSiteStormWater.aspx

Scott J. Nally

Director



Page 1 of 37 Ohio EPA Permit No.: OHC000004

Date:	April 11, 2013
Date:	April 21, 2013
on Date:	April 20, 2018

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In the description of requirements for post-construction stormwater management, Part III.G.2.e references the Water Quality Volume, or WQv. Based on Ohio EPA guidance, the WQv is the volume of stormwater runoff that should be captured and treated during any storm in order to remove a majority of pollutants on an average annual basis, and is calculated from an equation outlined in the CGP:

$WQ_v = C \cdot P \cdot A/12$

The values for C (runoff coefficient) and A (tributary drainage area, in acres) are specific to the unique conditions of the development site and the area draining to the SCM. The value for P is equal to 0.75 inches and was determined based on an analysis of long-term rainfall data, which showed that 85% of storm events in Ohio result in a rainfall depth of 0.50 inches or less. Multiplying 0.5 inches by 1.5 (in order to maximize volume capture) results in 0.75 inches, which is the precipitation depth used for the P variable in the calculation of the WQv.

Capturing and treating the WQv results in the capture and treatment of the entire volume for 85% of the average annual storm events. The CGP defines two scenarios. Redevelopment and New Development, each of which has different requirements. Redevelopment refers to construction projects on land where impervious surfaces exist and where the newly-constructed land use (i.e., the post-construction condition) will not increase the runoff coefficient. If the runoff coefficient will increase, then the project is considered to be new development.

In a planning context, most of the land in the Opportunity Corridor Study Area will be considered as redevelopment since new land use types will replace former land uses or vacant property; however, for the purposes of compliance with Chapter 3116 and the CGP, any redevelopment that results in increasing impervious surfaces compared to existing conditions is considered to be a new development.

The process for sizing post-construction SCMs for compliance with Chapter 3116 and the CGP falls under one of two categories:

Large Sites (greater than 5 acres)

For new development projects, stormwater SCMs must be sized to treat the WQv plus an additional 20% for sediment storage.

For redevelopment projects, there are three options for meeting post-construction requirements:

- 1. Reduce the post-construction impervious area by 20% when compared to the pre-construction impervious area; or,
- 2. Provide treatment for at least 20% of the WQv: or.
- 3. A combination (1) and (2)

Small Sites (between 1 acre and five acres) Structural measures should be placed on upland soils to the degrees attainable. Note, however, that the Ohio EPA clarified in 2007 that the requirements for small sites do not imply that structural controls are optional. In fact, post-construction SCMs are required to address anticipated impacts on water quality similarly to what is required on large sites.

The 2007 Post-Construction Q&A Document published by the Ohio EPA is a helpful resource for clarifying questions related to the CGP.

ChieFPA Infide of Surface Nator Post-Construction Q&A Document

RE: Guidance Regarding Post-Construction Storm Water Management Requirements of Ohio EPA's Storm Water Construction General Permit #OHC000002

Date: March 20, 2007

On April 21, 2003. Ohio EPA renewed the storm water NPDES Construction General Permit (CGP). The new CGP contains requirements for nost-construction Best Management Practices (RMPs) on all sites where the larger common plan of development or sale calls for 1 or more acres of land disturbance. Since the renewal of the CGP. Ohio EPA has received a number of questions regarding the requirements. It is the intention of this document to clarify and provide guidance regarding those requirements.

1. When are post-construction BMPs required?

construction BMPs are required on all sites where the larger common plan of development or sale calls for 1 or more acres of land disturbance except:

- (1) Linear projects that do not create impervious surfaces (e.g., installation of a gas pipeline), or
- Road construction projects by public entities where construction activities are initiated prior to March 10, 2006.

The exemption for public road projects is not automatic. Part III.G.2.e of the CGP states that post-construction BMPs must be implemented on these projects as of April 21, 2003, where practicable (see Question 2).

All other projects are subject to these requirements at this time and must include postconstruction BMPs in the Storm Water Pollution Prevention Plan (SWP3

2. How do I determine if a public transportation project is exempt from post-construction requirements prior to March 10, 2006?

in financed and planned years in advance of the CGP renewal (OHC000002), additional time has been provided for public transportation projects to include post-construction BMPs that comply with the requirements of Part III.G.2.e of the CGP. Public transportation projects often involve unique planning challenges, such as the use of eminent domain and obtaining easements. Therefore, public entities (i.e., the State of Ohio, counties, townships, cities or villages) shall comply with the post-construction storm water management requirements of Part III.G.2.e on roadway construction projects initiated after March 10, 2006, and where practicable for projects initiated as of the effective date of the CGP and thereafter. Ohio EPA considers "where practicable" to mean that if financing and planning for the public road projects occur after

Regardless of the size of the site, post-construction SCMs must be included to manage stormwater runoff if impervious surfaces will increase. If impervious surfaces decrease, then post-construction SCMs may also be required if the total decrease in impervious is less than 20%.

All on-site stormwater control measures shall be designed in accordance with the methodology included in the most current edition of the Rainwater and Land Development Manual, which is issued by the Ohio Department of Natural Resources. The steps for calculating the WQv for a development site are as follows:

- . Calculate the minimum required WQv The calculation is based on the proportional mix of new development and redevelopment areas within the proposed disturbed area
- 2. Calculate the WQv for each SCM Calculations are based on tributary drainage area characteristics to each proposed SCM
- 3. Verify Compliance The sum of each SCM's associated WQv must meet or exceed the minimum required WQv for the site



Rainwater and Land Development

Ohio's Standards for Stormwater Management Land Development and Urban Stream Protection

Ohio Department of Natural Resources Division of Soil and Water Conservation

2045 Morse Road, Building B-3 Columbus, Ohio 43229-6605 (614) 265-6610

THE MOST CURRENT VERSION OF THIS GUIDANCE MANUAL IS AVAILABLE FOR DOWNLOAD AT: http://epa.ohio.gov/dsw/storm/technical_guidance.aspx

A QUESTIONS & ANSWERS GUIDANCE DOCUMENTS IS AVAILABLE FROM OHIO EPA AT: http://www.epa.ohio.gov/dsw/storm/CGPPCQA.aspx



*Third Edition 2006

*Updated to include all new materials changes and corrections as of 11-6-14

This publication was landed in part by the Diso Water Development Authority through a neuranch and development gran

COMPLIANCE PROCESS

The process for demonstrating compliance with local on-site stormwater management regulations varies depending on the size of the property and the characteristics of the proposed development - specifically, the change in the total impervious surface area.

0.5 acres up to 1 acre

For projects impacting between 0.5 acres and one acre, the compliance process for stormwater management focuses on managing peak flow rates to ensure no negative impacts on downstream sewer capacity. Applicable regulations include the Northeast Ohio Regional Sewer District's Title IV Combined Sewer Code and the City of Cleveland's Chapter 541.

Figure 2-6 summarizes the two potential scenarios for projects of this size. If the project decreases the total area of impervious surfaces, then on-site SCMs are not required; however, a submittal to the District for Title *IV* compliance review is still necessary. The intent of the submittal to the District is to demonstrate that postdevelopment peak discharge rates (Q_{DDE}) will not exceed pre-development peak discharge rates (Q_{POST}).

If the project increases the total area of impervious surfaces, then on-site SCMs are required and shall be designed to meet the requirements outlined in the District's Submittal Requirements for Connections to the Combined Sewer System. Note that per Chapter 541, WPC may require on-site SCMs in either scenario. Coordination with WPC early in the design process is recommended.



REGULATORY PROCESS DIAGRAM FOR PROJECTS BETWEEN 0.5 ACRES AND ONE ACRE



Greater than or equal to 1 acre

For projects impacting one acre or more, the compliance process for stormwater management focuses on managing peak flow rates to ensure no negative impacts on downstream sewer capacity and on improving water quality during and after construction activities. Applicable regulations include the Northeast Ohio Regional Sewer District's Title IV Combined Sewer Code, and Chapters 541 and 3116 of the Codified Ordinances of the City of Cleveland.

Figure 2-7 summarizes the two potential scenarios for projects of this size. If the project decreases the total area of impervious surfaces, a submittal to the District for Title *IV* compliance review is still necessary to demonstrate that post-development peak discharge rates (Q_{ppc}) will not exceed pre-development peak discharge rates (Q_{POST}). If Q_{post} exceeds Q_{post} then on-site SCMs are required and shall be designed to meet the requirements outlined in the District's Submittal Requirements for Connections to the Combined Sewer System. Additionally, compliance with Chapter 3116 is required by capturing and treating 20% of the WQv or through a 20% reduction in impervious surfaces (or a combination of the two).

If the project increases the total area of impervious surfaces, then on-site SCMs are required per Title IV and Chapter 3116 and shall be designed to meet the requirements in the most current versions of the District's Submittal Requirements for Connections to the Combined Sewer System and ODNR's Rainwater and Land Development Manual.

Note that per Chapter 541, WPC may require on-site SCMs in either scenario. Coordination with WPC early in the design process is recommended.



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CHAPTER 3116 - CONSTRUCTION AND POST-CONSTRUCTION SITE STORM WATER RUNOFF CONTROL

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3136.08 Approval or Disapproval of Storm Water 2

3156-08 Particular Inspections of Communities Activities 3135.10° Antendence of Approval Plan

313647 Issuesce of Permit, Appeal

3135.11 Periodic and Final Reportion Face



FIGURE 2-7 ► THAN OR EQUAL TO ONE ACRE



INCENTIVES: TITLE V

The Title V Stormwater Management Code is part of the District's Code of Regulations. It provides the District with the authority to operate, maintain, improve, administer, and provide stormwater management of the Regional Stormwater System and to facilitate and integrate activities that benefit and improve watershed conditions across the District's stormwater service area.

In addition to impacting the combined sewer system, stormwater runoff contributes to regional flooding, erosion, and water-quality issues. Title V creates the basis for the District's Regional Stormwater Management Program (RSMP). Through the RSMP, the District addresses stormwater problems within the regional stormwater system, which includes the system of watercourses, stormwater conveyance structures, and SCMs in the District's service area that receive drainage from 300 acres or more of land.

Property owners within the stormwater service area pay a monthly stormwater fee based on Equivalent Residential Units (ERUs). One ERU is equal to 3,000 square feet of impervious area. For example, property with 25,000 square feet of impervious area would have 8.33 ERUs.

Title V is not a compliance requirement for developments that connect to combined sewers; however, when property owners manage stormwater runoff on their property, they may be eligible for a credit towards the monthly stormwater fee under Title V. This applies to property owners anywhere in the District's stormwater service area, including the combined sewer system.

Customers can receive a credit, which is a conditional reduction in the stormwater fee, if an account holder takes measures to reduce the stormwater rate and/or volume, and/or protect the water quality of runoff flowing from the property to the RSS. The credit can be obtained through:

- Installation and continuing use, operation, and maintenance of a District-approved SCM that the District does not own, maintain, or operate; or
- Activities that reduce or alleviate the District's cost of providing a RSMP.

The credit can be a quantity credit and/or a quality credit (Figure 2-8), each of which has separate criteria that must be met, as determined by the District. The types of Districtapproved SCMs and the associated requirements of each are outlined in the most recent version of the District's Stormwater Fee Credit Policy Manual. Additionally, this manual also contains the required credit application, which must be submitted to the District's Watershed Programs Department.



THE MOST CURRENT VERSION OF THE DISTRICT'S STORMWATER FEE CREDIT POLICY MANUAL IS AVAILABLE FOR DOWNLOAD AT: http://www.neorsd.org

QUANTITY CREDIT

.........

A STORMWATER QUANTITY CREDIT UP TO 75% IS AVAILABLE TO APPLICANTS WHO HAVE **DISTRICT-APPROVED SCMs THAT REDUCE THE** RATE AND/OR VOLUME OF STORMWATER RUNOFF FLOWING FROM IMPERVIOUS SURFACES ON THE APPLICANT'S PROPERTY. ONLY THE IMPERVIOUS SURFACES OF A PARTICULAR SITE THAT DRAIN THROUGH THE SCM ARE ELIGIBLE FOR A CREDIT.









100-YEAR 50%

2-YEAR 25%

FIGURE 2-8 OVERVIEW OF STORMWATER FEE CREDITS AVAILABLE UNDER TITLE V

************************ QUALITY CREDIT

> A STORMWATER QUALITY CREDIT OF UP TO 25% IS AVAILABLE TO APPLICANTS WHO HAVE DISTRICT-APPROVED SCMS THAT PROVIDE WATER **QUALITY TREATMENT** TO STORMWATER RUNOFF FLOWING THROUGH THE SCM. THE CREDIT IS ONLY AVAILABLE FOR THE IMPERVIOUS SURFACES THAT DRAIN TO EACH SCM.



















STORMWATER CONTROL MEASURES



STORMWATER CONTROL MEASURES

Stormwater Control Measures (SCMs) refer to the range of strategies for managing stormwater runoff - both volume and peak discharge rates - generated on a development site before discharging to a downstream system. On some sites, one centrally-located SCM is sufficient for meeting local stormwater regulations, while on others, multiple SCMs may be necessary. SCMs can include traditional infrastructure like underground storage chambers and extended detention basins, or green infrastructure like pervious pavements and bioretention. Regardless of the SCMs used, each has its own unique requirements.

This chapter provides general descriptions of SCMs that are commonly used to manage runoff on an individual site. The descriptions cover system components, and spatial, design, construction, and maintenance considerations. Conceptual cross sections and photos of installed SCMs are also included.

SCMs are organized into one of three categories:

- Surface Management,
- Subsurface Management, and
- Above-Ground Management

The categories relate to the unique site conditions that typically impact the physical characteristics of a development. For example, sites with available open space adjacent to a surface parking lot or building may provide opportunities to manage stormwater runoff on the surface, while sites that have constraints due to building footprints, parking needs, or topography may require managing stormwater runoff below the surface or aboveground. Subsurface and above-ground management strategies are also appropriate for site uses that have demand for non-potable water - for example, for landscape irrigation.

Categories and types of SCMs are shown in Figure 3-1. Surface management SCMs include bioretention, dry extended detention basins, wet extended detention basins, and tree planters.

Subsurface management SCMs include pervious pavements (concrete, pavers, or asphalt), infiltration, and underground storage.

Above-ground management SCMs include rainwater harvesting (cisterns, rain barrels) and green roofs.











FIGURE 3-1 >





TREE PLANTERS



BIORETENTION

Bioretention refers to a surface depression with engineered soil, stone layers, and specialized plants. While maintenance requirements are often higher than traditional extended detention, bioretention provides greater water quality benefits and improved aesthetics. Bioretention can range in size from large detention basins to small planters integrated within parking lots.

Bioretention is a method for managing stormwater runoff on the surface. Bioretention delays and reduces the volume of stormwater runoff through native soil infiltration and adsorption from plants and within soil (i.e., evapotranspiration). Water quality is improved by promoting settling, microbial breakdown, and nutrient assimilation by plants.



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When sized to comply with Title IV regulations, which is often achieved with enhanced designs (e.g., oversizing), bioretention may be eligible for a 15% Peak Flow Credit. A 25% credit may be available with higher levels of control.

A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume. Significant infiltration is required to obtain this credit.

When properly designed, installed, and maintained, bioretention may be eligible for a 25% Stormwater Quality Credit, which is the typical credit for this type of control measure.

SYSTEM COMPONENTS

Components of bioretention (Figure 3-2) include native plants, bioretention soil, and filter and aggregate layers, Typical depths of the soil, filter, and aggregate storage layers are 24 inches, 6 inches, and 12 inches, respectively; however, depths of the filter and aggregate storage layer can vary depending on storage needs and/or site constraints.

An overflow structure regulates flows from the bioretention system to downstream sewer systems. A subsurface underdrain system, with clean-outs, is typically connected to the overflow structure when infiltration into native soils is not feasible. Edge restraints – for example, a concrete curb flush with the ground surface – can be included to separate bioretention areas from the adjacent landscape.

SPATIAL CONSIDERATIONS

Bioretention can take the form of a bioretention basin or a bioswale. Basins are most suitable within open space, lawn areas, or integrated within or adjacent to large parking areas. Bioswales are linear strips of bioretention systems with minimum slope. They are most suitable adjacent to roadways or small parking areas, or downstream of building downspouts. Figures 3-3 through 3-7 show examples of bioretention.



