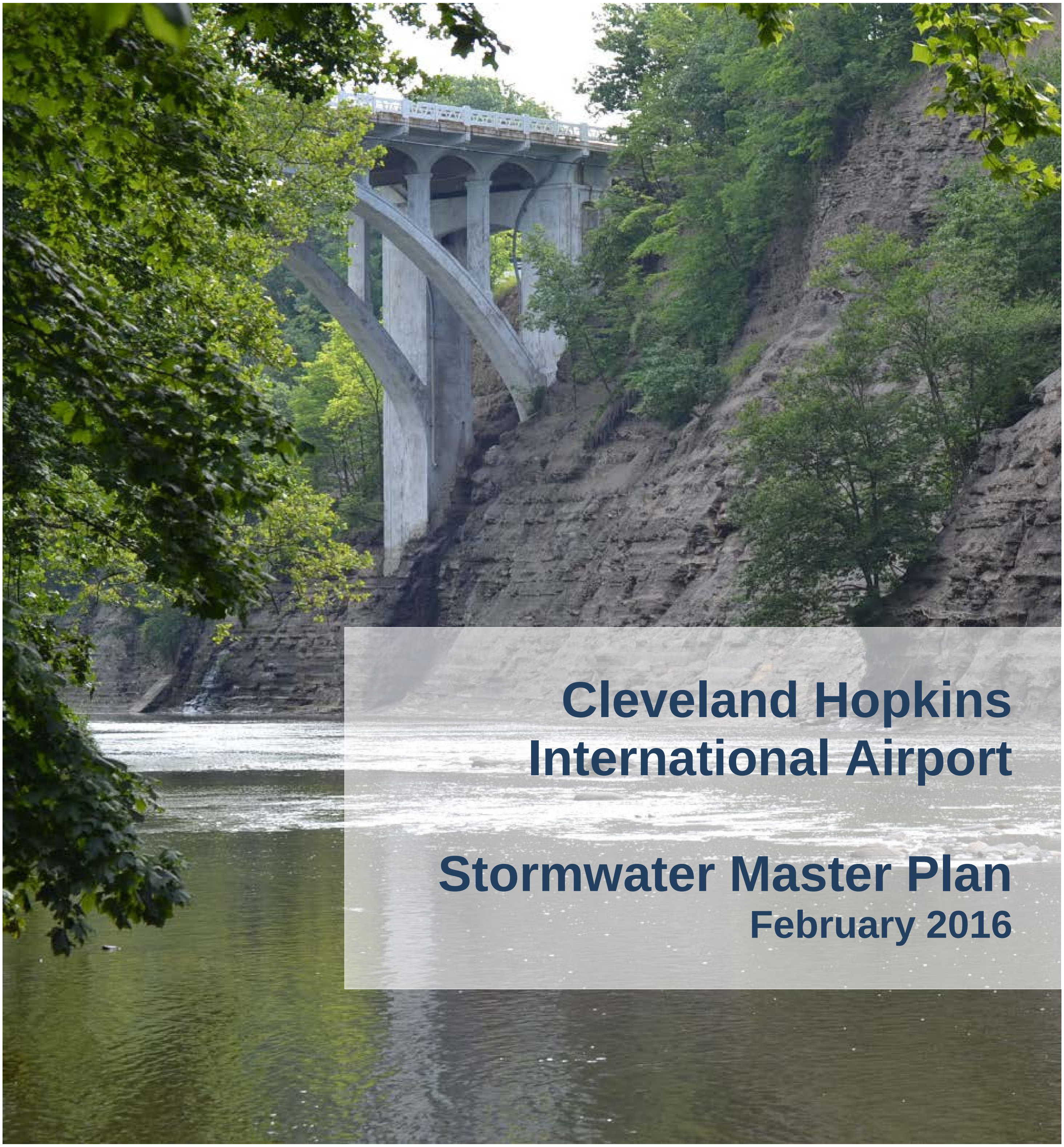
CLEVELAND AIRPORT SYSTEM

CLE CLEVELAND HOPKINS INTERNATIONAL AIRPORT



Cleveland Hopkins International Airport

Stormwater Master Plan

February 2016

This document was prepared by:

Michael Baker Jr., Inc.
Cleveland, OH

and

GS&P/OH, Inc.
an affiliate of Gresham, Smith and Partners
Columbus, OH

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Appendices

To minimize the size of this document and use of printing resources additional information related to the Stormwater Master Plan can be found in the *Reference* folder on the enclosed DVD. The *Reference* folder contains the following:

- Storm Sewer System Database and Maps
- Impervious Area Excel Tables (Existing, Proposed, and to be removed)
- Hydrologic and Hydraulic Report for the Outfall 012 Central Detention Basin
- Hydrologic and Hydraulic Report for the Outfall 003 Retention Basin
- Example FAA Technical Specifications for Stormwater Pollution Prevention Plan aspects of construction projects
- Editable Forms
- Drainage Reports from Past Projects
- SWMM Files

1.0 INTRODUCTION

Stormwater management regulations are becoming increasingly stringent and complex as regulators strive to reduce flooding, reduce discharges of pollutants from industrial and construction activities, and improve or maintain the quality of receiving water bodies. Airports are subject to the same federal, state, and local stormwater regulations as other industrial facilities; however, airports' operations and settings pose unique challenges. While typical stormwater management controls are demonstrated effective for typical developments and operations; these controls often are in direct conflict with Federal Aviation Administration (FAA) life safety regulations including those that intend to limit wildlife attraction. Even though challenges exist for airports, alternatives that meet both the safety of airport operations and the quality of the receiving waterbodies can be identified through comprehensive planning so that long-term sustainable airport development can be achieved.

This Stormwater Master Plan (SWMP) was developed for the Cleveland Hopkins International Airport (CLE) by the City of Cleveland Department of Port Control (DPC), which owns and operates CLE. The SWMP provides documentation of DPC's approach to stormwater management at CLE to comply with applicable regulations, in the context of existing facilities and the airport's plan for development through 2035. This SWMP may be updated by DPC at any time to accommodate changes to airport development plans. The SWMP will also be updated within 90 days of each renewal of the Ohio EPA General NPDES Permit for Storm Water Associated with Construction Activities or any watershed-specific NPDES permit issued for storm water discharges associated with construction activity applicable to the watersheds to which the airport discharges. Certain updates may require review and approval by the Ohio Environmental Protection Agency (EPA).

1.1 SWMP Objectives

The SWMP has been prepared for Ohio EPA's approval and DPC contractors' use to provide guidance on how DPC intends to address post-construction best management practice (PCBMP) requirements at CLE to meet federal, state, and local regulations. Additional objectives of the SWMP are to:

- Maintain compliance with the provisions of the federal Water Pollution Control Act, Ohio's National Pollutant Discharge Elimination System (NPDES), the City of Cleveland's stormwater regulations, and FAA;
- Account for anticipated changes in stormwater regulations;
- Provide a regional approach and conceptual plan for PCBMPs that minimize wildlife attractants, supports sustainability efforts, and conserves natural resources while maintaining safe airport operations;
- Optimize capital, operating and maintenance costs associated with stormwater management through strategic selection and placement of PCBMPs;
- Demonstrate the use of on-site regional PCBMPs as the preferred approach for addressing post-construction treatment requirements for development at CLE, as it makes use of existing PCBMPs with available capacity while complying with FAA safety regulations and helps to minimize project and airfield impacts; and
- Provide a communication tool to assist DPC and its contractors with planning and implementing the stormwater management aspects of airport construction projects.