The geometry of bioretention is flexible and usually depends on the unique set of site constraints: for example, existing topography, proximity to buildings or roadways, or existing utilities. Incorporate appropriate setbacks from building foundations and property lines, and avoid conflicts with the groundwater table.

DESIGN CONSIDERATIONS

Stormwater runoff is conveyed to bioretention via overland flow, through curb cuts near adjacent pavement, or through a headwall connected to upstream storm sewer infrastructure. In all scenarios, sufficient erosion protection, energy dissipation, and flow spreading measures are required.

The typical ratio of bioretention surface area to tributary drainage area is 1:15 (i.e., one square foot of bioretention system would manage the stormwater runoff from 15 square feet of drainage area), although ratios can range between 1:10 and 1:20 depending on spatial constraints and the land cover characteristics of the upstream drainage area. At a minimum, bioretention systems should be sized to fully capture and treat the Ohio EPA's water quality volume, which is the stormwater runoff generated during the 0.75-inch rain event.

HEADWALL

discharges runoff into bioretention from upstream infrastructure



NATIVE PLANTS

reduce runoff volume, improve water quality, and provide habitat

and helps with maintenance

BIORETENTION SOIL

specialized soil that provides a controlled infiltration rate (minimum depth = 24 inches)

FILTER LAYER

protects aggregate and underdrain from fine particles (depth = 6 inches)

UNDERDRAIN

connects to overflow structure; prevents standing water and controls stormwater runoff peak flow rates

AGGREGATE LAYER

provides subsurface storage of stormwater runoff (minimum depth = 12 inches)

FIGURE 3-2



EDGE RESTRAINT

(optional) separates different landscape types



The design of the overflow structure should be based on meeting local requirements for maximum postdevelopment peak flow rates and volume attenuation. The bioretention system, including the underdrain(s) and overflow structure, should be fully drained within 48 hours. Surface ponding should draw down within 24 hours.

Plant species should be non-invasive and native to Northeast Ohio. Species should be able to withstand variable moisture and temperature conditions, as well as periodic inundation and saturated soil conditions. Trees are typically not planted within the bottom of bioretention, but can be planted on side slopes so long as roots will not negatively impact sewer infrastructure.

CONSTRUCTION CONSIDERATIONS

Sediment control measures must be incorporated and maintained at all times during construction. These measures prevent construction site runoff and sediment from entering and clogging the bioretention system. In the case that sediment enters a bioretention feature during construction, sediment should be immediately removed and properly disposed.

Construction should be suspended during periods of rainfall to limit compaction of bioretention layers and clogging of the bioretention system. Inspect and maintain all sediment control measures following periods of rainfall. Installation of vegetation should coincide with industryaccepted planting windows for specific vegetation types. After plants are installed, weekly maintenance is recommended during the first two to three years to ensure proper establishment.

Verify that all vegetation meets American Standard for Nursery Stock, and verify post-construction warranty periods for all vegetation, including seed, plants, and trees.

MAINTENANCE CONSIDERATIONS

Routine inspection and maintenance will ensure that bioretention systems function as intended over the longterm. During the first year after construction, inspections of the vegetation, underdrain system, and overflow structure should occur weekly and following rain events. After the first year, inspections should occur monthly and following rain events.

The minimum vegetation maintenance activities include weeding, watering, seasonal mulching, seasonal pruning, and restoration/replacement of plants, when needed.

Adequate watering is critical during the first three years of establishment and during dry periods within the active growing season. Fertilizing should only be performed if plant health requires it or if over time soil becomes deficient of nutrients. An organic, slow-release fertilizer is recommended in these situations.



FIGURE 3-3 A BIORETENTION WITHIN OPEN SPACE







FIGURE 3-5 **BIORETENTION BASIN WITHIN A SURFACE PARKING LOT.**







FIGURE 3-7 NEWLY-INSTALLED BIOSWALE WITH RIGHT-OF-WAY



DRY EXTENDED DETENTION BASIN

Dry extended detention basins, or "dry ponds," are a type of stormwater pond that dewaters between storm events. These basins are designed to detain runoff for up to 48 hours to reduce peak flow rates and to allow time for sediment to filter out.



Dry extended detention basins are a method for managing stormwater runoff on the surface. They reduce peak flow rates and loadings of coarse and fine sediments, as well as some pollutants. Thoughtful grading and strategic use of stone and native plants can increase water quality benefits, provide habitat, and create a unique landscape feature for a development site.



When sized to comply with Title IV regulations, extended detention basins may be eligible for a **15% Peak Flow Credit**. A 25% credit may be available with higher levels of control.



SYSTEM COMPONENTS

Dry extended detention basins (Figure 3-8) contain a forebay, the main ponding area, and a micropool. A forebay is a settling pool at the basin inlet that serves as pre-treatment by capturing coarse sediment. Additionally, the forebay provides an opportunity to integrate energy dissipation and distribute flow so that erosion and scouring do not impact basin performance in the longterm.

The main ponding area provides the majority of detention capacity during rain events. The micropool is a shallow depression, similar to the forebay, located at the most downstream portion of the basin. The main ponding area and micropool are drained by an outlet control structure, which regulates flows to downstream sewer systems.

SPATIAL CONSIDERATIONS

Dry extended detention basins are best suited for large properties - typically, drainage areas larger than five acres - in commercial, industrial, or multi-family residential land uses. (Figures 3-10 and 3-11 show examples of dry extended detention basins).

DESIGN CONSIDERATIONS

The grading of the basin footprint should relate to organic forms and provide for a variety of water depths. Side slopes should not be steeper than 3:1 or shallower than 12:1, and should be vegetated to help reduce erosion and sediment loadings from overland flow. The basin floor and side slopes up to the maximum ponding elevation should also be planted with appropriate vegetation to help increase water quality improvement and add visual interest. Appropriate vegetation includes grasses, sedges, and rushes. Trees and woody shrubs are not appropriate within basin ponding limits, as they may impact sediment removal efficiency over time.

After determining the required size of the basin to meet local and state requirements, an additional 20% storage capacity should be included beyond the calculated water quality volume to account for sediment accumulation.

When infiltration into native soils is not feasible, or if standing water is a concern, a subsurface underdrain system, with clean-outs, can be included in the basin and connected to the outlet control structure. A liner may be necessary when the depth to groundwater is less than five feet from the bottom of the basin or on sites with contaminated soils.

FIGURE 3-8 CONCEPTUAL CROSS SECTION OF A DRY EXTENDED DETENTION BASIN



For additional design considerations and technical guidance, consult Section 2.6 of the Ohio Department of Natural Resource's Rainwater and Land Development Manual.



An emergency spillway should be integrated as part of the basin design to safely direct flows that exceed basin capacity during extreme rain events, or in situations where the basin outlet control structure is clogged.

The outlet control structure (Figure 3-9) regulates the duration that stormwater runoff is detained in the basin. The design of this structure - specifically, the configuration of openings and the outlet pipe - is the key to ensuring compliance with local and state regulations. The outlet should drain less than 50% of the extended detention volume in the first 16 hours, and the full extended detention volume within 48 hours. In areas with downstream capacity concerns, additional restrictions may be required.



FIGURE 3-9 OUTLET CONTROL STRUCTURE WITH MULTIPLE OPENINGS TO REGULATE PEAK DISCHARGE RATES DURING SPECIFIC RAIN EVENTS

CONSTRUCTION CONSIDERATIONS

Dry extended detention basins that are used for sediment control during construction activities should be cleaned out once the site is stabilized. If underdrains are included in the basin design, they should be completely flushed of sediment and debris following construction to ensure they function properly.

MAINTENANCE CONSIDERATIONS

The basin design should incorporate sufficient maintenance access to allow for routine inspections of inlet and outlets. Monthly inspections will ensure proper drawdown times and will help to identify debris or sediment that may lead to clogging.

Debris and sediment will inevitably accumulate in the basin after rain events and over time, and should be properly removed and disposed of.

Vegetation management - for example, mowing of side slopes - is the most frequent maintenance activity. If enhanced vegetation is included, more frequent maintenance, especially during the initial plant establishment period, will be required.





FIGURE 3-10 EXTENDED DETENTION ADJACENT TO A ROADWAY

FIGURE 3-11 EXTENDED DETENTION HEAVILY PLANTED WITH NATIVE VEGETATION TO IMPROVE WATER QUALITY BENEFITS





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WET EXTENDED DETENTION BASIN

Wet extended detention basins, sometimes referred to as "wet detention" or "wet ponds," hold a permanent pool of water and provide additional detention capacity during storm events. Compared to dry ponds, this stormwater control measure can provide increased habitat for wildlife and higher levels of water quality improvement.



Wet extended detention basins are a method for managing stormwater runoff on the surface. They reduce peak flow rates by providing temporary storage capacity above a permanent pool of water. The depth of water and various biological and chemical processes make this feature highly effective with respect to water quality improvement.



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When sized to comply with Title IV regulations, wet detention basins may be eligible for a 15% Peak Flow Credit. A 25% credit may be available with higher levels of control.



SYSTEM COMPONENTS

Wet detention basins (Figure 3-12) contain a forebay, the permanent pool area, and an outlet control structure. A forebay is a settling pool at the basin inlet that serves as pre-treatment by capturing coarse sediment.

The permanent pool area contains the permanentlyretained water and provides freeboard for temporary detention storage during rain events. The temporary storage above the permanent pool is drained by an outlet control structure, which regulates flows to downstream sewer systems.

An aquatic bench can also be included around the perimeter of the permanent pool. This feature is a flat, vegetated area that eliminates steep grades adjacent to the permanent pool and therefore improves public safety.

SPATIAL CONSIDERATIONS

Wet extended detention basins are best suited for drainage areas larger than twenty acres. Figures 3-13 and 3-14 show examples of wet detention basins.

DESIGN CONSIDERATIONS

The typical ratio of surface area to tributary drainage area is 1:6 (i.e., one square foot of wet pond surface area would manage the stormwater runoff from six square feet of drainage area).

The grading of the basin footprint should relate to organic forms. An irregular shape helps to lengthen the flow path and increase contact time with the plants. Side slopes should not be steeper than 3:1 or shallower than 12:1, and should be vegetated to help reduce erosion and sediment loadings from overland flow. Additionally, the basin bottom can be graded to provide multiple cells provided the overall storage requirements are met.

An emergency spillway should be integrated as part of the basin design to safely direct flows that exceed basin capacity during extreme rain events, or in situations where the basin outlet control structure is clogged.

After determining the required size of the basin to meet local and state requirements, an additional 20% storage capacity should be included beyond the calculated water quality volume to account for sediment accumulation.



FIGURE 3-12 EXTENDED DETENTION BASIN

For additional design considerations and technical guidance, consult Section 2.6 of the Ohio Department of Natural Resource's Rainwater and Land Development Manual.

The overall depth of the permanent pool should fluctuate between three and six feet to encourage suspended particles to settle. Depths up to eight feet are possible. Pools shallower than three feet often have issues with algae and do not have enough depth for the sediment to settle. While depths up to eight feet can be considered, increasing depth simply to fit spatial constraints and satisfy volume requirements often results in a short flow path, which reduces water quality benefits.

At least 30% of the surface area of a wet extended detention pond should be vegetated with native wetland plants. Vegetation must be appropriate for the specific site conditions, including inundation depth and duration, sunlight, and salt tolerance. Trees should be planted on the south and west sides of the permanent pool to cast shade on the water surface.

The outlet control structure should release the extended detention volume within 24 hours. The outlet design should include peak discharge control such as orifices or weirs to draw down 50% of the detention volume within the first eight hours.

CONSTRUCTION CONSIDERATIONS

After excavation and grading, the base soils that represent the bottom and side slopes of the basin must be free of construction debris and other undesirable materials. If the basin is used for sediment control during construction, the contractor must drain the pond and remove accumulated sediment before planting.

MAINTENANCE CONSIDERATIONS

The basin design should incorporate sufficient maintenance access to allow for routine inspections of inlet and outlets. Monthly inspections will ensure proper drawdown times and will help to identify debris or sediment that may lead to clogging.

Debris and sediment will inevitably accumulate in the basin after rain events and over time, and should be properly removed and disposed of.

Vegetation management - for example, harvesting and thinning of aquatic plants, mowing of side slopes - is the most frequent maintenance activity. More frequent vegetation maintenance will be required during the initial plant establishment period.

FIGURE 3-13 A WET DETENTION BASIN WITH A VEGETATED AQUATIC BENCH

FIGURE 3-14 WET DETENTION BASIN WITH GRADED CELLS THAT PROVIDE OPPORTUNITIES FOR PLANTED ISLANDS

TREE PLANTERS

Tree planters are small landscape areas designed to receive stormwater runoff from parking lots, sidewalks, streets, or other areas of right-of-way. Tree planters also can provide a high-quality landscape barrier between pedestrians and roadways. Sometimes known as "tree filters," they detain runoff, reduce peak flow rates, and improve water quality. They also help to reduce runoff volume through infiltration and evapotranspiration.

Tree planters are a method for managing stormwater runoff on the surface. These features are similar in function to bioretention; however, they are smaller in scale and manage smaller drainage areas. Significant volume reduction and water quality improvement are possible when tree planters are placed in series, or when they are part of an integrated system of stormwater control measures.

> When sized to comply with Title IV regulations, and when part of an integrated system of control measures, tree planters may be eligible for a **15% Peak Flow Credit.** A 25% credit may be available with higher levels of control.

A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume.

When properly designed, installed, and maintained, tree filters may be eligible for up to a **20% Stormwater Quality Credit**.

SYSTEM COMPONENTS

Components of tree planters (Figure 3-15) vary based on the required size, spatial constraints, and characteristics of the tributary drainage area. In many cases, tree planters consist of a surface trench that is supported by a structural curb. The trench is backfilled with aggregate storage layers to provide storage and detention capacity, specialized planting soil, and native plant materials including trees, shrubs, and perennials. Underdrains are usually included in the aggregate layer to prevent long periods of standing water.

Tree planters are also available as proprietary systems that can be directly installed within new sidewalks, pedestrian plazas, or parking islands. These systems typically look like a standard tree planted in a tree well; however, there are additional components below the surface that provide detention storage.

SPATIAL CONSIDERATIONS

Street planters are ideal for urban spaces because they can be placed where space is limited – for example, near a building, as a buffer between roadways and sidewalks, or integrated as parking islands in parking lots. Examples of tree planters are shown in Figures 3-16 through 3-18.



DESIGN CONSIDERATIONS

The typical ratio of tree planter surface area to tributary drainage area varies based on the system type. It is unlikely that a single tree planter will meet local stormwater regulations for peak flow discharge rates. Planters are often combined in series or combined with additional on-site control measures to meet peak flow discharge and volume requirements.

The top of the planting soil is lower than the adjacent grade so that water can enter the tree planter and temporarily pond at the surface as it infiltrates the system. Successfully designing inlets to the tree planter system is critical to performance. Slopes of adjacent finish grades should be such that flow is directed to the inlets. Inlet design options include depressed curbs, curb cuts, or grated trench drains to direct runoff from impervious surfaces into the tree planter. At the inlet, it is important to integrate some form of pretreatment to dissipate energy and collect sediment and debris. Pretreatment can include a concrete pad surrounded by stone, check dams, or vegetated filter strips.

There is a balance between providing adequate space for proper root growth for trees and accommodating utilities or adjacent site uses. These factors should be considered in the placement of tree planters.

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FIGURE 3-15 A STREET PLANTER



When placed adjacent to utilities or building foundations, a waterproof liner and/or underdrain system may be necessary to prevent infiltration.

Surface ponding depths should range from six to nine inches, and it should take less than 48 hours to completely drain the system. An overflow route should be included to accommodate storms beyond the design storm.

The planting soil – often similar to a bioretention soil mixture – should be a minimum of 36 inches deep. Mulch placed on the surface of the planting soil can retain moisture within the system, which will benefit trees and other vegetation.

CONSTRUCTION CONSIDERATIONS

Sediment control measures must be incorporated and maintained at all times during construction. These measures prevent construction site runoff and sediment from entering and clogging bioretention system. In the case that sediment enters a bioretention feature during construction, sediment should be immediately removed and properly disposed.