The strategy for the SWMP was developed based on the following:

- Anticipated airport improvements shown on the 2012 Airport Layout Plan;
- The Ohio EPA Construction General Permit (CGP) effective April 21, 2013;
- An inventory of existing storm sewer systems at CLE;
- An assessment of existing PCBMPs and their locations within the delineated outfall drainage areas; and
- A representation of stormwater runoff and detention storage needs as simulated by a stormwater management model.

1.2 Regulatory Approach

As described above, the primary purpose of the SWMP is to document DPC's approach for implementation of BMPs at CLE to meet applicable regulations. The Ohio EPA's CGP serves as the primary driver for the implementation of those BMPs applicable to new development and redevelopment projects at CLE. Due to the rapidly evolving nature of airport development and the unique challenges faced by airports in stormwater management, it is essential that DPC have a regulatory compliance approach identified and approved well in advance of planned development timeframes to minimize the potential for significant cost and schedule impacts.

This SWMP provides documentation of DPC's proposed approach to comply with the post-construction requirements of the CGP, based on an analysis of planned future development at CLE and existing PCBMP capacity. The proposed approach involves the following strategies:

- Take credit for existing BMPs that are already providing significant water quality benefits to stormwater runoff from developed areas at CLE;
- Identify opportunities to use existing PCBMPs as regional on-site or off-site PCBMPs for new or redevelopment areas with modifications as required to comply with CGP criteria;
- Consider opportunities to perform off-site mitigation using BMPs at CLE that have excess capacity, or through consideration of an in-lieu fee program; and
- Implement new PCBMPs (on a regional level for airfield drainage or on a project-specific basis when BMPs will not conflict with safety requirements) to address remaining requirements for new development or redevelopment.

DPC has been involved in regular coordination with Ohio EPA related to stormwater management at CLE. In a letter to DPC dated February 9, 2015, the Ohio EPA expressed support for DPC's development of a SWMP as a means to document DPC's proposed approach to comply with post-construction requirements at CLE and eliminate the need for project-by-project reviews. Ohio EPA recommended DPC incorporate the SWMP into CLE's Individual Industrial National Pollutant Discharge Elimination System (NPDES) Permit #3II00179*ED. This permit authorizes on-going stormwater discharge from day-to-day airport operations (e.g., industrial activities). DPC is currently coordinating with Ohio EPA on review and approval of the SWMP.

Following Ohio EPA approval of the SWMP, DPC will submit an application to modify the individual industrial permit to incorporate this SWMP into the industrial permit to consolidate CLE storm water management efforts. In accordance with the February 9, 2015 letter, Ohio EPA will include language to allow plan amendments to account for changing priorities. The SWMP will remain in effect for the life of the individual permit term, which ends on March 31, 2018. The SWMP will be updated during the industrial permit renewal period and submitted for approval with subsequent permit renewals. DPC will continue to obtain authorization to discharge stormwater associated with construction activity for applicable projects in accordance with the CGP Notice of

Intent (NOI) process; however, Ohio EPA has indicated that approval of the SWMP will meet the need for prior approval of off-site mitigation approaches.

1.3 SWMP Organization

The content of the SWMP is summarized below by section:

- Section 1: Introduction – This section provides an overview of SWMP objectives, regulatory context, and report content.
- Section 2: Storm Sewer System – This section describes the existing CLE storm sewer system, including watershed and general drainage information, a summary of drainage basins and infrastructure, and existing stormwater best management practices (BMPs).
- Section 3: Anticipated Projects – This section provides a summary of planned development at CLE through 2035, based on the Airport Layout Plan and Capital Improvement Plans.
- Section 4: Stormwater Management Strategy – This section identifies strategies for compliance with the post-construction requirements of the CGP, as applicable toward future development projects. It provides guidance on overall strategies, as well as detailed strategies to be considered within each outfall drainage area.
- Section 5: Stormwater Analysis – This section describes the stormwater modeling analysis performed to characterize the capacity of CLE detention basins in both existing conditions (2012) and future conditions (2035).
- Section 6: Rationale for Selection of Post-Construction BMPs – This section provides general guidance on how to select and design new PCBMPs, where required, for development projects at CLE.
- Section 7: Construction Inspections and BMP Maintenance – This section provides general guidance for construction stormwater-related inspections and BMP maintenance during construction projects to facilitate compliance with the CGP.

2.0 STORM SEWER SYSTEM

This section describes the CLE storm sewer system, including watershed and general drainage information, a summary of drainage basins and stormwater infrastructure, and existing stormwater BMPs. A site map showing the airport configuration, drainage areas, and locations of PCBMPs is located in **Appendix A.** Additional reference materials, including an inventory of past stormwater management improvements and a summary of applicable stormwater regulations and stakeholders, are provided in **Appendix B.**

2.1 Watershed

CLE is located in the Rocky River basin in hydrologic unit code (HUC) 04110001. The Rocky River basin drains approximately 292 square miles in northeastern Ohio, including parts of four counties: Cuyahoga, Lorain, Medina, and Summit[1]. CLE is located in the Abram Creek and main stem subwatersheds downstream of the confluence of Abram Creek, the East branch and the West Branch of Rocky River (**Figure 2-1**). Stormwater from the airport discharges through several outfalls into Abram Creek, Silver Creek (a tributary to the main stem of Rocky River), and directly into Rocky River.

A baseline biological and chemical stream survey of the basin was conducted in 1992 under the Total Maximum Daily Load (TMDL) program established under Section 303(d) of the Clean Water Act. Since 1992, many improvements have occurred in the basin resulting in reduced pollutant loadings. TMDL studies are documented in the following reports:

- Ohio Environmental Protection Agency. *Biological and Water Quality Study of the Rocky River and Selected Tributaries*, August 1993.
- Ohio Environmental Protection Agency. *Biological and Water Quality Study of the Rocky River and Selected Tributaries*, March 1999.
- Ohio Environmental Protection Agency. *Total Maximum Daily Loads for the Rocky River Basin Final Report*, October 2001.
- Ohio Environmental Protection Agency. *Draft Total Maximum Daily Loads for Bacteria in the Rocky River Watershed*, March 2005.

[1] Ohio Environmental Protection Agency. *Total Maximum Daily Loads for the Rocky River Basin Final Report*. October 2001.

Ohio EPA conducted a study of the watershed in 2014. Results of this study have not been published.

Figure 2-1 Rocky River Watershed and Subwatersheds

(Source: Rocky River Watershed Council, http://myrockyriver.ning.com/page/subwatersheds)

2.2 Soil Information

Soil information for CLE was obtained from the Web Soil Survey published by the United States Department of Agriculture Natural Resources Conservation Service. **Appendix C** contains copies of the soil map and soil property information from the Web Soil Survey. The soil map shows the soil type distribution at CLE. There are three predominant soil types at CLE, including Mahoning-Urban land complex undulating (MmB) at 34.6%, Urban Land (Ub) at 23.9%, and Jimtown-Urban land complex nearly level (JuA) at 18.1% of the total land area. There are 11 other soil types ranging from 0.008% to 6.2% of the total land area. Note that the total land area (2,249.5 acres) shown on the soil map is larger than the actual airport property (2,091 acres) because the land area encompasses highways and areas slightly outside airport property to provide a complete map. In general the soils at CLE are somewhat poorly drained and are classified as Hydrologic Soil Groups "C/D" and "B/D," as defined below:

- Soils in Group B have a moderate infiltration rate when thoroughly wet;
- Soils in Group C have a slow infiltration rate when thoroughly wet; and
- Soils in Group D have a very slow infiltration rate and high runoff potential when thoroughly wet.

Depth to groundwater for predominant soil types ranges from 53 centimeters (20.8 inches) to over 200 centimeters (78.7 inches); however, groundwater is not usually encountered during construction projects at CLE. Perched water zones are sometimes encountered within the glacial till above shale bedrock.

2.3 Development of the Drainage System at CLE

The airport opened in 1925 on 1,040-acres[2] of land at the intersection of Brookpark Road and Riverside Drive. The airport's first terminal building was constructed in 1927. Based on the 1940 aerial photograph of the airport shown on **Figure 2-2**, the airfield consisted of a flat, primarily turf, landing field with hangars and facilities to the east.

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[2] The Encyclopedia of Cleveland History, The Cleveland Hopkins International Airport. Web site maintained by Case Western Reserve University.

Figure 2-2
An aerial view of Cleveland Municipal Airport in August 1940 shows the aircraft hangars that then made up the bulk of its infrastructure. The building with the elaborate lawn is the main administration building. It was topped by a glass-enclosed dome that housed air traffic control.
(Source: Cleveland State Library Special Collections)

Over time, the City of Cleveland expanded the airport. A new terminal building was built in 1956, with a south concourse opening in April 1968, and a north concourse opening in August 1978[3]. The airport continued to expand the airfield and paved runways to meet passenger demands. The 1963 United States Geological Survey (USGS) topographic map, **Figure 2-3**, shows the configuration of the paved airfield following these major airfield improvements. An aerial photograph taken in 1967 depicts a portion of the airport's parking and airfield facilities as shown on **Figure 2-4**.

[3] The Encyclopedia of Cleveland History, The Cleveland Hopkins International Airport. Web site maintained by Case Western Reserve University.

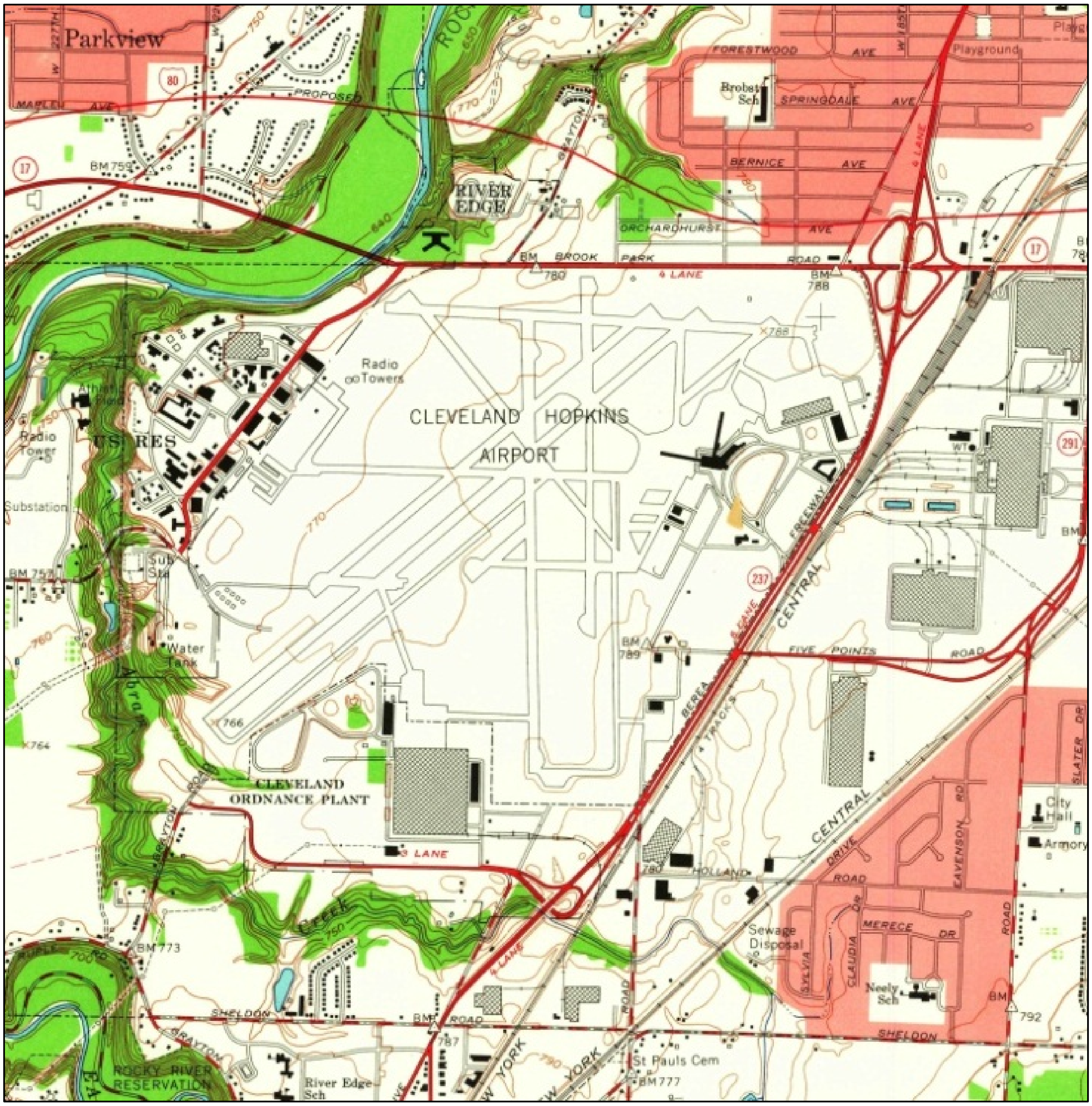

Figure 2-3
1963 USGS Lakewood Quadrangle Ohio-Cuyahoga Co., 7.5 Minute Series map. Cleveland Hopkins International Airport.

Figure 2-4
April 20, 1967 Aerial Photograph looking northwest across the airport showing surface parking along State Route 237 in the foreground and the airfield in the background.
(Source: Cuyahoga County Engineer's Photography Collection. Cuyahoga County Archives. Box 27)

The Expansion Program commenced in 2001 was a 1.4-billion dollar infrastructure investment into the facility which included the construction of a new 9,000-foot long Runway 6L-24R on the west side of the airport, extension of existing Runway 6R-24L to 9,956 feet, associated taxiways, and support facilities. Drainage improvements included installation of a culvert replacing approximately one mile of Abram Creek, filling in of a ravine (Outfalls 004 and 005 discharged to this ravine), construction of the North and Central Detention Basins, and connecting storm sewers. The May 16, 2013 aerial photograph shown on **Figure 2-5** provides an updated image of the airfield configuration.