Construction should be suspended during periods of rainfall to limit compaction of bioretention layers and clogging of the bioretention system. Inspect and maintain all sediment control measures following periods of rainfall.

Installation of vegetation should coincide with industryaccepted planting windows for specific vegetation types. After plants are installed, weekly maintenance is recommended during the first two to three years to ensure proper establishment. Verify that all vegetation meets American Standard for Nursery Stock, and verify postconstruction warranty periods for all vegetation, including seed, plants, and trees.

MAINTENANCE CONSIDERATIONS

If a tree planter is designed in a public right-of-way, a maintenance agreement should be agreed upon by the property owner and city.

Routine inspection and maintenance will ensure that tree planters function as intended over the long-term. During the first year after construction, inspections of the system inlets, vegetation, underdrain system, and overflow structure should occur weekly and following rain events. After the first year, inspections should occur monthly and following rain events.

The minimum vegetation maintenance activities include weeding, watering, seasonal mulching, seasonal pruning, and restoration/replacement of plants, when needed.

Adequate watering is critical during the first three years of establishment and during dry periods within the active growing season. Fertilizing should only be performed if plant health requires it or if over time soil becomes deficient of nutrients. An organic, slow-release fertilizer is recommended in these situations.



FIGURE 3-16 TREE PLANTER WITHIN PUBLIC RIGHT-OF-WAY AND ADJACENT TO A MIXED-USE DEVELOPMENT





FIGURE 3-17 TREE PLANTER BETWEEN A PEDESTRIAN PLAZA AND PARKING LOT

FIGURE 3-18 A TREE PLANTER INSTALLED IN A ROADWAY MEDIAN



PERVIOUS PAVEMENT

Pervious pavements allow stormwater runoff to soak through the surface rather than sheet flow across. Sub-surface storage layers provide detention capacity and can reduce peak flow rates. Where favorable soils exist, infiltration can reduce the volume of runoff leaving the site. Pervious pavements improve water quality by reducing suspended solids, heavy metals, and petroleum hydrocarbons. Additionally, aggregate storage layers can host microbial organisms that biodegrade pollutants.

Pervious pavement is one method for managing stormwater runoff below the surface. By storing water in subsurface aggregate layers, the pavement system functions similarly to an underground detention basin. Types of pervious pavements include pavers, concrete, and asphalt. Design parameters, costs, and installation methods vary slightly for each type; however, in general each type of pervious pavement system has the same general composition. The footprint of pervious pavement is not considered impervious surface and is therefore exempt from NEORSD stormwater fees once an exemption is submitted and approved. Gravel driveways are not considered a type of pervious pavement.

> When sized to comply with Title IV regulations, pervious pavement systems may be eligible for a **15% Peak Flow Credit**. A 25% credit may be available with higher levels of control.

A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume.

When properly designed, installed, and maintained, pervious pavement may be eligible for a **20% Stormwater Quality Credit**.

SYSTEM COMPONENTS

Pervious pavers (Figures 3-19 and 3-20) can be made of concrete, clay, or high-strength plastic. The spaces between pavers typically represent a minimum of 10 percent of the total pavement area and are filled with uniformly-graded gravel to allow water to infiltrate below. Pervious concrete (Figure 3-21) is a specialized mix of mostly large aggregate and appears much coarser than traditional concrete. Pervious asphalt is made of standard bituminous asphalt, but the fines are screened and reduced to produce small voids at the surface.

Each type of pervious pavement is underlain by aggregate layers of varying depths and gradations. For example, pavers are placed on top of a setting bed that provides structural support, followed by an aggregate base layer – to filter stormwater and provide additional structural support – and an aggregate sub-base layer that temporarily stores stormwater runoff.

Where favorable soils exist, systems are designed to infiltrate into the underlying soil, reducing the volume of water leaving the site. For sites where infiltration is not feasible, a perforated underdrain is placed within the aggregate base to ensure the system is fully drained between rain events. Overflow structures should be included to manage runoff volume during large rain events.

SPATIAL CONSIDERATIONS

Pervious pavements can be installed within parking stalls or as part of pedestrian plazas, sidewalks, or building entries. Pervious pavers offer the most flexibility in terms of design aesthetics as they come in multiple shapes, sizes, and colors. Examples of pervious pavement are shown in Figures 3-22 and 3-23. These systems are typically not suitable for areas subject to heavy vehicle loadings (e.g., loading bays); on roadways with travel speeds greater than 25 miles per hour; on slopes greater than five percent; on bedrock; or in areas with contaminated soils. These systems should be placed sufficiently away from building foundations and sanitary sewers.

SUBSURFACE

MANAGEMENT

DESIGN CONSIDERATIONS

The ratio of pervious pavement surface area to tributary drainage area is 1:5 (i.e., one square foot of pervious pavement would manage the stormwater runoff from five square feet of drainage area), although ratios can range between 1:2 and 1:5 depending on the land cover characteristics of the upstream drainage area. Pervious pavement systems most often intercept runoff from adjacent impermeable hardscape areas. Drainage areas that generate high sediment loading should be avoided unless filter strips or other means of sediment removal are included as a pretreatment.

The application of stormwater credits assumes review and approval of on-site stormwater control measures by the Northeast Ohio Regional Sewer District. See the NEORSD Stormwater Fee Credit Policy Manual for additional information.

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FIGURE 3-19 ► CONCEPTUAL CROSS SECTION OF PERVIOUS PAVERS WITHIN A PARKING AREA



For additional structural design and installation considerations, see the Interlocking Concrete Pavement Institute. For additional design considerations and technical guidance, consult Section 2.11 of the Ohio Department of Natural Resource's Rainwater and Land Development Manual.



The thickness of the pervious pavement structure profile should be 0.50 to 0.65 times the frost depth. In Northeast Ohio, the frost depth is 42 inches; therefore, the minimum thickness should be 21 to 27 inches. In all applications, the design of the pervious pavement must be based on the anticipated structural loadings.

A concrete curb surrounding the perimeter of pervious pavement provides structural stability for the system and creates a clean edge adjacent to different surface types.

The aggregate layers must be free draining and should not permit extended periods of ponding. Typically, all water should be drained from the system within 48 hours, since trapped water is subject to freeze/thaw cycles and can impact the integrity of pervious pavement systems.

CONSTRUCTION CONSIDERATIONS

Installers of pervious pavement systems should be experienced with the means and methods of construction, and should have proper certifications to ensure quality control. For example, installers of pervious concrete should be certified according to standards established by the National Ready Mixed Concrete Association (NRMCA) and American Concrete Institute (ACI).

Pervious pavements should be installed in areas of uncompacted cut, as compaction will adversely affect system performance. Additionally, the subsurface aggregate layers should not be compacted. The bottom of the aggregate layer should be nearly level to promote even distribution of stormwater runoff across the entire system

Sediment control measures must be incorporated and maintained at all times during construction. These measures prevent construction site runoff and sediment from entering and clogging the pervious pavement system. Following construction, the system should be tested to ensure that the surface is even and that runoff properly infiltrates.

MAINTENANCE CONSIDERATIONS

Pervious pavement systems that are properly designed, installed, and maintained can have life spans longer than conventional, non-pervious pavement systems. The most important aspect of maintenance is to prevent sediment and organic matter from clogging the void spaces at the surface and the subsurface aggregate. Annual vacuum sweeping is required to remove accumulated sediment. For pervious paver systems, periodic replacement of uniformly-graded gravel between pavers may be required

Concrete and asphalt should be inspected annually for deterioration or spalling and repaired as needed. All construction vehicles or anything transporting hazardous waste should not be permitted on pervious concrete surfaces.

Additional maintenance considerations include inspections after large rain events, removing leaf litter in fall, and avoiding the use of sand as a de-icing agent in winter.



FIGURE 3-20 CONCEPTUAL CROSS SECTION OF PERVIOUS PAVERS WITHIN A PEDESTRIAN AREA





FIGURE 3-22 PERVIOUS CONCRETE PARKING STALLS



FIGURE 3-23 PERVIOUS PAVER PARKING LOT

FIGURE 3-21 CONCEPTUAL CROSS SECTION OF

For additional design considerations and technical guidance, consult Section 2.11 of the Ohio Department of Natural Resource's Rainwater and Land Development Manual.



INFILTRATION

Infiltration includes a range of practices for infiltrating stormwater runoff into native, permeable soils. Runoff is temporarily stored in aggregate layers or structural chambers and then slowly filters into native soils. Permeability rates of existing native soils must be verified through site-specific geotechnical testing and evaluation.





When sized to comply with Title IV regulations, infiltration systems may be eligible for a **15% Peak Flow Credit.** A 25% credit may be available with higher levels of control.

A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume.



When properly designed, installed, and maintained, certain infiltration systems (i.e., infiltration basins) may be eligible for up to a **25% Stormwater Quality Credit.** Credits range from 20% up to 25% depending on the type of control measure.

SYSTEM COMPONENTS

Infiltration trenches (Figure 3-24) are buried beds of stone, often installed in linear strips. Runoff enters the buried stone via a thinner stone channel at the surface. Infiltration basins include perforated pipes or chambers placed in an aggregate layer that is hydraulically connected to permeable layers. Dry wells can be as simple as vertical pits filled with gravel, or more complex with reinforced concrete or plastic chambers with perforated sides and an open bottom.

For each type of infiltration practice, a pretreatment system and an overflow must be included. Pretreatment will reduce coarse sediment loadings, which adversely impact system performance. The overflow structure will address excess runoff during larger storm events.

SPATIAL CONSIDERATIONS

Infiltration practices can be integrated in a variety of situations – for example, under roadways, parking lot pavement, or pedestrian hardscape areas, or within open space. Examples of infiltration SCMs are shown in Figures 3-25 and 3-26.



The maximum recommended drainage area varies, as multiple infiltration features are often connected in series in order to achieve necessary peak flow discharge rates and increase the potential for volume reductions.

Infiltration features should be placed sufficiently away from building foundations, utilities, and combined/sanitary sewers. Infiltration is likely not appropriate for sites that have contaminated soils (e.g., former heavy industrial sites and fueling stations) or sites that have the potential for contamination (e.g., on-site chemical storage).

DESIGN CONSIDERATIONS

The required size of an infiltration feature will be controlled by the permeability of native soils. Both permeability and depth must be verified through sitespecific geotechnical testing and evaluation.

To limit the potential for sediment buildup and clogging, pretreatment should be included upstream. Pretreatment can include inlet sumps or proprietary devices for storm sewer networks, or grass filter strips for overland flow. For infiltration trenches, the top and sides of gravel storage layer must be wrapped with a non-woven geotextile. Infiltration practices should be designed to drain through the bottom floor of the structure in 24 to 48 hours. An









depth and infiltration rates to be determined based on geotechnical testing

overflow structure must be included to handle large storm events, during which the available storage capacity would be exceeded.

Appropriate inspection and access measures must be incorporated within the feature. This includes observation wells to monitor performance, cleanouts to remove accumulated sediment, and manholes or other structures to provide necessary maintenance access.

CONSTRUCTION CONSIDERATIONS

Infiltration practices should not be installed until site grading is complete and upstream drainage areas are stabilized.

Sediment control measures must be incorporated and maintained at all times during construction. These measures prevent construction site runoff and sediment from entering and clogging the infiltration system.

During excavation of the infiltration feature, native soils must not be compacted. After excavation is complete, the bottom of the pit should be tilled to a depth of 6 inches.

Site testing and inspection of the entire system should be performed before construction is completed to ensure that the system is functioning as intended.

MAINTENANCE CONSIDERATIONS

The greatest threat to any infiltration system is sediment clogs. Drain-down times must be periodically evaluated within 72 hours of a rain event.

Upstream infrastructure (e.g., inlet sumps or proprietary pretreatment devices) and underground structures to remove sediment should be regularly cleaned out to remove sediment.

Pretreatment devices and overflow structures should be inspected for sediment build-up and structural damage.

For infiltration trenches, the surface stone and filter fabric should be inspected for debris and cleaned/replaced as needed. Stone fill may need to be replaced if accumulated sediment is impacting performance.





FIGURE 3-25 INFILTRATION BASIN IN THE WATERLOO ARTS AND ENTERTAINMENT DISTRICT

FIGURE 3-26 SERIES OF INFILTRATION BASINS INTEGRATED WITH MIXED-USE DEVELOPMENT



UNDERGROUND STORAGE

Underground storage refers to subsurface pipes, structures, or chambers that capture and temporarily detain stormwater runoff. They are effective at reducing peak flow rates to meet stormwater management requirements; however, without significant infiltration, volume reductions are minimal. Opportunities for water quality improvements are limited as well.

Underground storage is a method for managing stormwater runoff below the surface - specifically, on sites with no potential for infiltration. Runoff enters the storage units through storm sewers or directly-connected inlets and is eventually released through an outlet control structure to downstream sewer infrastructure. These systems are designed primarily to reduce peak flow rates. They are often used in conjunction with other stormwater management features when water quality improvement and/or volume reductions are required.

> When sized to comply with Title IV regulations, an underground storage system may be eligible for a 15% Peak Flow Credit. A 25% credit may be available with higher levels of control.

A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume achieved by infiltration

If designed to include water quality treatment, an <u>underground storage system may be eligible for a</u> 15% Stormwater Quality Credit.

SYSTEM COMPONENTS

A typical underground storage system (Figure 3-27) includes upstream infrastructure to collect and convey stormwater runoff, pretreatment measures, storage chambers, and an outlet control structure. Pretreatment measures are integrated upstream of the storage chambers to remove sediment, debris, and oils and can include inlet sumps, inlet filters, grass filter strips, vegetated swales, proprietary devices, or water quality control measures like bioretention or pervious pavement.

The storage chambers can be concrete vaults, large diameter pipes, or arches made from plastic, steel, fiberglass, or aluminum. They can also be as simple as stone beds wrapped in filter fabric. The outlet control structure regulates peak flow discharges to downstream sewer systems.

SPATIAL CONSIDERATIONS

Underground storage applies to almost any land use type. Since the system is subsurface, it is particularly useful in urban development and has minimal impacts on the geometry and function of the site surface. They are often installed under impervious surfaces such as parking lots, roadways internal to a development site, or other paved surfaces. Examples of underground storage are shown in Figures 3-28 and 3-29.

DESIGN CONSIDERATIONS

Tributary drainage areas for underground storage systems are typically five acres or less. Larger drainage areas are still feasible, but often result in higher construction costs due to the need for more extensive excavation and may lead to depth constraints.

When sizing the stormwater chambers, an additional 20% is often included to allow for long-term sediment accumulation.

The stone backfill is often wrapped in geotextile to separate it from native soil layers. The floor of the storage chambers should have a maximum of two percent slope to promote positive water flow.

The outlet control structure should contain a low-flow orifice - to regulate peak flow discharges - and an emergency overflow to convey flows during rain events that exceed capacity of the system. A multi-stage outlet structure may be necessary to achieve peak flow rate discharge requirements.

QUANTITY

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FIGURE 3-27 CONCEPTUAL CROSS SECTION OF UNDERGROUND STORAGE





An underdrain is usually included in the stone backfill to ensure the system is completely emptied during rain events. The entire system should drain within 48 hours.

At a minimum, access should be incorporated at the inlet and outlet to the system. Observation wells can be included to allow for routine performance inspections, and clean-outs can be provided for access hoses and other maintenance equipment.

CONSTRUCTION CONSIDERATIONS

Flows from upstream drainage areas should be properly diverted until construction is complete. Once system components have been inspected, and after upstream drainage areas have been fully stabilized, the underground detention system can receive runoff.

After excavation and installation of system components, and prior to backfilling, it is important to verify grades and invert elevations.

MAINTENANCE CONSIDERATIONS

Properly maintained underground stormwater storage systems are extremely durable and can last several decades. Routine inspections should verify that the system is draining within the designed timeframes.

The greatest maintenance challenge is clogging from sediment or debris. Routine maintenance of the upstream drainage area will reduce the accumulation of sediment, trash, and other debris.

Any sediment that does enter the system should be removed on at least an annual basis. For storage vaults and chambers, sediment can be removed using vacuum cleaning. Removing sediment from wrapped stone beds is more difficult and costly. In all cases, a professional should be consulted before performing maintenance.