Much of the storm sewer collection system installed in the 1960s is still in operation today, with the exception of the modifications and additions constructed during the airport *Expansion Program* between 2001 and 2010, the Taxiway Q and Hold Pad project completed in 2010, the Runway 10-28 Safety Area Project completed in 2012, and the Parking Redevelopment project and South Cargo/Taxiway N rehabilitation project completed in 2014.

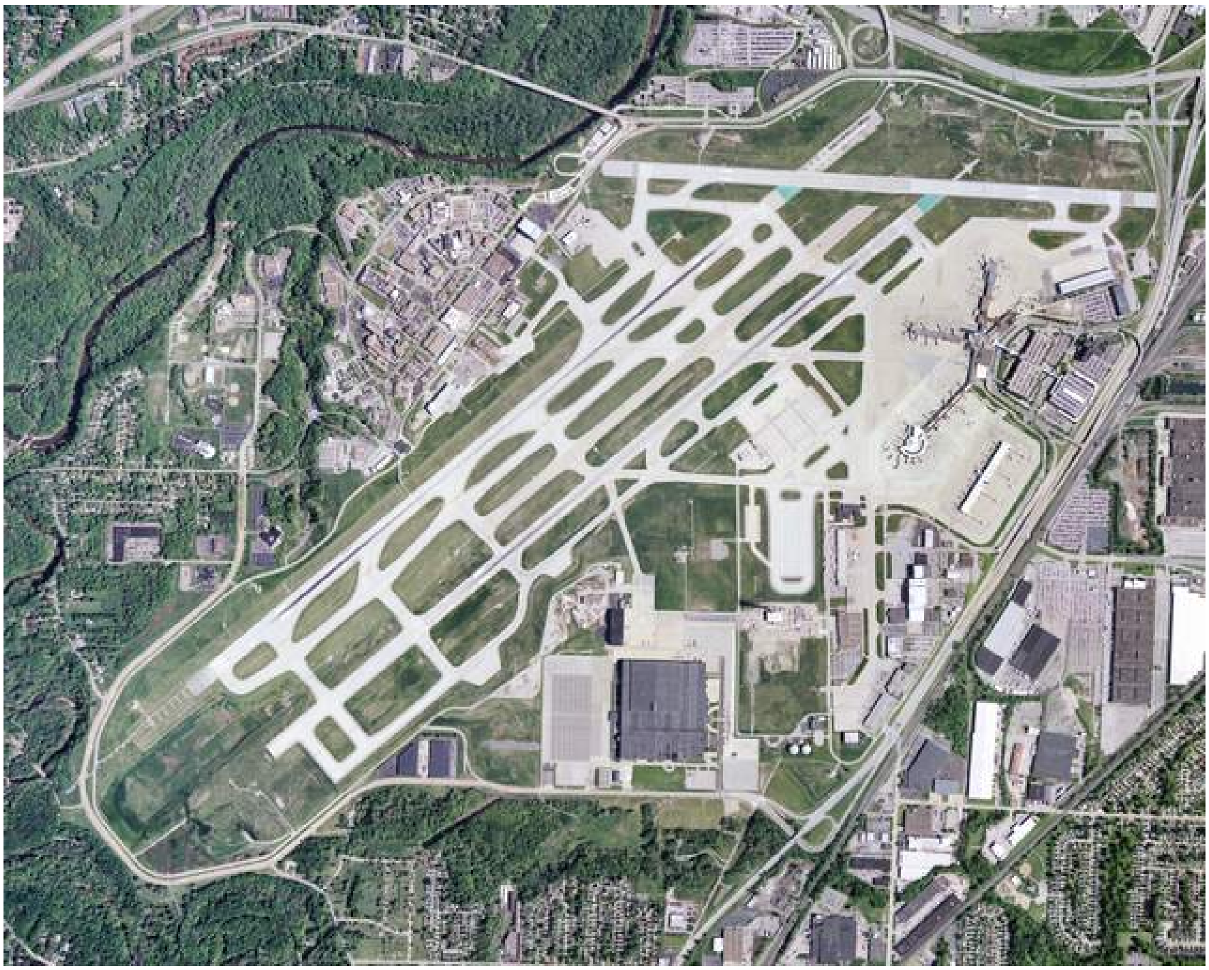

Figure 2-5
May 16, 2013 aerial photograph of Cleveland Hopkins International Airport
(Source: City of Cleveland, Department of Port Control)

According to the 2012 Airport Layout Plan (ALP), the land owned in fee is 2,091 acres with an additional 296.8 acres of land controlled by avigation easements to limit development of tall structures and growth of vegetation for runway safety. This information is located in the airport data table on sheet 3 of 17 in the ALP. The airport has nearly doubled in size, by an increase of 1,051-acres, since the airport opened in 1925. The 2012 ALP consists of a plan set of 18 sheets depicting various airport information. Only the *Proposed Airport Layout Plan* sheet is pertinent to the SWMP, and a copy of this sheet is included in **Appendix D**.

2.4 Existing Drainage System

The drainage system at CLE is made up of several drainage areas that collect and convey stormwater in underground pipes to outfalls. Stormwater from the airport discharges from the outfalls into three receiving streams: Abram Creek, Silver Creek, and Rocky River. The drainage areas and outfalls are shown on the site map in Appendix A. **Table 2-1** summarizes the characteristics of the drainage areas.

An inventory of CLE storm sewers has been tabulated in a database. The storm sewer database contains pipe properties including shape, material, size, length, and invert elevation, as well as a table of structures including coordinates, rim elevations, and sump elevations, where known. If a parameter was missing or incorrect, the value was interpreted based on other available information. For example, if the invert elevation datum could not be found then the value was calculated based on pipe length and slope. The storm sewer inventory table was initiated using survey data collected by KS Associates as part of the 1999 Master Drainage Plan. Next, storm sewer survey data collected during the 2007 Stormwater Collection System investigation for Outfall 012 was added to the inventory. Duplicate entries were removed from the database. Plans were obtained from DPC for major improvements since the 1999 Master Drainage Plan was completed and reviewed for storm sewer information. Pipes and structures shown as “to be demolished or abandoned” were removed from the database and those proposed were added to the database. The database contains information on approximately 1,086 pipes ranging from 2 inches to 120 inches in diameter, an estimated 1,104 structures, and approximately 39 miles of pipe. When data entry was completed a field visit was conducted to spot check some of the structure locations in question. The database was subsequently updated based on information obtained during the field visits. The storm sewer database and pipe location maps are included in the *Reference* folder on the enclosed DVD. This data was used in the development of the stormwater management model discussed Section 5.