FIGURE 3-28 LARGE-DIAMETER PIPES USED AS UNDERGROUND STORAGE CHAMBERS



FIGURE 3-29 PRE-MANUFACTURED UNDERGROUND STORAGE ARCHES



RAINWATER HARVESTING

Rainwater harvesting includes storage vessels that capture and store stormwater runoff from rooftops or other impervious surfaces. The stored water can then be infiltrated into the ground, discharged to downstream sewer infrastructure, or used for landscape irrigation or other non-potable water service needs.



DESIGN CONSIDERATIONS

The size of the storage vessel is entirely dependent on the volume generated by the tributary drainage area and the intended use of stored water. For example, vessels storing water simply for detention purposes will be smaller than those storing water for both detention and irrigation.

A basic formula states that 0.6 gallons of capacity is needed per square foot of drainage area to capture a one-inch rainfall event. As a contingency, the storage vessel should be sized 25 percent more than the required storage volume. The system should completely drain between 24 and 72 hours to provide capacity for future rain events. Additional storage and an orifice can be designed to provide peak discharge control.

Runoff captured from building rooftops is the most common source for harvested rainwater, since sediment and pollutant loadings are low. Harvesting runoff from hardscape areas or parking lots is possible, but these areas will have higher sediment and pollutant loadings and will therefore require a higher level of pretreatment.

Rainwater harvesting features include tanks or cisterns, either of which can be located above the surface or below ground. Harvesting systems should be used in conjunction with additional stormwater management controls if peak flow and volume reduction requirements cannot be consistently met. These features are designed primarily to reduce peak flow rates. Volume reductions are possible when infiltration is feasible - for example, when a harvesting system is part of a system with other SCMs - or if stored water is used for other purposes like irrigation.

> When sized to comply with Title IV regulations, rainwater harvesting systems may be eligible for a **15% Peak Flow Credit**. A 25% credit may be available with higher levels of control.

A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume.



QUANTITY

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When properly designed, installed, and maintained, rainwater harvesting systems may be eligible for a **25% Stormwater Quality Credit.** For harvesting systems that include seasonal usage (e.g., irrigation), prorated credits are applied.

SYSTEM COMPONENTS

A rainwater harvesting system (Figure 3-30) consists of the storage vessel – either a tank or a cistern – a connection from the upstream drainage area, a spigot or other plumbing hardware for draining the vessel, and an overflow. The storage vessels are typically sized between 500 and 12,000 gallons (although some can be sized up to 50,000 gallons or more), and can be reinforced concrete, galvanized steel, or plastic. Underground tanks or cisterns typically incorporate a pumping system if water will be re-used - for example, for on-site for irrigation.

The overflow can discharge to dowstream storm infrastructure or the sanitary system, as well as to open space provided that the flow will not impact building foundations or lead to downstream erosion or flooding.

SPATIAL CONSIDERATIONS

Rainwater harvesting systems are appropriate for residential,industrial, and commercial land uses. Because they can be installed at ground level, elevated, or placed underground, they can meet a variety of spatial constraints. Storage vessels are often placed adjacent to or within buildings, but they can also be installed below open spaces, parking lots, or other pedestrian hardscape surfaces so long as adequate access to the system is provided. Examples of storage vessels are shown in Figures 3-31 and 3-32.

The application of stormwater credits assumes review and approval of on-site stormwater control measures by the Northeast Ohio Regional Sewer District. See the NEORSD Stormwater Fee Credit Policy Manual for additional information.







Pretreatment will drastically reduce the amount of dust, leaves, or debris that enters the storage vessel. The type of pretreatment required will depend on the characteristics of the contributing drainage area. Pretreatment can include simple structures such as sumped inlets or inlet inserts, gutter screens, or strainers; or they can be more complex measures like grit chambers, media filters, or proprietary devices. Additionally, all openings should be screened to prevent debris and insects from entering the system.

An overflow or bypass mechanism must be included so that if the storage vessel is full, the excess water can be safely diverted.

CONSTRUCTION CONSIDERATIONS

Flows from upstream drainage areas should be properly diverted away from the storage vessel until construction is complete. Once system components have been inspected, and after upstream drainage areas have been fully stabilized, the harvesting system can receive runoff.

During construction, the soil bearing capacity should be verified to ensure that settling or structural failure will not occur.

MAINTENANCE CONSIDERATIONS

Maintenance requirements include regular inspections (to verify performance or identify issues) and periodic removal of sediment and debris from pretreatment devices, screens, and the storage vessel. Removing sediment is typically performed twice a year with vacuum or flushing systems.

In the winter months, if there is no use for stored rainwater, the bypass mechanism can be left open.



FIGURE 3-31 ▲ STORAGE TANKS INSTALLED ADJACENT TO A COMMERCIAL BUILDING



FIGURE 3-32 A CISTERN INSTALLED ADJACENT TO A STORAGE BUILDING



GREEN ROOF

A green roof is a vegetated system installed on flat or moderately-sloped building rooftops. They contain specialized plants, soil media, and drainage layers that intercept stormwater runoff to provide peak flow reduction and volume reduction, as well as water quality improvement. Green roofs also provide insulation benefits by regulating building temperature yearround.

A green roof is a method for managing stormwater runoff above ground. They are classified as "extensive" or "intensive" depending on the thickness of the system components. Benefits include reducing stormwater runoff volumes and peak flow rates, improving water quality, and increasing thermal and sound insulation. When properly installed and maintained, green roofs can even extend the life of a conventional roofing system by up to 20 years. The footprint of green roof is not considered impervious surface and is therefore exempt from NEORSD stormwater fees once an exemption is submitted and approved.

> When sized to comply with Title IV regulations, a areen roof may be eligible for a 15% Peak Flow Credit. A 25% credit may be available with higher levels of control.

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A 25% or 50% Runoff Volume Credit may also be available depending on the level of reduction in post-development runoff volume.

When properly designed, installed, and maintained, a green roof may be eligible for a 20% Stormwater Quality Credit.

SYSTEM COMPONENTS

A green roof system (Figure 3-33) includes specialized plants and growing media, which are underlain by filter and drainage layers. These layers are separated from the roof deck by root barriers and waterproofing membranes in order to protect structural integrity.

Storage of captured rainwater is provided in both the growing media and the drainage layer. Volume reductions are achieved through plant uptake and evaporation. A filter layer between the growing media and drainage layers prevents migration of soil and silt.

Excess stormwater is released through underdrains and overflow structures to internal plumbing or to downstream stormwater control measures.

SPATIAL CONSIDERATIONS

Green roofs can be used on new or existing rooftops, parking decks, storage sheds and even bus stops. They are most effective on buildings with a large area, such as commercial buildings, industrial buildings, schools, or multi-family complexes. Flat roofs are preferred, but roofs with minimal slopes up to 25 degrees can be considered. Example green roofs are shown in Figures 3-34 through 3-36.



Green roofs are often integrated in a series of stormwater management controls. For example, a scupper or downspout can direct stormwater discharges from a green roof to adjacent rainwater harvesting systems, bioretention basins, infiltration practices, or underground detention.

DESIGN CONSIDERATIONS

Green roof designs must be adhere to ASTM International Green Roof Standards as well as local building codes. The additional weight of the plant material, growing medium, filter layer, drainage layer, waterproofing membrane and temporarilyretained water must be considered in relation to the structural integrity of a roof.

Green roofs are classified into two categories: extensive and intensive. Extensive green roofs typically have a thinner soil layer (3-6 inches) with drought-tolerant plants such as short grasses, succulents or sedum. Intensive green roofs have a much thicker soil layer (12-24 inches) that can sustain larger variety of plant material such as shrubs and trees. In both cases, the growing media is a specialized, light-weight soil with organic or mineral additives such as peat, humus, wood chips, sand, or expanded clay.









A soil medium depth of 3 to 24 inches is recommended to encourage healthy plant growth. A 3-inch growing medium profile has the highest benefit to cost ratio; however, the thinner profile of extensive green roofs makes the soil media susceptible to drying out between rain events. This creates a challenging environment for plant growth, thus limiting the variety of successful plant species.

This thin design still regulates temperature, reduces runoff, and prolongs the lifespan of the roof itself. Most importantly, the thin profile makes this system lightweightmeaning it can often be retrofitted onto existing roofs without structural modifications. A deeper 14 inch profile can sustain a larger variety of plant material and can reduce total annual runoff by 85-95 percent. Therefore, green roofs can attain a zero discharge state and match pre-development conditions.

To improve plant establishment and increase biodiversity, half the plant palette should consist of sedums, of which there should be four different species. The remaining plants should be a mixture of native herbs, grasses and flowers conducive to wet and dry conditions.

An overflow system with inlets above the elevation of the soil surface should redirect runoff during large storm events.

CONSTRUCTION CONSIDERATIONS

An alternative to installing individual layers of a green roof during construction is to use premanufactured modular tray systems that house the growing medium. These trays can be purchased with pre-grown plant materials or plants can be installed into the trays once they are in-place.

To prevent possible roof leaks, the waterproofing membrane must pass a flood test before additional layers are constructed.

MAINTENANCE CONSIDERATIONS

Establishing the vegetation during the first three years is the most important aspect of green roof maintenance. Similar to traditional landscaping, tasks include debris removal, fertilizing, and weeding. During droughts, it may be necessary to water the plant material.

Drain inlets and pipes should be cleared of debris and inspected for clogs. Any ponding should be remedied by addressing compaction or clogging in the soil media or drainage layer. Potential leaks in the waterproof membrane should be fixed immediately to prevent flooding in the structure below.



FIGURE 3-34 ▲ A GREEN ROOF IN CHICAGO





FIGURE 3-35 ▲ A GREEN ROOF IN DOWNTOWN CLEVELAND

FIGURE 3-36 ▲ A GREEN ROOF ON ONE PORTION OF AN OFFICE BUILDING





ADDITIONAL RESOURCES

INSPECTIONS AND MAINTENANCE

Routine inspection and maintenance of on-site SCMs is equally as important as planning, design and installation. Once installed and after construction activities are complete, SCMs will require inspection and maintenance to ensure that they function as intended in the long-term. This will not only reduce risks of system failure, which could lead to flooding or even property damage, but also help to reduce the potential for costly repairs or replacement of system components.

Inspections are required seasonally and following large rain events. During the initial establishment period, inspections should be more frequent to ensure SCMs are properly draining and meeting design intent, and that vegetation is being established sufficiently. Maintenance is recommended monthly following construction, especially for surface management SCMs that have vegetation or for any SCMs that have custom-designed components such as outlet control structures. Once SCMs are established. usually after three years, then at a minimum maintenance is required annually. Some SCMs require seasonal or monthly maintenance.

In addition to the general guidance provided in this chapter, there are other local resources with detailed information on inspection and maintenance requirements. For example, the Northeast Ohio Stormwater Training Council (NEOSWTC) provides a document titled, "Maintaining Stormwater Control Measures, Guidance for Private Owners and Operators." The document provides detailed information for a range of SCMs, including those previously described, and identifies key requirements for maintenance activities.

The NEOSWTC's website (http://neohiostormwater.com/) is also a helpful resource, providing fact sheets, check lists, and educational materials, and identifying upcoming workshops and training sessions.

Maintaining Stormwater **Control Measures**



THE MAINTENANCE GUIDANCE DOCUMENT PRODUCED BY THE NORTHEAST OHIO STORMWATER TRAINING COUNCIL IS AVAILABLE AT: http://neohiostormwater.com/



COST INFORMATION

Cost for SCMs, both construction and long-term operation and maintenance costs, vary considerably and are challenging to generalize since each development project and site is unique. Unit costs for construction are impacted by existing site conditions (e.g., the presence of bedrock or unsuitable soils), the scale of the project, the level of integration of SCMs with other site improvements, construction schedules, market conditions, and the complexity of installation. Likewise, operation and maintenance costs depend on frequency, labor demands, and material costs, each of which varies significantly depending on site conditions.

Because of the challenges associated with providing specific costs for each type of SCM, and the fact that cost information can quickly become outdated, this information is excluded from the scope of this document. There are, however, multiple resources available that provide construction and operation and maintenance cost data for many types of SCMs, which can often be used during the planning phase. These resources include local, state, and national organizations.

- Green Infrastructure Incentives for Northeast Ohio Communities. An Evaluation of Regulatory, Cost, and Development Considerations. Available on the NEOSWTC website
- Green Values National Stormwater **Management Calculator** Available from the Center for Neighborhood Technology website.
- International Stormwater BMP Database Multiple resources available on the Water Environment & Reuse Foundation (WERF) website
- National Stormwater Calculator Available on the US EPA's website
- Green Infrastructure Cost-Benefit Resources Available on the US EPA's website.

Ultimately, the SCM costs developed for a development project should be specific to the site and should consider the necessary system components and the range of variables that impact costs.





THIS GUIDANCE DOCUMENT CONTAINS COST INFORMATION ON GREEN INFRASTRUCTURE SCMs AND IS AVAILABLE AT: http://neohiostormwater.com/



IMPLEMENTATION



5

IMPLEMENTATION

Large-scale public infrastructure projects like the Opportunity Corridor can inspire new innovations with community planning and urban development. They also present opportunities to consider potential approaches to compliance with regulatory requirements, like those for on-site stormwater management.

Over the past decade, the City of Cleveland, community development corporations, key stakeholders, and neighborhood residents worked together to establish a shared vision for desired future development surrounding the Opportunity Corridor. When the roadway is completed and as plans for the individual development sites are refined and implemented, each project will advance the overarching goals for the corridor and the surrounding neighborhoods.

At the same time, each development site must comply with applicable on-site stormwater management regulations. In this context, the planning-level study of the City's Opportunity Corridor Target Areas and the surrounding Study Area required merging the multi-faceted goals of urban planning and community redevelopment with traditional sewer and stormwater management planning (Figure 4-1).

The content presented herein serves as a planning-level framework for on-site stormwater management within the City's Opportunity Corridor Target Areas and the Study Area. It highlights information that can guide the approach to compliance, while supporting the long-term goal of transforming the Study Area from what it is today (Figure 4-2) into an opportunity for the City and the adjacent neighborhoods (Figure 4-3).



FIGURE 4-1

REPRESENTATION OF THE MULTI-FACETED PLANNING GOALS RELATED TO DEVELOPMENT SURROUNDING THE OPPORTUNITY CORRIDOR PROJECT

STORMWATER MANAGEMENT COMPLIANCE

This includes the following sections to guide implementation of on-site stormwater management strategies:

Planning Overview

Each of the City's Opportunity Corridor Target areas is characterized based on location, boundaries, planning district, and relevant planning documents. Maps showing existing conditions, based on 2016 aerial imagery, are included for reference.

Land Use and Land Cover

Existing and future land use and land cover are intended to guide future development within the City's Target Areas and the overall Study Area. Existing land use was available from parcel-level data provided by the City of Cleveland, and future land use was based on the City's Connecting Cleveland 2020 Citywide Plan. Data for existing land cover was obtained from the District's impervious land cover shapefile, and future land cover was based on information contained in publicly-available planning documents developed by the Cleveland City Planning Commission, Community Development Corporations, and other stakeholders.

Assumptions for both future land use and future land cover are subject to change based on additional coordination, market conditions, site constraints, and public and stakeholder engagement.

Collections System

The collections system refers to natural watershed boundaries and sewer catchments. Sewer catchments are similar to watersheds in that they represent a boundary that drains a particular area; however, catchments account for underground sewer networks and may not always follow natural surface drainage patterns. The boundaries for sewer catchments are based on existing information from the District's system-wide sewer hydraulic/hydrologic models, and are delineated based on areas tributary to a specific downstream point - for example, a combined sewer overflow (CSO).

Relevant information for watersheds and sewer catchments are presented for the City's Opportunity Corridor Target Areas and the Study Area. This information is important since stormwater management requirements may differ based on the capacity of the downstream sewer system.

Existing Drainage Facilities

Existing drainage facilities include culverts, separate storm sewers, stormwater outfalls (SWOs), and detention basins. This infrastructure discharges directly to the environment rather than to the combined sewer system. The locations and characteristics of existing drainage facilities within the City's Opportunity Corridor Target Areas and the Study Area are presented to identify potential opportunities for offloading runoff from combined sewers, assuming all applicable regulations are met.