Table 2-1

Drainage Area Summary

Total Area of Airport Property (acres) = 2,091

(Source: 2012 Airport Layout Plan)

DRAINAGE AREA DESCRIPTION[a]	AREA (ACRES)	STORMWATER CONTROLS	RECEIVING STREAM
Outfall 001	58.7	None	Silver Creek
Outfall 002	187.7	North Detention Basin and Oil/Water Separator	Silver Creek
Outfall 003	42.8	None	Abram Creek
Outfall 006	19.5	Oil/Water Separator and Bioretention Cell	Abram Creek
Outfall 008	98.1	Glycol Recovery System and Oil/Water Separator	Rocky River
Outfall 010	18.7	None	Rocky River
Outfall 011	143.4	Oil/Water Separator	Rocky River
Outfall 012	985.4	Central Detention Basin, Centralized Deicing Facility, Underground Detention System and Sand Filter, Bioretention Cells, and Oil/Water separators	Abram Creek
Outfall 013	15.6	Retention Basin	Abram Creek
Rental Car Facility and Maplewood Area	192.2	North Detention Basin	Silver Creek
Riveredge Parking Lot	16.5	Retention Basin and Two Bioretention Cells	Silver Creek
Other Areas (IX Center parcels, undeveloped)[b]	312.4	None	Varies
TOTAL	***2,091**[c]*		
Sysco[d]	43.7	North Detention Basin	Silver Creek

a. Outfalls 004, 005, and 007 are abandoned.
b. Other areas include airport property dedicated to non-aviation use such as the IX Center and property protected for future development beyond 2035 or noise abatement. These other areas were not included in this SWMP.
c. CLE is comprised of a total of 2,091 acres of land owned by the City of Cleveland.
d. Sysco is not on airport property; however, the Sysco detention pond drains into the North Detention Basin and was accounted for in the SWMM model.

2.5 Management of Runoff from Industrial Activities

To control both the quantity and quality of stormwater runoff potentially impacted by industrial activities (e.g., fueling, deicing) at CLE, several existing structural BMPs are used to divert, infiltrate, reuse, or otherwise manage stormwater discharges. The controls include:

- Oil/water separators;
- Deicer management system consisting of deicing pads, glycol recovery vehicles, collection, and containment systems for deicer fluid recycling, snow melt and disposal; and
- Grass and rock swales and filter strips.

2.5.1 Oil/Water Separators

Oil/water separators are located on storm and sanitary sewer lines that serve areas where vehicles, equipment, and aircraft are maintained, fueled, cleaned, and deiced. A summary of the oil/water separators maintained by CLE and oil/water separators at the two primary fuel farms maintained by tenants is provided in **Table 2-2**. Other oil/water separators maintained by tenants are excluded. For each separator, the table lists the size, drainage basin served, and the outfall at which the flow is discharged.

Table 2-2

CLE Oil/Water Separator Summary

MAP DESIGNATION	SIZE (GALLONS)	DRAINAGE AREA SERVED	DISCHARGE OUTFALL
O/W 01	1,000	Vehicle Maintenance Bldg.	Sanitary
O/W 03	10,000[a]	ASIG/CLE Bulk Fuel Farm	Outfall 012
O/W 04	8,000	BP Fuel Farm	Outfall 002
O/W 05	52,000	Concourse A	Outfall 001
O/W 06	2,000	Consolidated Maintenance Facility	Sanitary
O/W 07	200,000	Concourse C	Outfall 012
O/W 08	40,000	Concourse C East (Gate C8)	Outfall 012
O/W 09	155,000	Concourse B	Outfall 011
O/W 10	40,000	Concourses C & D (Gate E8)	Outfall 012
O/W 11	40,000	West Cargo Ramp	Outfall 008
O/W 12	15,000	South Cargo Ramp	Outfall 003
O/W 13	25,000	Consolidated Maintenance Facility	Outfall 006
O/W 14	15,000	Orange Parking Lot (Former Long-Term Parking Garage)	Outfall 012

a. 10,000 gallon diversion tank.

2.5.2 Deicing Management System

To manage operations during inclement weather, CLE has in place a deicing management plan to ensure both safe winter operations and the use of environmentally sensitive practices. The goals of the deicing management plan are to meet Ohio EPA permitting requirements, minimize deicer exposure to stormwater and the Publically Owned Treatment Works (Northeast Ohio Regional Sewer District – NEORSD) to the maximum extent possible, contain deicer-impacted snow melt runoff, and collect and recycle the spent deicing fluids with the highest concentrations achievable.

2.5.3 Swales and Filter Strips

Swales and other stormwater conveyances are stabilized with grass, stone, or concrete. Many grass-lined swales are located around the airport not only for erosion control but also to allow the stormwater to infiltrate and remove pollutants. On steeper slopes or swales draining large areas, rock and rip rap are present to reduce runoff velocity.

The vegetated infield areas (i.e. areas between intersecting runways and taxiways) and much of the vegetated perimeter of the airfield at CLE are linear BMPs to slow stormwater runoff to allow sedimentation prior to discharging to existing PCBMPs and receiving waters. In many areas of the airport stormwater travels relatively long distances through vegetation before reaching catch basins.

2.6 Post-Construction Best Management Practices (PCBMPs)

DPC operates several PCBMPs at the airport. A description of each PCBMP is provided on the following pages. The first two PCBMPs, the Central Detention Basin and North Detention Basin, were constructed during the Airport Expansion Program which began in 2001. Since then, several other PCBMPs have been constructed, including the Riveredge parking lot retention basin and two bioretention cells, Taxiways K1 and Q (or Taxiway Q and Hold pad) underground detention system and sand filter, South Retention Basin, the North Detention Basin retrofit, Consolidated Maintenance Facility Phase 3B bioretention cell, and Orange Parking Lot bioretention cells near the terminal (former Long Term Parking Garage location).

Name of PCBMP:	North Detention Basin (NDB)
Type:	Detention Basin
Location:	North of I-480, just west of Rental Car Facility
Drainage Area/Outfall:	235.9 acres / Outfall 012
Receiving Water:	Silver Creek
Year Constructed (Completed):	Initial Construction 1999. Retrofit 2012
Approximate Construction Cost:	$753,000[a]

a. Cost included sewer connection to the airfield.

Description:

The North Detention Basin underwent a retrofit in 2012 to meet regulatory requirements that applied to the Runway 10-28 Safety Area project. An Engineered Materials Arresting System (EMAS) was constructed at each end of the runway along with other associated improvements. The EMAS is a bed of specially engineered concrete designed to slow down an aircraft in the event of an overrun. The project increased the impervious area and therefore required post-construction best management practices. The North Detention Basin retrofit consisted of enlarging the existing basin and modifying the flow path and outlet structure.

North Detention Basin after 2012 Retrofit

Cleveland Hopkins International Airport

Post-Construction Best Management Practice

Name of PCBMP:	Riveredge Retention Basin and Bioretention Cells
Type:	Retention Basin and Bioretention Cells
Location:	North of I-480, Employee Parking Lot
Drainage Area/Outfall:	16.54 acres / Riveredge Parking Lot
Receiving Water:	Silver Creek
Year Constructed (Completed):	2003 (retention basin), 2011 (2 bioretention cells)
Approximate Construction Cost:	$14,200 (bioretention cells)

Description:
A retention basin was constructed at the northwest corner of the project site to control post-construction stormwater runoff from the new parking facility during Phase I. As part of Phase II to expand the parking lot to the west, two bioretention cells were constructed along the west edge of the property which discharge into the retention basin constructed during Phase I.

Riveredge Bioretention Cell

Cleveland Hopkins International Airport

Post-Construction Best Management Practice

Name of PCBMP:	Central Detention Basin (CDB)
Type:	Detention Basin
Location:	Southwest area of airfield
Drainage Area/Outfall:	985.5 acres / Outfall 012
Receiving Water:	Abram Creek
Year Constructed (Completed):	2004
Approximate Construction Cost:	$3,540,000

Description:

A 650 acre-ft detention basin is located at the southeastern end of the airport between Runway 6L-24R and Runway 6R-24L. The purpose of the CDB to prevent downstream flow increases and control sediment-borne pollutants. Accepting stormwater runoff from 985 acres of CLE property, the basin outlets through Outfall 012 which discharges to Abram Creek. The basin is designed to provide 24-hour first flush detention for 2-year, 24-hour storms. For larger storms, the basin is designed to control the flow of runoff from a 10-year, 24-hour storm and dewater in 48 hours. For a 100-year, 24-hour storm, the basin is designed to capture, detain, and dewater in 60 hours. The peak flow of Abram Creek upstream of CLE, after a 100-year storm, is calculated to be 3,900 cfs. Downstream of CLE, resulting from the detention provided by the CDB and the increased capacity of the newly installed culvert pipes, the peak flow of Abram Creek after a 100-year storm is calculated to be 3,600 cfs.

Central Detention Basin

Cleveland Hopkins International Airport

Post-Construction Best Management Practice

Name of PCBMP:	Taxiway Q and Hold Pad Underground Stormwater Management (SWM) Facility
Type:	Underground detention and sand filter
Location:	Southeast area of airfield
Drainage Area/Outfall:	13.2 acres / Outfall 012
Receiving Water:	Drains to Central Detention Basin which discharges to Abram Creek
Year Constructed (Completed):	2010
Approximate Construction Cost:	$800,000

Description:

The Taxiway Q and Hold pad project involved the removal and replacement of taxiways and installation of a concrete aircraft hold pad area. The project included the installation of an underground stormwater management facility and storm sewers.

The detention system consists of buried 12-ft diameter corrugated metal pipes (CMP) totaling 655 feet in length and total volume of 74,000 cubic feet. The purpose of the detention system is to detain runoff from the concrete pad and to limit the peak discharge from a 10-year, 24-hour storm event of 3.36 inches to less than 25 cubic feet per second (cfs) and that from a 100-year, 24-hour storm event of 5.15 inches to less than 29 cfs.

The sand filter consists of a buried 10.5-ft diameter CMP 188 feet long and a 156 foot filtration chamber. The sand filter is designed to treat runoff from the entire drainage area of 13.2 acres, generated from a water quality storm event of 0.75-inches in 24-hours equating to a volume of 18,500 cubic feet. Additional volume of 3,700 cubic feet is included for sediment storage. The inflow structure to the sand filter system is designed to divert flows from storm events in excess of the water quality storm (0.75-inches) to the detention system.

Underground Stormwater Management Facility Under Construction

Taxiway Q and Hold Pad

Source: Phase I Storm Water Pollution Prevention Plan (SWP3) for Taxiway Q and Hold Pad WBS No. F341-3, Cleveland Hopkins International Airport Cleveland, Ohio. Prepared by Michael Baker Jr., Inc.

Cleveland Hopkins International Airport

Post-Construction Best Management Practice

Name of PCBMP:	South Retention Basin (SRB)
Type:	Water Quality Retention Basin
Location:	Southeast Corner of Airport
Drainage Area/Outfall:	15.6 acres / Outfall 013
Receiving Water:	Abram Creek
Year Constructed (Completed):	2013
Approximate Construction Cost:	$500,000

Description:
The South Retention Basin is located south of Postal Road just west of the Berea Freeway (S.R. 237). The basin has a surface area of approximately 1.2 acres. The basin has a wet pool with a 6' wide aquatic bench to address the permanent pool required volume. The wet pool volume was maximized to create capacity for future water quality needs. A modified 4' x 4' catch basin serves as the outlet structure on the northeastern bank of the basin to control discharge flow and allow for the required 48-hr extended detention draw down time. The permanent pool and extended detention volumes provided are 1.135 ac-ft and 0.717 ac-ft, respectively. The elevation of the top of bank is 788.00. The bottom of the basin is at 765.00 with a permanent pool elevation at 722.80. Because the invert of the 60" HDPE discharge sewer was over 25 feet below the existing ground elevation, the basin had to be excavated to a depth to match the 60" storm sewer. This provided a total volume of 11.1 ac-ft. above the permanent pool elevation.

South Retention Basin
(Photograph Taken 11/21/2013)

3.0 ANTICIPATED PROJECTS

A summary of planned development at CLE through 2035, based on the Airport Layout Plan and Capital Improvement Plans, is presented in this section. Understanding future development is important in planning for future stormwater management needs. The amount of change in impervious area will directly affect the type and scale of PCBMPs that need to be considered in the future.

3.1 Airport Layout Plan (ALP) and Capital Improvement Plan

Airports in the National Program for Integrated Airport Systems (NPIAS) are eligible for grants through the Airport Improvement Program (AIP) administered by the FAA. Grant recipients are obligated by grant assurances to maintain an up-to-date ALP and Capital Improvement Plans (CIP). The 2012 ALP for CLE shows anticipated projects through 2035 on the *Proposed Airport Layout Plan* sheet (included as Appendix D). The projects shown on the ALP are broken down into three phases and include pavement improvements, proposed structures, pavement demolition, and roadway improvements. The anticipated AIP projects which will involve earth disturbing activities with potential impact to stormwater include, but are not limited to, the following:

- Taxiway R/A Reconstruction and Reconfiguration
- Taxiway L/L2 Rehabilitation
- Rehabilitation of Postal Road
- Deicing Disposal Facility Phase III
- Stormwater and Sanitary System Rehabilitation
- Consolidated Maintenance Facility Phase IIIC
- Taxiways S/J Reconstruction and Reconfiguration
- Ramp Rehabilitation near Vehicle Maintenance
- Runway 24L Reconstruction
- Taxiway C Reconstruction

Certain types of airport support facilities such as parking lots are not eligible for funding through the AIP and are funded through other sources. Non-AIP earth disturbing projects with potential to impact stormwater include, but are not limited to, the following:

- South Campus Development (Cargo, Corporate Aviation, and General Aviation improvements);
- Parking Improvements;
- New On-Airport Hotel; and
- Gas Station / Fast Food Restaurant.

3.2 Existing and Proposed Impervious Areas

Existing impervious areas, proposed impervious areas, and impervious areas to be removed have been inventoried based on projects listed on the 2012 ALP. The AutoCAD files and the 2012 aerial photograph from the 2012 ALP and 2013 airport base map were used to calculate the existing and proposed impervious areas. Each section of impervious area (i.e., runway, taxiway, building roof, etc.) was given an identification number and corresponding area and the information was tabulated. The spreadsheet files (file names: "Existing Impervious Areas.xlsx," "Proposed Impervious Areas.xls," and "Proposed Demolished Pavement.xlsx") are included in the *Reference* folder on the enclosed DVD. Maps showing the existing and proposed impervious areas are included in Appendix A. **Table 3-1** summarizes existing impervious acreage per outfall.