On-Site Stormwater Management Examples of potential approaches to on-site stormwater management compliance are included for development sites within several of the City's Opportunity Corridor Target Areas. The examples are planning-level representations of compliance with applicable stormwater management regulations. They are not prescriptive; rather, they are intended to inspire meaningful dialogue about approaches to stormwater management during the early planning phases of an individual development site.





FUTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS

FAIRHILL



STUDY AREA: COLLECTIONS SYSTEM



FIGURE 4-4 WATERSHED BOUNDARIES IN THE STUDY AREA

The Study Area crosses two watershed boundaries (Figure 4-4): the Cuyahoga River Watershed and the Lake Erie Direct Tributaries Watershed, which cover 809 and 128 square miles, respectively. Subwatersheds include the Kingsbury Run Subwatershed, which is part of the Cuyahoga River Watershed, and the Doan Brook and Lake Erie Direct Tributaries East of the Cuyahoga River subwatersheds, both of which are in the Lake Erie Direct Tributaries Watershed.

Figure 4-6 shows the Study Area boundary in relation to subcatchments. In the Southerly System, there are twenty subcatchments covering 670 acres and tributary to regulators S-9, S-10, S-11, S-14, S-20, and S-21.

In the Easterly System, there are 17 subcatchments covering 783 acres and tributary to regulators DV-22, E-33, E-34, and E-37.

Additionally, there are seven subcatchments in the Southerly System classified as "separate catchments," which means there are no combined sewers and that natural drainage or stormwater runoff does not enter the combined sewer system. The total area of the separate catchments is 333 acres.



FIGURE 4-5 **A** SEWER CATCHMENT BOUNDARIES IN THE STUDY AREA

The Study Area overlaps five CSO catchments in two separate treatment districts: CSO 040 in the Southerly District, and CSOs 202, 203, 204, and 222 in the Easterly District. Sewer catchments are shown in Figure 4-5.

FIGURE 4-6 ►



STUDY AREA: EXISTING DRAINAGE FACILITIES

Existing drainage facilities in the Study Area (Figure 4-7) include the following:

Kingsbury Run Culvert System

The Kingsbury Run Culvert system is a network of sewers that conveys stormwater runoff, natural base flows, and CSOs from upstream regulators to the Cuyahoga River via the CSO 040 structure. The system is categorized by branches - A through E - each of which passes through the Study Area.

- Branch A is the main stem of the culvert, which ranges in width from 60 inches to nine feet, and parallels the alignment of the railroad from east to west.
- Branch B is 48 inches wide and runs from south to north. It meets Branch A under the railroad.
- Branch C, the shortest segment, ranges in width from six to nine feet. It runs from the southeast to the northwest through a natural ravine and meets Branch A under the railroad.
- Branch D ranges in width from 42 to 78 inches and runs from east to west, meeting Branch A near the railroad and Kinsman Road.
- Branch E runs from west to east, ranges in size from nine to 12 feet, and meets Branch A just west of I-77.

Branch B conveys only stormwater runoff, while the remaining branches convey runoff as well as overflows during wet weather events. A new segment of the Kingsbury Run Culvert will be constructed parallel to Branch A between Kinsman Road and East 79th Street. The width of this new branch is 5 feet.

Stormwater Outfalls

Stormwater Outfalls, or SWOs, are sewers that originate within a regulator structure. During wet weather, these sewers convey overflows downstream to culverts or the environment. There are SWOs located throughout the Study Area, and each connects to the Kingsbury Run Culvert System.

Appendix 3 Green Infrastructure

Two of the District's Appendix 3 Green Infrastructure Projects are located in the Study Area boundary: the Green Ambassador – Urban Agriculture Project and the Woodland Central Green Infrastructure Project. The former is located north of Kinsman Road, between East 79th and East 83rd streets, and the latter is located south of Woodland Avenue between East 55th and East 75th streets. Both projects include a network of separate storm sewers, which collects stormwater runoff and directs it to large-scale green infrastructure features. The green infrastructure features are bioretention or detention basins that discharge to the Kingsbury Run Culvert System.

Existing Storm Sewers

Areas with existing separate storm sewers include the residential area southwest of East 75th Street and Woodland Avenue; an extension of the Kingsbury Run culvert east of East 79th Street and north of the railroad; CMHA's Garden Valley Homes Estate west of East 79th Street and south of Kinsman Road; and individual development sites. These networks were identified based on local sewer GIS data or digitized based on a review of available record drawings and on field investigations completed as part of previous District efforts.

STORMWATER OFFLOADING

Within the Study Area, the branches of the Kingsbury Run Culvert System, the SWOs downstream of regulators, and the District's Appendix 3 storm sewers present opportunities for offloading stormwater runoff from the combined sewer system. Storm-only connections to these existing sewers would be subject to both NEORSD Title IV and City of Cleveland Chapter 3116 review. Upstream development would be required to treat 100% of the Ohio EPA's water quality volume. Additional on-site controls may be necessary for proposed connections to ensure that peak discharges do not negatively impact the infrastructure downstream.

FIGURE 4-7
IN THE STUDY AREA



STUDY AREA BOUNDARY

FUTURE OPPORTUNITY CORRIDOR ROADWAY

STORM SEWER

APPENDIX 3 STORM SEWER

KINGSBURY STORM RELIEF

swo

 KINGSBURY RUN CULVERT
 KINGSBURY RUN CULVERT (FUTURE)



STUDY AREA: GENERAL RECOMMENDATIONS

Two existing planning studies that contain recommendations for stormwater management include the Cleveland Complete and Green Streets Typologies Plan and the Cleveland Tree Plan. Many of the recommendations would apply to the development proposed adjacent to the Opportunity Corridor and, specifically, in locations where changes to the existing street network are proposed.

Cleveland Complete and Green Streets Typologies Plan This plan, developed in 2013, recognizes that streets and the associated right-of-way not only serve cars and utilities, but also provide access to places, goods, and services. The plan describes design strategies that support pedestrians, bicyclists, transit, traffic calming, intersection improvements, and green infrastructure, each of which is a component of a Complete and Green Street. Green infrastructure strategies for stormwater management include street trees, sheet flow dispersion, bioretention, street planters, and pervious pavement.

The document also includes cross sections for street typologies appropriate to Cleveland, and applies the typologies to the City street network.



THE CLEVELAND COMPLETE AND GREEN STREETS PLAN IS AVAILABLE FOR DOWNLOAD AT: http://www.city.cleveland.oh.us/sites/default/files/forms_publications/ ClevelandCGSTypologiesPlan2013.pdf?id=3364







The Cleveland Tree Plan

The Cleveland Tree Plan was developed in 2015 as a targeted response to the fact that the City is losing approximately 97 acres of tree canopy each year. The loss of canopy occurs at the same time that the effects from climate change are threatening public health and the environment. The Plan provides recommendations for increasing tree canopy, implementing best practices in urban forestry, leveraging the economic advantages of urban trees, and prioritizing trees in the public and private sectors.

Trees offer a long list of environmental, economic, and social benefits. They also provide three key stormwater management benefits:

Volume Reduction

Trees absorb rainwater, which slows and reduces the volume of runoff that enters storm drains and the combined sewer system. It is estimated that 100 mature trees can intercept 100,000 gallons of rainfall per year. They also aerate the soil, which increases infiltration of runoff into the ground.

Water Quality Improvement

Trees trap contaminants like oils, solvents, pesticides, and fertilizers. These contaminants are often present in stormwater runoff from pavement, roadways, and treated landscapes. Over time, the water quality benefits that trees continue to increase.

Erosion Prevention and Sediment Reduction Trees stabilize hillsides and stream banks and can

help reduce sediment that is intercepted by stormwater runoff. This is important in Cleveland, where erosion and sedimentation continuously impact stream and river corridors, property, infrastructure, and shipping channels.

Whenever possible, on-site stormwater management strategies should consider opportunities to maximize tree canopy within open space and landscaped areas, along sidewalks and parking lots, and adjacent to buildings.



The Cleveland Tree Plan

Together, We're Making Cleveland the Forest City Once Again

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October 2015
  The Cleveland Forest Coalition:

    City of Cleveland
    Cleveland Neighborhood Progress

    Holden Arboretum

    LAND Studio

    · Western Reserve Land Conservancy/Thrising Communities Institute
Prepared by:
Darrey Resource Group
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THE CLEVELAND TREE PLAN IS AVAILABLE FOR DOWNLOAD AT: http://www.city.cleveland.oh.us/sites/default/files/forms_publications/ ClevelandTreePlan.pdf







NEW ECONOMY NEIGHBORHOOD

The New Economy Neighborhood (Figure 4-8) is located east of the Opportunity Corridor roadway, close to where the alignment meets with the existing street network. The Target Area is bounded by Cedar Avenue at the north; Fairhill Road and Petrarca Road to the east; the Norfolk Southern railroad at the south; and East 105th Street at the west. Covering 41 acres, it is the smallest of the City's Target Areas and overlaps the University Circle neighborhood. Figure 4-9 shows existing conditions within the New Economy Neighborhood.



FIGURE 4-8 LOCATION OF THE NEW ECONOMY NEIGHBORHOOD RELATIVE TO THE CITY OF CLEVELAND'S OPPORTUNITY CORRIDOR TARGET AREAS

Existing planning documents that cover all or portions of the New Economy Neighborhood Target Area include:

- Thrive 105-93 Corridor Plan. 2017
- Innovation Square Fairfax Neighborhood Plan. 2017
- Fairfax Strategic Investment Plan. 2014
- Cleveland Opportunity Corridor Brownfields Area Wide Plan. 2013
- Cleveland Opportunity Corridor Eastern Section Expanded Plan. 2013
- Reclaiming Cleveland, Target Area Plans. 2011
- Fairfax Strategic Investment Plan. 2009
- Connecting Cleveland 2020 Citywide Plan. 2009

The primary community development corporations are the Fairfax Renaissance Development Corporation and University Circle, Inc. The Target Area is located in the City's Planning District 5.



Reclaiming Cleveland











EXISTING CONDITIONS MAP FOR THE NEW ECONOMY

Linking Healthy, Equitable, & Sustainable Communities





AIRFAX TRATEGIC INVESTMENT PLAN



FAIRFAX STRATEGIC INVESTMENT PLAN 2014-2019



FIGURE 4-9 NEIGHBORHOOD



CITY OF CLEVELAND OPPORTUNITY CORRIDOR TARGET AREA BOUNDARY

OPPORTUNITY CORRIDOR RIGHT-OF-WAY



LAND USE & LAND COVER



FIGURE 4-10

EXISTING LAND USE IN THE NEW ECONOMY NEIGHBORHOOD

There is a varied mix of existing land use types in the New Economy Neighborhood (Figure 4-10). Excluding rightof-way, the top three land uses are vacant, light industry, and retail. Future land use types (Figure 4-11) represented in the City's Connecting Cleveland 2020 Citywide Plan show the conversion of all existing land use types, except for right-of-way, to office. This would complement existing development north of Cedar Avenue.





▼ FIGURE 4-11 FUTURE LAND USE IN THE NEW ECONOMY NEIGHBORHOOD

FIGURE 4-12

COMPARISON OF EXISTING AND FUTURE LAND USES IN THE NEW ECONOMY NEIGHBORHOOD

Existing impervious land cover (Figure 4-13) accounts for 47 percent of the total area, while pervious land cover accounts for 53 percent. Based on desired future land uses represented in existing planning documents (Figure 4-14), impervious land cover increases to 83 percent, and pervious land cover decreases to 17 percent. The quantification of future impervious includes the pavement associated with the Opportunity Corridor roadway.

FIGURE 4-13 ► EXISTING LAND COVER IN THE NEW ECONOMY NEIGHBORHOOD





FIGURE 4-15 COMPARISON OF EXISTING AND FUTURE LAND COVER IN THE NEW ECONOMY NEIGHBORHOOD

FIGURE 4-14 FUTURE LAND COVER IN THE NEW ECONOMY NEIGHBORHOOD







COLLECTIONS SYSTEM



FIGURE 4-16 WATERSHED BOUNDARIES IN THE NEW ECONOMY NEIGHBORHOOD

The New Economy Neighborhood is in the Doan Brook Subwatershed, which is part of the Lake Erie Direct Tributaries Watershed. Figure 4-16 shows watershed boundaries. Natural surface flow patterns are from the southwest towards the northeast; however, these flow patterns were modified over time by land development and the underground collections system.

Local combined sewers within New Economy Neighborhood are tributary to the District's Doan Valley Main Branch Interceptor, which flows north towards regulator DV-22 on East 105th Street. Figure 4-18 shows sewer subcatchment boundaries in relation to the Target Area.



FIGURE 4-17 SEWER CATCHMENT BOUNDARIES IN THE NEW ECONOMY NEIGHBORHOOD

Figure 4-17 shows sewer catchment boundaries. The entire Target Area is in the CSO 222 catchment in the Easterly System, and represents approximately 8.6% of the total catchment area.

> FIGURE 4-18 SEWER SUBCATCHMENT BOUNDARIES IN THE NEW ECONOMY NEIGHBORHOOD

CEDAR HISO 10907201 TOLIST FRANK 108TH DOAN VALLEY MAIN BRANCH INTERCEPTOR HIOO 10887501 ARTHUR HUDSON 80 NORMAN 437 QUEBEC



LOCAL COMBINED SEWER EASTERLY CATCHMENTS DOAN VALLEY CATCHMENTS

Allone

125 250

OPPORTUNITY CORRIDOR TARGET AREA BOUNDARY



EXISTING DRAINAGE FACILITIES

Figure 4-19 shows existing drainage facilities in the New Economy Neighborhood, which only includes the existing combined sewer system.

There is an existing storm sewer outside of the Target Area boundary - east of the intersection of Fairhill Road and Cedar Avenue; however, this infrastructure is separated from the Target Area. Discharges to this existing infrastructure would require the installation of separate storm sewers on Cedar Avenue and/or sections of Fairhill Road.

Planned Drainage Facilities

In terms of planned drainage facilities, stormwater infrastructure associated with the Opportunity Corridor roadway in this area will connect to the existing combined sewer system.

STORMWATER OFFLOADING

There are no existing separate storm sewers within the New Economy Neighborhood; therefore, there are no opportunities to offload stormwater runoff to existing storm infrastructure.



FIGURE 4-19 DRAINAGE FACILITIES IN THE NEW ECONOMY NEIGHBORHOOD



LOCAL COMBINED SEWER EXISTING STORM SEWER

C. LOUIS

125 250

CITY OF CLEVELAND TARGET AREA BOUNDARY



ON-SITE STORMWATER MANAGEMENT

The City's Thrive 105-93 Corridor Plan and the Fairfax Renaissance Development Corporation's Innovation Square Fairfax Neighborhood Plan refer to this area as the "New Economy Neighborhood Node." Key objectives of these planning studies are to increase development density; improve connections to the neighborhood west of the Opportunity Corridor; incorporate parks, open space, accessible streets, and amenities; and implement green infrastructure to increase sustainability.

The representation of desired future development within this Target Area (Figure 4-20) shows reconfiguring the internal street network and associated right-of-way to create a centralized open space. The open space is flanked by infill of institutional and office buildings and parking structures. Total impervious surface is anticipated to increase from 13 acres (40% of the Target Area) to 27 acres (80% of the Target Area).

Ten separate development parcels (Figure 4-21) were defined based on the street network and proposed land cover represented in existing planning documents. Two parcels are less than one acre and would be subject to compliance with both the District's Title IV regulations and the City's Chapter 541. Eight parcels are greater than one acre and would be subject to Title IV, Chapter 541, and Chapter 3116.

Development parcels 2, 5, and 6 were selected to demonstrate a potential approach to compliance with stormwater management requirements.

Development parcel 2 is the centralized open space created by the newly-configured street network specifically, East 106th and East 107th streets. It covers 4.5 acres and is primarily pervious surface. Development parcel 5 covers more than four acres and is bounded by the Opportunity Corridor (East 105th Street) on the west, Wain Court on the north, and East 106th Street on the east and south. Impervious surfaces are anticipated to cover the majority of the site. Development parcel 6 is four acres and primarily impervious cover. It is bounded by East 107th Street to the west, Wain Court to the north, East 108th Street on the east, and Norman Avenue on the south. On this parcel impervious surfaces are anticipated to increase from three acres to 8.5 acres.