Table 3-1

Summary of Existing Impervious Areas by Outfall

DRAINAGE AREA	IMPERVIOUS AREA (ACRES)	TOTAL DRAINAGE AREA (ACRES)	% IMPERVIOUS
Outfall 001	11.1	58.7	19%
Outfall 002	87.2	187.7	46%
Outfall 003	27.5	42.8	64%
Outfall 006	9.4	19.5	48%
Outfall 008	38.5	98.1	39%
Outfall 010	6.9	18.7	37%
Outfall 011	98.4	143.4	69%
Outfall 012	448.7	985.5	46%
Outfall 013	12.7	15.6	81%
TOTAL	***740.3***	***1,570.0[a]***	

a. See Table 2-1 for other airport drainage areas.

Proposed pavement areas are summarized in **Table 3-2** and are shown on an Existing Impervious Map located in Appendix A. According to the 2012 ALP, the majority of the proposed airport improvements based on number of acres will occur within the Outfall 012 drainage area. Acreage in respective drainage areas is anticipated to change as storm sewers are updated and rerouted to improve drainage and utilize stormwater management features.

Table 3-2

Summary of Proposed Impervious Areas by Outfall

DRAINAGE AREA	PROPOSED INCREASE IN IMPERVIOUS AREA (ACRES)	TOTAL % IMPERVIOUS FOLLOWING DEVELOPMENT	CHANGE IN IMPERVIOUS AREA (%)
Outfall 001	0.0	19%	0%
Outfall 002	4.2	49%	2%
Outfall 003	8.2	83%	19%
Outfall 006	3.8	67%	19%
Outfall 008	0.0	39%	0%
Outfall 010	0.9	41%	5%
Outfall 011	4.5	72%	3%
Outfall 012	91.4	55%	9%
Outfall 013	0.1	82%	1%
TOTAL	***113.1***		

Based on the 2012 ALP, an estimated 31 acres of pavement will be removed before 2035. Most of the pavement removed will be on the airfield, and will involve updating taxiway geometry and removing pavement sections no longer used. The 31 acres of pavement removal was not used in the evaluation of existing PCBMPs to be conservative and allow opportunities for changes in the ALP configuration and imperviousness which often occurs in a dynamic airport environment. A net increase in impervious areas of 82 acres (3.9%) is anticipated over the planning period from 2012 through 2035.

4.0 STORMWATER MANAGEMENT STRATEGY

Strategies for compliance with the post-construction requirements of the CGP, as applicable toward future development projects, are identified in this section. Specifically, the applicability and exclusions from CGP requirements, guidance for the application of PCBMPs, and drainage area-specific compliance strategies are addressed. Guidance on the selection of specific new PCBMP types is provided in Section 6.

4.1 Overview

Stormwater management at CLE begins in the planning phase to minimize the need for structural PCBMPs. For each proposed project, DPC considers the following Low Impact Development (LID) strategies:

1. How new impervious surfaces can be minimized;
2. If any impervious surfaces can be removed; and
3. If green infrastructure (GI) such as pervious pavements, green roofs, etc., can be utilized.

Reducing the amount of runoff at the source will in-turn put less burden on the existing PCBMPs and minimize the need for new costly PCBMPs. However, as an airport facility with vast amounts of impervious areas, large-scale stormwater management facilities are required to control the quality and quantity of stormwater discharges from the facility.

This SWMP provides an overview of DPC's strategy to modify and/or expand existing PCBMPs or strategically locate new BMPs, if needed, to provide post-construction treatment of runoff generated by the proposed projects in accordance with the CGP. DPC conducted an evaluation of the drainage system at CLE to determine how to best utilize the stormwater infrastructure already in place and to identify what additional improvements will be needed to manage stormwater associated with future airport development. In general, the following stormwater management strategies were identified:

- Retrofit the Central Detention Basin (CDB) outlet structure to meet the current CGP and accommodate development within the area tributary to the CDB;

- Utilize available capacity in the North Detention Basin as off-site mitigation for development areas that are not served by a PCBMP (applying the required off-site mitigation ratio of 1.5:1 times the WQv) if needed.
- Expand the South Retention Basin to accommodate the South Campus Development;
- Reroute stormwater from various Outfalls to the Central Detention Basin (or existing basins);
- Install new PCBMPs where necessary; and
- Consider off-site mitigation and in-lieu fee if other options are not feasible.

The sections below outline DPC's process for compliance with Ohio's CGP.

4.2 How to Obtain Authorization to Discharge Stormwater from Construction Activities

Projects disturbing one or more acres of ground must obtain NPDES permit coverage from Ohio EPA to discharge stormwater associated with construction activities from the project site. In accordance with this requirement, applicable projects at CLE generally seek permit coverage under Ohio EPA Permit #OHC000004, which became effective April 21, 2013 and expires April 20, 2018. The permit is titled "*General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System*", and is generally referred to as the Construction General Permit (CGP).

The CGP permit sets forth requirements for implementing stormwater management controls during construction and installing PCBMPs to treat a portion of the runoff from the drainage area of the project unless already served by an existing PCBMP with capacity to meet CGP requirements (refer to Section 4.5). Applicable projects disturbing at least one acre but less than five acres are regulated as small construction activities, while applicable projects disturbing over five acres are regulated as large construction activities.

Figure 4-1 presents a CGP decision flowchart. A copy of the CGP and associated forms are provided in **Appendix E**. The CGP and forms can also be downloaded from Ohio EPA's website at: http://www.epa.state.oh.us/dsw/permits/GP_ConstructionSiteStormWater.aspx.

Note: DPC requires a Stormwater Pollution Prevention Plan (SWP3) for **ALL** projects that have the potential to discharge pollutants to stormwater, regardless of acres disturbed. For small projects (i.e. projects less than an acre) the designer may submit an abbreviated SWP3 covering the applicable items. Refer to Section 6 for guidance on SWP3 requirements.

Locally, the City of Cleveland, Building and Housing Department is responsible for Construction Site Runoff Control. In 2009, City Ordinance 3116, *Construction and Post-construction Site Runoff Control*, was passed and became effective. Prior to construction for areas greater than 1 acre, a permit is required from the City. To obtain a permit, submit a building permit application along with the applicable fee and a copy of the SWP3 to the Building and Housing Department. Following construction and upon written request, permittees must obtain a certificate of completion by the Director finding satisfactory evidence of compliance with the approved SWP3 and adequate stabilization. Continuing obligations include maintenance and compliance with PCBMPs. The Cuyahoga Soil and Water Conservation District (SWCD) entered into a Memorandum of Understanding (MOU) with the City of Cleveland to perform SWP3 reviews, field reviews, and technical assistance to assist the City with carrying out Clean Water Act responsibilities. SWP3s requiring a CGP are submitted by the Building and Housing Deparment to the SWCD for review. Once the SWCD has completed their technical review and feel the SWP3 meets the intent of the CGP and local regulations a *Plan Review Recommendation of Approval* letter will be provided to the applicant.