FIGURE 4-21 DEVELOPMENT PARCELS IN THE NEW ECONOMY NEIGHBORHOOD



FIGURE 4-20 NEIGHBORHOOD

FUTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY **DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS** All three development parcels are greater than one acre and therefore must demonstrate compliance with NEORSD Title IV and Cleveland's Chapters 541 and 3116. The anticipated peak flow discharge rates (in cubic feet per second, CFS) and the corresponding, approximate target control volumes for each development parcel are as follows:

	EXISTING PEAK DISCHARGE 6-month, 24-hour	FUTURE PEAK DISCHARGE 5-year, 24-hour	APPROXIMATE TARGET VOLUME
2	3.3 CFS	6.9 CFS	74,000 GALLONS
5	3.1 CFS	15.2 CFS	240,000 GALLONS
6	2.4 CFS	14.2 CFS	235,000 GALLONS

Per Title IV, the future 5-year, 24-hour peak discharge rate cannot exceed the existing condition, 6-month, 24-hour peak discharge rate. On-site SCMs are required to store the necessary volume, and outlet control structures must be designed to ensure that peak discharge requirements are met. The City's Division of Water Pollution Control (WPC) may require additional control measures based on the capacity of local sewers.

In terms of compliance with Title IV, if each parcel is developed independently, it is likely that the approach to on-site stormwater management would be considered separately. Approximately 550,000 gallons of storage would be distributed among SCMs on the three sites, and maintenance responsibility would fall on each property owner. Space limitations on parcels 5 and 6 would likely require subsurface SCMs (e.g., underground storage), which can reduce potential water quality benefits and credits available under Title V.

Based on input from the City of Cleveland, the intent of the centralized open space is to connect residents and workers to the new development. In this context, the three sites present an opportunity for an integrated approach to on-site stormwater management. Figure 4-22 shows a strategy for using the centralized open space to detain runoff to comply with Title IV. The strategy includes the following elements:

- Stormwater runoff from development parcels 5 and 6 would be captured and then conveyed via underground storm sewers to the central open space.
- Development parcel 2 would contain a series of bioretention basins covering approximately 35,000 square feet. The basins would be connected via conveyance swales. Runoff from the streets bounding the centralized open space would also be conveyed to bioretention features.
- The open space would include alternating areas of native meadow and traditional lawn, which would help to reduce landscape maintenance and create habitat.

• Flow patterns would be from the south towards the north, with a potential sewer connection on Cedar Avenue.

This integrated strategy for on-site stormwater management complements planning objectives of increasing sustainability through green infrastructure. It also allows for creating a multi-purpose open space that manages stormwater runoff and incorporates public amenities like walking trails, furnishings, and resting areas. Perhaps most importantly, this strategy:

- Creates opportunities for shared maintenance responsibility among multiple property owners (parcels that direct stormwater runoff to this feature would contribute towards shared operations and maintenance):
- Demonstrates the benefits of shared infrastructure investments:
- Enhances collaboration among the City, land owners/ developers, and the neighborhood during the early planning phases; and,
- Incorporates SCMs that provide enhanced water quality improvement, which can increase potential credits available through Title V.





DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS



CORE JOB ZONE

The Core Job Zone (Figure 4-23) is located at the center of the Study Area and is bisected by the Opportunity Corridor roadway. This Target Area is bounded by the Norfolk Southern railroad at the north, Buckeye Road and the Norfolk Southern railroad at the east, and the RTA line at the south and west. It covers approximately 183 acres, the largest of all the City's Target Areas, and overlaps the Kinsman and Buckeye-Woodhill neighborhoods. Primary north-south roadways include East 75th and East 79th streets. Primary east-west roadways include Grand and Holton Avenues. Figure 4-24 shows existing conditions within the Core Job Zone.



Existing planning documents that relate to all or portions of the Core Job Zone Target Area include:

- East 79th Street Corridor Study. 2017
- Building Stronger Neighborhoods, Kinsman & Central Neighborhood Plan. 2016
- Kinsman Master Plan, 2014
- Cleveland Opportunity Corridor Brownfields Area Wide Plan. 2013
- Cleveland Opportunity Corridor Eastern Section Expanded Plan. 2013
- Reclaiming Cleveland, Target Area Plans. 2011
- Connecting Cleveland 2020 Citywide Plan. 2009
- Ward 5 Forgotten Triangle. 2007.

The Burten, Bell, Carr Development Corporation serves the area west of the Norfolk Southern railroad, and the Buckeye Shaker Square Development Corporation serves the area east of the railroad. The Target Area is located in the City's Planning District 4.













Reclaiming Cleveland







4-23



CITY OF CLEVELAND OPPORTUNITY CORRIDOR TARGET AREA BOUNDARY

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OPPORTUNITY CORRIDOR RIGHT-OF-WAY



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YEAKEL





LAND USE & LAND COVER



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FIGURE 4-25 EXISTING LAND USE IN THE CORE JOB ZONE

FIGURE 4-26

FUTURE LAND USE IN

THE CORE JOB ZONE

In terms of area, the top three existing land uses (Figure 4-25) in the Core Job Zone are heavy industry, land bank/vacant, and light industry. Together, these land uses account for 60 percent of the total area. Right-of-way accounts for 13 percent. Based on the City's Connecting Cleveland 2020 Citywide Plan, all heavy industry and vacant land uses are converted to light industry and office; mixed-use development is incorporated on East 79th Street south of Rawlings Avenue; and a small cluster of commercial services is integrated on Buckeye Road. Future land use is shown in Figure 4-26.



FIGURE 4-27 ►

COMPARISON OF EXISTING AND FUTURE LAND USES IN THE NEW ECONOMY NEIGHBORHOOD GHT-OF-WAY COMMERCIAL SERVICES



FIGURE 4-28 EXISTING LAND COVER IN THE CORE JOB ZONE



FIGURE 4-29 FUTURE LAND COVER IN THE CORE JOB ZONE





FIGURE 4-30 ▲ COMPARISON OF EXISTING AND FUTURE LAND COVER IN THE NEW ECONOMY NEIGHBORHOOD





COLLECTIONS SYSTEM



FIGURE 4-31 WATERSHED BOUNDARIES IN THE CORE JOB ZONE

Watershed boundaries within the Core Job Zone are shown in Figure 4-31. The existing railroad splits the Target Area into two separate watersheds. The portion west of the railroad is in the Kingsbury Run Subwatershed, which is part of the Cuyahoga River Watershed. Natural surface flow patterns are from the east towards the west. The portion of the Target Area east of the railroad is in the Lake Erie Direct Tributaries Watershed. Natural surface flow patterns are towards the north.

The Target Area overlaps subcatchments within the Southerly System and the Easterly System. Local combined sewers within the Southerly subcatchments are tributary to the District's Southerly Main Branch Interceptor. During wet weather, overflows are conveyed to additional downstream regulators, to the Easterly System via the Addison Branch Interceptor, or to the Kingsbury Run Culvert.

Local combined sewers within the Easterly subcatchments are tributary to the Easterly East 79th Branch Interceptor, which flows to regulator E-37 in Gordon Park. Dry weather flows are conveyed to the Easterly Main Branch Interceptor, while wet weather overflows are conveyed to Lake Erie. Figure 4-33 shows the Target Area boundary in relation to subcatchments.



FIGURE 4-32 SEWER CATCHMENT BOUNDARIES IN THE CORE JOB ZONE

The Target Area also spans two separate sewer catchments and treatment districts (Figure 4-32). The portion west of the railroad is located in the CSO 040 catchment in the Southerly System, and represents approximately 2.5% of the total catchment area. The portion east of the railroad is located in the CSO 204 catchment in the Easterly System and represents approximately 4.7% of the total catchment area.

FIGURE 4-33 SEWER SUBCATCHMENT BOUNDARIES IN THE CORE JOB ZONE



0	EXISTING REGULATOR
/	DISTRICT COMBINED
1	LOCAL COMBINED SEWER
1	KINGSBURY RUN CULVERT
	SOUTHERLY CATCHMENTS
	EASTERLY CATCHMENTS
	CITY OF CLEVELAND OPPORTUNITY CORRIDOR

EXISTING DRAINAGE FACILITIES

Existing drainage facilities in Core Job Zone (Figure 4-34) include the combined sewer system, the Kingsbury Run Culvert System, stormwater outfalls, and existing storm sewers.

Kingsbury Run Culvert System

Two segments of the Kingsbury Run Culvert system, Branches A and D, border the Target Area. All flows in the culvert discharge to the Cuyahoga River via the CSO 040 outfall. Branch A, which is the main stem of the culvert, flows from east to west under the existing railroad. Adjacent to the Target Area boundary, the width of Branch A ranges from 60 to 72 inches.

The Branch D alignment borders the southern border of the Target Area. It joins Branch A just east of Kinsman Road. The width of Branch D adjacent to the Target Area ranges from 48 to 72 inches.

Stormwater Outfalls

Two stormwater outfalls are located within the Core Job Zone. These include a 42-inch SWO on East 79th Street downstream of regulator S-21A, which discharges to Branch A of the Kingsbury Run Culvert, and a 42-inch SWO on Grand Avenue downstream of regulator S-20, which discharges to Branch D.

Existing Storm Sewers

Based on a review of available record drawings, there is on-site stormwater management infrastructure south of Buckeye Road between East 92nd and East 89th streets. This infrastructure, associated with the Miceli's Dairy Expansion, includes separate storm sewers and surface detention facilities that connect to the combined sewer system. Additinally, there is a segment of existing local storm sewer near the intersection of Lisbon and Buckeye Roads that connects to Branch A of the Kingsbury Run Culvert. This segment is a No. 6 egg-shaped sewer.

Appendix 3 Green Infrastructure

Additional drainage facilities outside of the Core Job Zone include the District's Green Ambassador – Urban Agriculture Project and the District's Woodland Central Green Infrastructure Project. The former is within the City's Urban Ag Zone Target Area boundary. The latter is located on East 75th Street north of the Core Job Zone. The existing railroad presents a physical barrier between the Core Job Zone and this stormwater management infrastructure.

Planned Drainage Facilities

Planned drainage facilities in the Core Job Zone include any stormwater management infrastructure associated with the Opportunity Corridor roadway. ODOT is directly responsible for the design and construction of this infrastructure, which will manage stormwater runoff from the right-of-way and roadway associated with the project. As of February 2015, ODOT proposed partial separation with connections to the existing Kingsbury Run Culvert.

Additionally, a future culvert will be constructed roughly parallel to Branch A of the Kingsbury Run.

STORMWATER OFFLOADING

The two branches of the Kingsbury Run Culvert System, the two SWOs downstream of regulators S-20 and S-21A, the No. 6 sewer near Lisbon and Buckeye roads, and ODOT's stormwater management infrastructure may present opportunities for offloading stormwater runoff from the combined sewer system. Storm-only connections to these existing sewers would be subject to both NEORSD Title IV and City of Cleveland Chapter 3116 review. Upstream development would be required to treat 100% of the Ohio EPA's water quality volume.

FIGURE 4-34



0	EXISTING REGULATOR
1	DISTRICT COMBINED
1	LOCAL COMBINED SEWER
/	KINGSBURY RUN CULVERT (FUTURE)
	KINGSBURY RUN CULVERT
/	SWO
1	EXISTING STORM SEWER
	CITY OF CLEVELAND TARGET AREA BOUNDARY



ON-SITE STORMWATER MANAGEMENT

The most recent planning documents that focus on redevelopment within the Core Job Zone are the Cleveland Opportunity Corridor Brownfields Area Wide Plan (2013) and the East 79th Street Corridor Study (2017). Both studies were led by the City of Cleveland. The 2013 study focused on strategies for site remediation, infrastructure (including on-site stormwater management), transit-oriented development, sustainable design, and zoning, and provided key recommendations for parcel consolidation and maximizing opportunities for mixed-use redevelopment. The City's 2017 study expanded upon the 2013 recommendations and prioritizes development that supports the existing RTA Red Line and Blue/Green Line stations. The plan splits the corridor into four separate Districts, which represent Areas of Focus for future development. These include, from north to south, the Regional Culinary Zone, the Core Job Zone, the Residential Core, and the Community Hub. The Target Area boundary overlaps the two former areas of focus.

The representation of desired future development within the Core Job Zone is shown in Figure 4-35. Targeted land use types include new office/industrial, agriculture, commercial/retail, and high-density residential. Total impervious surface is anticipated to increase from 50 acres (44% of the Target Area) to more than 69 acres (61% of the Target Area).



PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION. NEIG DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS

IOLTON

Example 1: Development Parcel 16

The first example is development parcel 16, which covers 1.6 acres at the northwest corner of Holton Avenue and East 81st Street. The City's 2017 plan proposes office/ industrial development with the building fronting East 81st street and a surface parking lot between Holton and Rawlings avenues. Impervious surfaces are anticipated to increase from approximately half an acre to 0.8 acres.

Development on this parcel is subject to NEORSD Title IV and Cleveland's Chapters 541 and 3116. The anticipated peak flow discharge rates (in cubic feet per second, CFS) and the corresponding, approximate target control volumes are as follows:

	EXISTING PEAK	FUTURE PEAK	APPROXIMATE
	DISCHARGE	DISCHARGE	TARGET
	6-month, 24-hour	5-year, 24-hour	VOLUME
16	1.1 CFS	3.9 CFS	54,000 GALLONS

Per Title IV, the future 5-year, 24-hour peak discharge rate cannot exceed the existing condition, 6-month, 24-hour peak discharge rate. On-site SCMs are required to store the necessary volume, and outlet control structures must be designed to ensure the peak discharge requirements are met. The City's Division of Water Pollution Control (WPC) may require additional control measures based on the capacity of local sewers.

Figure 4-37 shows a potential strategy for compliance with Title IV. The strategy proposes an extended detention basin in the open space between the building and the street. The basin would be sized to manage runoff from both the building and the surface parking lot, and would likely discharge to the local combined sewer system on Rawlings Avenue. Additionally, trees are planted in residual landscape areas on the site to intercept stormwater runoff, provide shade, and reduce maintenance needs for the underlying landscape.

This proposed strategy is one of several potential approaches to on-site stormwater management. Other surface management strategies (e.g., bioretention or wet extended detention) or subsurface management strategies (e.g., underground storage) may also be feasible on this development parcel.



FUTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS



Example 2: Development Parcels 17, 18, and 19 The second example considers development parcels 17, 18, and 19 located between East 79th Street and East 81st Street, with Holton Avenue to the north and the RTA rail to the south. The City's 2017 plan proposes high-density residential with surface parking on both parcels 17 and 18, and community and public open space on parcel 19. Collectively, the parcels cover 4.4 acres. Total impervious surfaces increase from 0.4 acres to three acres.

Development on each parcel is subject to NEORSD Title IV and Cleveland's Chapters 541 and 3116. The anticipated peak flow discharge rates (in cubic feet per second, CFS) and the corresponding, approximate target control volumes for each development parcel are as follows:

	EXISTING PEAK DISCHARGE 6-month, 24-hour	FUTURE PEAK DISCHARGE 5-year, 24-hour	
17	0.9 CFS	5.9 CFS	100,000 gallons
18	0.9 CFS	4.7 CFS	75,000 gallons
19	0.5 CFS	2.1 CFS	32,000 gallons

If each parcel is developed independently, more than 200,000 gallons of storage would be distributed among SCMs on the three sites, and maintenance responsibility would fall on each property owner. Development parcels 18 and 19 are both high-density residential with shared surface parking, and parcel 19 is community and public open space that would likely serve the adjacent residents. The three sites present an opportunity for an integrated approach to on-site stormwater management. (Figure 4-38). The strategy includes the following elements:

- Pervious pavement is proposed in the parking stalls to manage sheet flow runoff from the surface parking lot. If the adjacent buildings include brick as a surface material, the same style of brick could be used in the pervious pavement system.
- An underground storage tank is proposed under the southern end of the central parking island. The underground storage tank would receive runoff from the pervious pavement and the adjacent building rooftops.
- The underground storage tank could be designed to include additional capacity for storing runoff for nonpotable uses (e.g., landscape irrigation of the site and/ or the adjacent community and public open space).
- The on-site SCMs could connect to the local combined sewer on Holton Avenue.

The SCMs are connected in series and intended to serve as a "treatment train." This means that SCMs are connected in series, and water quality benefits increase as runoff flows downstream. This would eliminate the need for one large, centralized SCM and can also increase the potential for credits available through Title V.

Additionally, the pervious pavement would provide visual interest to the large central parking lot and could complement the materials of the surrounding infrastructure. Note that this approach to on-site stormwater management is one of many possible examples.

FUTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS

FIGURE 4-38 IN THE CORE JOB ZONE





Example 3: Development Parcels 21 and 22

The third example in the Core Job Zone is development parcels 21 and 22. These parcels cover 8.2 acres south of the Opportunity Corridor roadway, between and East 75th and East 79th streets. The City's 2017 plan shows commercial/retail development with a shared surface parking lot. Total impervious surfaces are anticipated to significantly increase from 1.9 acres to seven acres.

Development on each parcel is subject to NEORSD Title IV and Cleveland's Chapters 541 and 3116. The anticipated peak flow discharge rates (in cubic feet per second, CFS) and the corresponding, approximate target control volumes for each development parcel are as follows:

	EXISTING PEAK DISCHARGE 6-month, 24-hour	FUTURE PEAK DISCHARGE 5-year, 24-hour	
21	3.8 CFS	19.4 CFS	312,000 GALLONS
22	1.4 CFS	7.1 CFS	112,000 gallons

Per Title IV, the future 5-year, 24-hour peak discharge rate cannot exceed the existing condition, 6-month, 24hour peak discharge rate. On-site SCMs must store the necessary volume and must be designed so that peak discharge requirements are met. Note that the City's Division of Water Pollution Control (WPC) may require additional control measures based on the capacity of local sewers.

The commercial/retail development shown on these parcels shares a common parking lot, and front highlyvisible roadway corridors; therefore, these sites present an opportunity for an integrated approach to on-site stormwater management. Figure 4-39 shows an example approach for integrating SCMs to comply with Title IV. The approach is based on a combination of surface, subsurface, and above-ground management strategies and includes the following elements:

- Bioretention in the parking islands intercepts runoff from the surface parking lot between the two proposed buildings. Together, the bioretention features manage all of the stormwater runoff from the shared parking.
- An extended detention basin is proposed in the open space along East 75th Street to intercept runoff from the adjacent parking lot and access drive.

- An underground storage tank is proposed in the surface lot adjacent to East 75th Street to manage runoff from the proposed building rooftop.
- A green roof is proposed on the commercial/retail building fronting East 79th Street.
- The bioretention and green roof would likely connect to the local combined sewer on East 79th Street, while the extended detention basin and underground storage tank would likely connect to the local combined sewer on East 75th Street.

While this strategy for on-site stormwater management is one of many possible approaches to compliance with local requirements, it is intended to function as a "treatment train." This means that SCMs are connected in series, and water quality benefits increase as runoff flows downstream. This can eliminate the need for one large, centralized SCM, which may not be feasible on sites with spatial constraints or with soil contamination concerns.

The bioretention and pervious pavement SCMs help to make stormwater management highly-visible and both can serve as unique site features for residents and visitors. Incorporating these SCMs can also increase potential credits available through Title V.

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FIGURE 4-39 IN THE CORE JOB ZONE

OPPORTUNITY CORRIDOR





EAST 79TH DEVELOPMENT ZONE

The East 79th Development Zone (Figure 4-40) includes the East 79th Street corridor from Quincy Avenue at the north to just near Kinsman Road at the south. It is approximately 400 feet wide from Quincy to where it overlaps with the City's Core Job Zone Target Area, where it then extends to include East 81st Street at the east. This zone covers approximately 60 acres, making it the third largest of the City's five Opportunity Corridor Target Areas. It crosses the Fairfax and Kinsman neighborhoods. Figure 4-41 shows existing conditions within the East 79th Development Zone.



FIGURE 4-40 LOCATION OF THE EAST 79TH DEVELOPMENT ZONE RELATIVE TO THE CITY OF CLEVELAND'S OPPORTUNITY CORRIDOR TARGET

Existing planning documents that relate to all or portions of the East 79th Development Zone include:

- East 79th Street Corridor Study. 2017
- Building Stronger Neighborhoods, Kinsman & Central Neighborhood Plan. 2016
- Kinsman Master Plan, 2014
- Central Master Plan. 2014
- Cleveland Opportunity Corridor Brownfields Area Wide Plan. 2013
- Reclaiming Cleveland, Target Area Plans. 2011
- Connecting Cleveland 2020 Citywide Plan. 2009
- Ward 5 Forgotten Triangle. 2007.

The primary community development corporations are the Fairfax Renaissance Development Corporation and Burten, Bell, Carr Development. The Target Area is located in the City's Planning Districts 4 and 5.

Cleveland Opportunity Corridor Brownfields Area Wide Plan













ARFAS





OPPORTUNITY CORRIDOR

NORFOLK SOUTHERN RAILROAD

82ND

84TH

Alexand and a second

RIGHT-OF-WAY



LAND USE & LAND COVER



◄ FIGURE 4-42 EXISTING LAND USE IN THE EAST 79TH DEVELOPMENT ZONE

FIGURE 4-43

FUTURE LAND USE IN THE

EAST 79TH DEVELOPMENT ZONE

In the East 79th Development Zone, heavy industry, light industry, and right-of-way account for more than half of the total existing land use (Figure 4-42). Future land use types represented in the City's Connecting Cleveland 2020 Citywide Plan (Figure 4-43) show the conversion of heavy industry and land bank/vacant land uses to mixed use and light industry. The extent of retail land uses are reduced, while recreation/open space land uses are increased. In general the total mix of land use types is greatly simplified along the corridor.



FIGURE 4-44 ►

COMPARISON OF EXISTING AND FUTURE LAND USES IN THE EAST 79TH DEVELOPMENT ZONE



Existing impervious and pervious land cover account for 54 percent and 46 percent, respectively. Based on development scenarios represented in existing plans, impervious land cover (Figure 4-45) increases to 59 percent. Under the future land cover scenario (Figure 4-46), the top three impervious land cover types are existing (i.e., impervious surfaces to remain), roadway pavement, and parking. The quantification of future impervious includes the pavement associated with the Opportunity Corridor roadway. FIGURE 4-45 ► EXISTING LAND COVER IN THE EAST 79TH DEVELOPMENT ZONE



FIGURE 4-46 ► FUTURE LAND COVER IN THE EAST 79TH DEVELOPMENT ZONE





COMPARISON OF EXISTING AND FUTURE LAND COVER IN THE EAST 79TH DEVELOPMENT ZONE

ND COVER IN THE ELOPMENT ZONE







COLLECTIONS SYSTEM



FIGURE 4-48 WATERSHED BOUNDARIES IN THE EAST 79TH DEVELOPMENT ZONE

The existing railroad splits the East 79th Development Zone into two separate watersheds (Figure 4-48). The portion of the Target Area south of the railroad is in the Kingsbury Run Subwatershed, which is part of the Cuyahoga River Watershed. Natural surface flow patterns are from the east towards the west. The portion of the Target Area north of the railroad is in the Lake Erie Direct Tributaries Watershed. Natural surface flow patterns are towards the north.

The Target Area overlaps five subcatchments within the Southerly System and two subcatchments in the Easterly System (448 and 436). Dry weather flows reach the District's Southerly Main Branch Interceptor. During wet weather, overflows are conveyed to additional downstream regulators, to the Easterly System via the Addison Branch Interceptor, or to the Kingsbury Run Culvert.

Local combined sewers with the Easterly subcatchments are tributary to the Easterly Addison Branch Interceptor. Dry weather flows are conveyed to the Easterly Main Branch Interceptor, while wet weather overflows are conveyed to Lake Erie. Figure 4-50 shows the Target Area boundary in relation to subcatchments.



FIGURE 4-49 SEWER CATCHMENT BOUNDARIES IN THE EAST 79TH DEVELOPMENT ZONE

The Target Area also spans two separate sewer catchments and treatment districts (Figure 4-49). The portion south of the railroad is located in the CSO 040 catchment in the Southerly System, and represents less than one percent of the total catchment area. The portion north of the railroad is located in the CSO 203 catchment in the Easterly System and represents approximately 3.1% of the total catchment area.

> FIGURE 4-50 > SEWER SUBCATCHMENT BOUNDARIES IN THE EAST 79TH DEVELOPMENT ZONE



0	EXISTING REGULATOR
/	DISTRICT COMBINED
1	LOCAL COMBINED SEWER
1	KINGSBURY RUN CULVERT
	SOUTHERLY CATCHMENTS
	EASTERLY CATCHMENTS
	CITY OF CLEVELAND OPPORTUNITY CORRIDOR
EXISTING DRAINAGE FACILITIES

Existing drainage facilities in East 79th Development Zone (Figure 4-51) include the combined sewer system, the Kingsbury Run Culvert System, a stormwater outfall, and District's Appendix 3 Green Infrastructure.

Kingsbury Run Culvert System

Two segments of the Kingsbury Run Culvert system, Branches A and D, pass through the Target Area. All flows in the culvert discharge to the Cuyahoga River via the CSO 040 outfall.

Branch A, which is the main stem of the culvert, flows from east to west under the existing railroad. Within the Target Area boundary, the width of Branch A is 48 inches. The Branch D alignment passes through the Target Area just south of the Greater Cleveland RTA line, and ranges in width from 48 to 60 inches. It joins Branch A just east of Kinsman Road

Stormwater Outfall

One stormwater outfall is located on East 79th Street. downstream of Regulator S-21A. During wet weather events, flows exceeding the capacity of the combined sewer system discharge to the SWO, which is 42 inches in width and connects to Branch A of the Kingsbury Run Culvert north of the railroad.

Appendix 3 Green Infrastructure

The District's Green Ambassador - Urban Agriculture Project is located in the southern extent of the Target Area boundary, north of Bristol Avenue. This project includes a network of separate storm sewers that discharge to one of two large-scale bioretention basins, which detain and treat stormwater before conveyance to the environment via the Kingsbury Run Culvert. The storm sewers that overlap this Target Area boundary discharge to the West Basin, which is located between East 79th and East 81st streets.

The District's Woodland Central Green Infrastructure is located west of the Target Area Boundary. The project includes a storm sewer network on Woodland Avenue and East 75th Street, which discharges to the East Basin, a large-scale detention basin that connects to the Kingsbury Run Culvert.

Planned Drainage Facilities

Planned drainage facilities in the East 79th Development Zone include any stormwater management infrastructure associated with the Opportunity Corridor roadway. ODOT is directly responsible for the design and construction of this infrastructure, which will manage stormwater runoff from the right-of-way and roadway associated with the project.

As of February 2015, ODOT proposed partial separation with connections to the existing Kingsbury Run Culvert. Additionally, a future 60-inch culvert will be constructed roughly parallel to Branch A of the Kingsbury Run.

STORMWATER OFFLOADING

Within the East 79th Development Zone, the two branches of the Kingsbury Run Culvert System, the SWOs downstream of regulators S-21A, and the District's Appendix 3 storm sewers present opportunities for offloading stormwater runoff from the combined sewer system. Storm-only connections to these existing sewers would be subject to both NEORSD Title IV and City of Cleveland Chapter 3116 review. Upstream development would be required to treat 100% of the Ohio EPA's water quality volume.

The Urban Ag storm sewers were designed for the 5-year storm event, and the East and West basins treat the runoff from the tributary drainage area up to the one-inch storm event. Additional on-site controls may be necessary for proposed connections to this separate system to ensure that peak discharges do not negatively impact the infrastructure downstream.

FIGURE 4-51 DRAINAGE FACILITIES IN THE EAST 79TH DEVELOPMENT ZONE





ON-SITE STORMWATER MANAGEMENT

The City's East 79th Street Corridor Study (2017) focuses on creating employment opportunities within this Target Area, and prioritizes development that supports existing transit stations (one for RTA's Red Line, and one for RTA's Blue/Green Line) and sustainable growth in the neighborhood. The plan splits the corridor into four separate Districts, which represent Areas of Focus for future development. These include, from north to south, the Regional Culinary Zone, the Core Job Zone, the Residential Core, and the Community Hub.

At the northern extent of the Target Area boundary, Burten, Bell, Carr's Central Neighborhood Plan (2014) focuses on mixed-use development on vacant parcels.

The representation of desired future development within this Target Area (Figure 4-52) shows urban infill on both sides of East 79th Street. Total impervious surface is anticipated to increase from approximately seven acres (33% of the Target Area) to twelve acres (61% of the Target Area).



FIGURE 4-53 DEVELOPMENT PARCELS IN THE EAST 79TH DEVELOPMENT ZONE

Sixteen separate development parcels (Figure 4-53) were defined based on proposed land cover represented in the existing planning documents. Desired future development on parcels 1-4 is represented in Burten, Bell, Carr's 2014 plan, and in the City's 2017 plan on parcels 5-16. The parcels in the center of the Target Area are included in the City's Core Job Zone; therefore, the numbering for development parcels in the East 79th Development Zone Target Area excludes these parcels.

Eight parcels are less than one acre and would be subject to compliance with both the District's Title IV regulations and the City's Chapter 541. The remaining eight parcels are greater than one acre and would be subject to Title IV, Chapter 541, and Chapter 3116. Development parcel 9 was selected to demonstrate a potential approach to compliance with stormwater management requirements.

FIGURE 4-52 EAST 79[™] DEVELOPMENT ZONE



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Development parcel 9 covers approximately 2.5 acres at the northwest corner of East 79th Street and Kinsman Road. In the City's 2017 plan, this parcel is located in the Residential Core Area of Focus and is shown as a senior housing development. Impervious surfaces are anticipated to increase from one acre to approximately 1.6 acres. The future imprevious land cover is primarily surface parking and building footprint.

If developed, this parcel must comply with NEORSD Title IV and Cleveland's Chapters 541 and 3116. The anticipated peak flow discharge rates (in cubic feet per second, CFS) and the corresponding, approximate target control volume are as follows:

	EXISTING PEAK	FUTURE PEAK	APPROXIMATE
	DISCHARGE	DISCHARGE	TARGET
	6-month, 24-hour	5-year, 24-hour	VOLUME
9	2.2 CFS	7.0 CFS	97,000 GALLONS

Per Title IV, the future 5-year, 24-hour peak discharge rate cannot exceed the existing condition, 6-month, 24hour peak discharge rate. On-site SCMs must store the necessary volume, and outlet control structures must be designed to ensure the peak discharge requirements are met. The City's Division of Water Pollution Control (WPC) may require additional control measures based on the capacity of local sewers.

Figure 4-54 shows a strategy for integrating multiple onsite SCMs to detain runoff and comply with Title IV. The strategy includes the following elements:

- Bioretention is shown in the parking island and intercepts sheet flow from a portion of the adjacent surface parking lot.
- Pervious pavement is integrated in two of the parking stalls that would receive the remainder of sheet flow from the parking lot. If the adjacent buildings include brick as a surface material, the same style of brick could be integrated as part of the pervious pavement system.
- The bioretention and pervious pavement SCMs would connect to an underground storage tank located in the primary access drive from Kinsman Road. The underground storage tank would also receive runoff from the adjacent building rooftops.
- The underground storage tank could be designed to include additional capacity for storing runoff for nonpotable uses (e.g., landscape irrigation).
- Flow patterns would likely be from the west towards the south or the east, with a potential sewer connection on Kinsman Road and/or East 79th Street.
- Trees are planted in residual landscape areas on the site to intercept stormwater runoff, provide shade, and reduce maintenance needs for the underlying landscape.

While this strategy for on-site stormwater management is one of many possible approaches to compliance with local requirements, it is intended to function as a "treatment train." This means that SCMs are connected in series, and water quality benefits increase as runoff flows downstream. This can eliminate the need for one large, centralized SCM, which may not be feasible on sites with spatial constraints or with soil contamination.

The bioretention and pervious pavement SCMs help to make stormwater management highly-visible and both can serve as unique site features for residents and visitors. Incorporating these SCMs can also increase potential credits available through Title V.

UTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY **DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS**

FIGURE 4-54





URBAN AG ZONE

The Urban Ag Zone (Figure 4-55) – "Ag" referring to Agriculture – covers 51 acres and borders the City's East 79th Development Zone and Core Job Zone Target Areas. It is the second smallest of the City's Target Areas. It is bounded by the RTA line at the north, the Norfolk Southern railroad at the east, Kinsman Road at the south, and East 81st Street at the west. It is located in the Kinsman neighborhood. Figure 4-56 shows existing conditions within the Target Area.



LOCATION OF THE URBAN AG ZONE RELATIVE TO THE CITY OF CLEVELAND'S OPPORTUNITY CORRIDOR TARGET AREAS

Existing planning documents that cover all or portions of the Urban Ag Zone include:

- East 79th Street Corridor Study. 2017
- Building Stronger Neighborhoods, Kinsman & Central Neighborhood Plan. 2016
- Kinsman Master Plan, 2014
- Reclaiming Cleveland, Target Area Plans. 2011
- Urban Agriculture Innovation Zone. 2010.
- Connecting Cleveland 2020 Citywide Plan. 2009
- Ward 5 Forgotten Triangle. 2007.

The primary community development corporation is Burten, Bell, Carr Development. The Target Area is located in the City's Planning District 4.







Connecting Cleveland 2020 Citywide Plan







EXISTING CONDITIONS MAP FOR THE CITY OF CLEVELAND'S URBAN AG ZONE TARGET AREA





LAND USE & LAND COVER



FIGURE 4-57 EXISTING LAND USE IN THE URBAN AG ZONE

FIGURE 4-58

URBAN AG ZONE

FUTURE LAND USE IN THE

COMPARISON OF EXISTING

URBAN AG ZONE

AND FUTURE LAND USES IN THE

Land bank/vacant, right-of-way, and light industry are the top three existing land uses in the Urban Ag Zone (Figure 4-57). Vacant land uses alone account for almost 37 percent of the total land area. The City's Connecting Cleveland 2020 Citywide Plan shows the conversion of all vacant and heavy industry to light industry land uses. Under this future scenario (Figure 4-58), light industry accounts for 70 percent, right-of-way for 25 percent, and transportation/public utility for 5 percent of the Target Area.





Existing impervious surfaces (Figure 4-60) were greatly reduced in the past few decades, and represent 20 percent of the Target Area boundary. Existing pervious represents 80 percent. Future development is anticipated to increase the total impervious surface (Figure 4-61) cover to 27 percent and decrease pervious surface cover to 73 percent. Under the future land cover scenario, the top three impervious land cover types are roadway pavement, existing (i.e., impervious surfaces to remain), and proposed buildings.

FIGURE 4-60 EXISTING LAND COVER IN THE URBAN AG ZONE



FIGURE 4-61 FUTURE LAND COVER IN THE URBAN AG ZONE





FIGURE 4-62 COMPARISON OF EXISTING AND FUTURE LAND COVER IN THE URBAN AG ZONE







COLLECTIONS SYSTEM



FIGURE 4-63 🛦 WATERSHED BOUNDARIES IN THE URBAN AG ZONE

The Urban Ag Zone is completely contained in the Kingsbury Run Subwatershed (Figure 4-63), which is part of the Cuyahoga River Watershed. Natural surface flow patterns are from the southeast towards the northwest.

The Target Area overlaps subcatchments within the Southerly System. Local combined sewers are tributary to the Southerly Main Branch Interceptor. During wet weather, overflows at each regulator are conveyed to a 48-inch SWO, both of which connect to the Kingsbury Run Culvert System. Figure 4-65 shows the Target Area boundary in relation to subcatchments.



FIGURE 4-64 SEWER CATCHMENT BOUNDARIES IN THE URBAN AG ZONE

The Target Area is located in the CSO 040 catchment (Figure 4-64) in the Southerly System, and represents approximately 1.2% of the total catchment area.



FIGURE 4-65





100 200



EXISTING DRAINAGE FACILITIES

Existing drainage facilities in the Urban Zone (Figure 4-66) include the Kingsbury Run Culvert System and the District's Appendix 3 Green Infrastructure.

Kingsbury Run Culvert System

One segment of the Kingsbury Run Culvert system, Branch D, passes through the northern extent of the Target Area. All flows in the culvert discharge to the Cuyahoga River via the CSO 040 outfall. The Branch D alignment starts at the east near Woodhill Road and ends where it joins the main stem of the culvert (i.e., Branch A) just east of Kinsman Road. Within the Target Area boundary, the width of Branch D ranges from 36 to 48 inches.

Appendix 3 Green Infrastructure

The District's Green Ambassador – Urban Agriculture Project is located in the Target Area boundary. This project includes a network of separate storm sewers, which collects stormwater runoff from upstream areas and conveys it to two bioretention basins - referred to as the West Basin (Figure 4-67) and East Basin (Figure 4-68) and two small-scale bioretention features - referred to as the Gateway Features. The West and East basins detain and treat stormwater before discharging to Branch D of the Kingsbury Run Culvert. The Gateway Features provide pre-treatment for runoff from Kinsman Road before discharging to the downstream separate storm sewers.



FIGURE 4-67 URBAN AGRICULTURE WEST BASIN

FIGURE 4-68 URBAN AGRICULTURE EAST BASIN



Planned Drainage Facilities

There are no planned drainage facilities in the Urban Ag Zone.

STORMWATER OFFLOADING

Within the Urban Ag Zone, Branch D of the Kingsbury Run Culvert System and the District's Appendix 3 storm sewers present opportunities for offloading stormwater runoff from the combined sewer system. Storm-only connections to these existing sewers would be subject to both NEORSD Title IV and City of Cleveland Chapter 3116 review. Upstream development would be required to treat 100% of the Ohio EPA's water quality volume.

The Urban Ag storm sewers were designed for the 5-year storm event, and the East and West basins treat the runoff from the tributary drainage area up to the one-inch storm event. Additional on-site controls may be necessary for proposed connections to this separate system to ensure that peak discharges do not negatively impact the infrastructure downstream.

NORFOLK SOUTHERN RAILROAD 84TH 83RD 5 GREEN AMBASSADOR URBAN AGRICULTURE PROJECT GATEWAY FEATURE EAST BASI ar ar GREEN AMBASSADC AN AGRICULTURE PROJEC GATEWAY FEATUR 81ST IOLTON

FIGURE 4-66







ON-SITE STORMWATER MANAGEMENT

Burten, Bell, Carr's Urban Agriculture Innovation Zone Concept (2010) a spectrum of agricultural land uses within this Target Area. These include farming plots, composting facilities, a community farmers' market, orchars, and public amenities. The plan also shows building upon proximity to the existing RTA station and improving connectivity to the Target Area, a goal further emphasized by the City's East 79th Street Corridor Study (2017). The City's 2017 study does not cover the full extent of the Target Area boundary, nor does it propose any changes to desired future land uses when compared to the 2010 concept plan by Burten, Bell, Carr. It does mention the identification of a vision for agricultural businesses/ programs in this area, which supports the 2010 concept.

The representation of desired future development within the City's Urban Ag Zone Target Area (Figure 4-69) shows farm plots, greenhouses, and several facilities supporting these land uses. Total impervious surface is anticipated to increase from approximately 1.2 acres (13% of the Target Area) to 3.8 acres (41% of the Target Area).



FIGURE 4-70 DEVELOPMENT PARCELS IN THE URBAN AG ZONE

Four separate development parcels (Figure 4-70) were defined based on proposed land cover represented in the existing planning documents. Desired future development on parcels 2-4 is represented in Burten, Bell, Carr's 2010 plan. Each parcel is subject to both the District's Title IV and the City's Chapter 541 regulations. Parcels 2 and 4 are greater than one acre, and are also subject to the City's Chapter 3116. Development on parcel 1 is based on recently-constructed improvements.

Updates to desired future land uses within this Target Area are still pending City and stakeholder coordination. As a result, and based on direction provided by the Cleveland City Planning Commission, an example for stormwater management compliance was not developed.

As site plans are refined and approved, it is recommended that the District be engaged during discussions related to stormwater management, as there may be opportunities to connect on-site systems to existing separate storm infrastructure.

NG DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY DEVELOPMENT

FIGURE 4-69





SLAVIC VILLAGE TOD

The Slavic Village TOD (Figure 4-71), which is an acronym for Transit-Oriented Development, is located at the intersection of I-490 and the western terminus of the Opportunity Corridor Roadway. The primary bounding roadways include I-490 at the north; East 64th Street at the east; Hyacinth Court, Maurice Avenue, and Sweeney Avenue at the south; and the Norfolk Southern railroad at the west. It covers more than 70 acres in the city's Broadway-Slavic Village neighborhood. Figure 4-72 shows existing conditions within the East 79th Development Zone.



FIGURE 4-71 🔺 LOCATION OF THE SLAVIC VILLAGE TOD RELATIVE TO THE CITY OF CLEVELAND'S OPPORTUNITY CORRIDOR TARGET AREAS

Existing planning documents that relate to all or portions of the Slavic Village TOD include:

- St. Hyacinth Transit Oriented Development Study. 2012
- Reclaiming Cleveland, Target Area Plans. 2011
- Connecting Cleveland 2020 Citywide Plan. 2009

The primary community development corporation is the Broadway Slavic Village Development Corporation. The Target Area is located in the City's Planning District 3.











SLAVIC VILLAGE TOD



FIGURE 4-73 EXISTING LAND USE IN THE SLAVIC VILLAGE TOD

FIGURE 4-74

FUTURE LAND USE IN THE

COMPARISON OF EXISTING

SLAVIC VILLAGE TOD

AND FUTURE LAND USES IN THE

SLAVIC VILLAGE TOD

Single-/two family, heavy industry, and light industry land uses represent slightly more than 60 percent of the Slavic Village TOD. Figure 4-73 shows existing land use. Future land use types represented in the City's Connecting Cleveland 2020 Citywide Plan (Figure 4-74) show converting all heavy industry west of East 55th Street to light industry. Vacant parcels east of East 55th are converted to single-/two-family residential or retail land uses.





Existing impervious surfaces (Figure 4-76) cover 63 percent of the Target Area. Future development, as represented in existing planning documents and shown in Figure 4-77, will decrease impervious surfaces to a total of 55 percent. A majority of this reduction is a result of the removal of a large area of impervious surface northeast of Francis Avenue and East 55th Street, which is associated with the construction of the Opportunity Corridor.

FIGURE 4-76 EXISTING LAND COVER IN THE SLAVIC VILLAGE TOD





FIGURE 4-78 COMPARISON OF EXISTING AND FUTURE LAND COVER IN THE SLAVIC VILLAGE TOD

FIGURE 4-77 FUTURE LAND COVER IN THE SLAVIC VILLAGE TOD







COLLECTIONS SYSTEM



FIGURE 4-79 WATERSHED BOUNDARIES IN THE SLAVIC VILLAGE TOD

The Slavic Village TOD is in the Kingsbury Run Subwatershed (Figure 4-79), which is part of the Cuyahoga River Watershed. The western edge of the Target Area boundary overlaps a negligible portion of the Morgana Run Subwatershed. In general, natural surface flow patterns are from the southeast to the northwest.

The Target Area overlaps four subcatchments in the Southerly System. During dry weather, flows are directed towards the District's Southerly Main Branch Interceptor on the western extent of the Target Area Boundary. During wet weather, overflows are conveyed past a leaping weir in regulator S-10 to a branch of the Kingsbury Run Culvert via a 78-inch SWO. There is an additional 96-inch relief sewer north of the regulator. This sewer connects to the branch of the Kingsbury Run Culvert that is located under the rail yard. Figure 4-81 shows the Target Area boundary in relation to subcatchments.



FIGURE 4-80 SEWER CATCHMENT BOUNDARIES IN THE SLAVIC VILLAGE TOD

The entire Target Area is in the CSO 040 catchment (Figure 4-80) in the Southerly System, and represents approximately 1.5% of the total catchment area.



FIGURE 4-81

CITY OF CLEVELAND OPPORTUNITY CORRIDOR TARGET AREA BOUNDARY

SOUTHERLY CATCHMENTS

KINGSBURY RUN CULVERT

LOCAL COMBINED SEWER

CATTE

DISTRICT COMBINED INTERCEPTOR

O EXISTING REGULATOR





FRANCIS

BUTLER



EXISTING DRAINAGE FACILITIES

Existing drainage facilities in Slavic Village TOD (Figure 4-82) include the combined sewer system, the Kingsbury Run Culvert System, and a stormwater outfall.

Kingsbury Run Culvert System

Two segments of the Kingsbury Run Culvert system, Branches B and E, traverse the Target Area. An additional segment, Branch A, is located north of the boundary under the existing rail yard. All flows in the culvert discharge to the Cuyahoga River via the CSO 040 outfall.

Branch B flows from south to north and crosses under industrial property between Sweeney and Praha avenues, under I-490, and under the rail yard where it joins Branch A (i.e., the main stem of of the culvert). Within the Target Area boundary, the width of Branch B ranges from 43 to 68 inches.

The Branch E alignment follows Francis Avenue and crosses East 55th Street to Praha Avenue. It joins Branch A just west of I-77. The width of Branch E through the Target Area ranges from 156 to 188 inches.

Branch A is under the existing railyard and has a width of approximately 108 inches (9 feet) within the extent shown on the adjacent map.

Stormwater Outfall

One stormwater outfall is located on East 55th Street, downstream of Regulator S-10. During wet weather events, flows exceeding the capacity of the combined sewer system discharge to the SWO, which is 78 inches in width and connects to Branch E of the Kingsbury Run Culvert just west of the intersection of Francis Avenue and East 55th Street.

Planned Drainage Facilities

Planned drainage facilities in the Slavic Village TOD include any stormwater management infrastructure associated with the Opportunity Corridor roadway. ODOT is directly responsible for the design and construction of this infrastructure, which will manage stormwater runoff from the right-of-way associated with the project. As of February 2015, ODOT proposed storm only separation; however, the discharge location to the environment is unknown.

STORMWATER OFFLOADING

Within the Slavic Village Target Area, both branches of the Kingsbury Run Culvert System and the SWO downstream of Regulator S-10 present opportunities for offloading stormwater runoff from the combined sewer system. Storm-only connections to these existing sewers would be subject to both NEORSD Title IV and City of Cleveland Chapter 3116 review. Upstream development would be required to treat 100% of the Ohio EPA's water quality volume.

NORFOLK SOUTHERN RAILROAD FEET BRANCH A GREATER CLEVELAND RTA PRAHA BRAG MAURIC BELLFORD

FIGURE 4-82 DRAINAGE FACILITIES IN THE SLAVIC VILLAGE TOD







ON-SITE STORMWATER MANAGEMENT

The St. Hyacinth Transit Oriented Development Study (2012) focuses on strategies for redeveloping vacant land within a quarter mile of the existing RTA station at East 55th Street. The strategies include filling in gaps on vacant land, improving streetscapes, and enhancing connectivity with new crosswalks and sidewalks.

The representation of desired future development (Figure 4-83) shows infill of single-family residential on more than forty lots within the neighborhood to the east of East 55th Street. Additionally, a new retail/office development is proposed within the right-of-way formed by the ramp connecting East 55th Street to the Opportunity Corridor roadway. Total impervious surface is anticipated to increase from approximately 0.90 acres (37% of the Target Area) to 1.3 acres (53% of the Target Area). The existing industrial land uses west of East 55th Street remain.

Only one development parcel (Figure 4-84) was defined based on proposed land cover represented in the 2012 study. The proposed single-family residential was excluded since the projects are each represented as less than 0.5 acres in size, and therefore would likely not require onsite stormwater management. Development parcel 1 is approximately 2.4 acres and is subject to the District's Title IV regulations and the City's Chapters 541 and 3116.



DEVELOPMENT PARCELS IN THE SLAVIC VILLAGE TOD

Updates to desired future land uses within this Target Area are still pending City and stakeholder coordination. As a result, and based on direction provided by the Cleveland City Planning Commission, an example for stormwater management compliance was not selected. As site plans are refined and approved, it is recommended that the District be engaged during discussions related to stormwater management, as there may be opportunities to connect on-site systems to existing separate storm infrastructure on Francis Avenue, Praha Avenue, and East 55th Street. FUTURE LAND COVER IS BASED ON INFORMATION CONTAINED IN PLANNING DOCUMENTS PRODUCED BY THE CLEVELAND CITY PLANNING COMMISSION, NEIGHBORHOOD COMMUNITY DEVELOPMENT CORPORATIONS, AND OTHER STAKEHOLDERS

FIGURE 4-83 AVIC VILLAGE TOD