4.2.1 Design-Build Projects

As the airport looks for schedule and possible cost savings, design-build delivery is an alternative to traditional design-bid-build delivery. DPC has experience with working with this type of delivery and understands changes to phasing during the project to expedite schedule or save construction dollars are to be expected. The key to successfully complying with the CGP is to be flexible and establish frequent communication with agencies involved with the project. DPC has established the following guidance with respect to the CGP and design-build projects:

- DPC obtains the NOI from Ohio EPA for the project.
- The design-build team shall be co-permittees.

- All temporary erosion and sediment control is the responsibility of the design-build team, including recommendations and approval from DPC prior to installation.
- Earth disturbing activity is not permitted prior to the Ohio EPA issuing of a facility permit number and fully executed co-permittee form.
- The SWP3 must be in place prior to the initiation of any earth disturbing activity.
- The design-build team shall describe the approach to temporary erosion and sediment control and PCBMPs for the overall project and implement during each phase of construction.
- In the event the project changes from what was initially anticipated, the design-build team shall update the NOI and SWP3 as needed within 5 business days of becoming aware of the change or as directed by DPC.

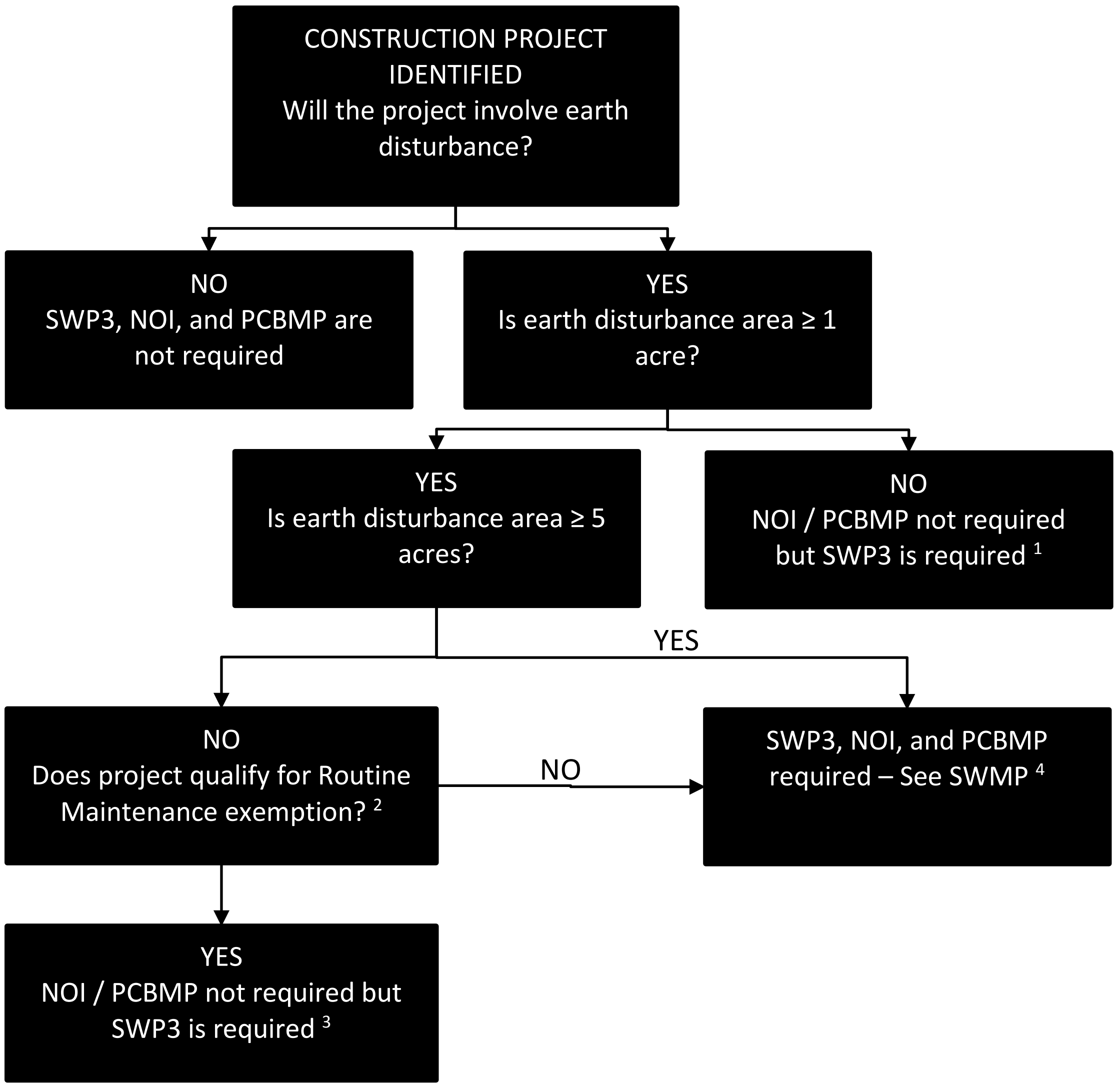

Figure 4-1 Construction General Permit Decision Flow Chart

Figure Notes:

1. Per the CGP, an NOI and PCBMP are not required for earth disturbance < 1 acre; however, CLE requires an abbreviated SWP3 to be provided.
2. Refer to Routine Maintenance exemption definition in Section 4.2.2 of this SWMP.
3. Include Routine Maintenance determination documentation in SWMP. A construction SWP3 is still required for earth disturbing activities.
4. Refer to SWMP for PCBMPs. Complete and submit Ohio EPA's Notice of Intent (NOI) form to DPC Environmental Services and complete and submit Building Permit to the City of Cleveland.

4.2.2 Routine Maintenance Exclusion

Maintenance activities are ongoing at CLE to maintain airport infrastructure, including airfield pavement, supporting facilities, and drainage infrastructure. The Ohio EPA defines a "routine maintenance exclusion" from CGP coverage requirements for select construction activities that meet the following criteria:

- Activities have a disturbance area (where soil is exposed) of at least 1 acre but less than 5 acres, and would otherwise qualify as small construction activities if not exempt;
- Activities involve only routine operations; and
- Activities are performed to maintain original purpose of existing facility or to existing line, grade, or hydraulic capacity of existing facility.

Ohio EPA's fact sheet on the routine maintenance exclusion can be found at: http://www.epa.state.oh.us/dsw/storm/routine_maint.aspx

PCBMPs are not required for routine maintenance projects. The following example activities are defined as routine maintenance activities that are eligible for the exclusion:

- Concrete pavement maintenance including crack sealing, spall repairs, joint repairs including saw cut and patching.
- Asphalt resurfacing by replacing asphalt wearing course by milling existing asphalt and replacing with new.
- Bridge maintenance including deck overlays, deck replacement and abutment repairs; it should be noted that should the bridge repair or replacement include hydro-demolition, a NPDES permit is required and all appropriate requirements will be addressed.
- Fence repair and replacement including repairing or replacing existing fencing and posts.
- Electrical and lighting maintenance including trenching that does not add impervious areas.
- Signing installation, maintenance, and repair including replacing airfield signs, and traffic signs and posts.
- Routine landscaping activities including tree and brush removal.
- Ditch cleanout to maintain or restore original flow line and cross-section.

- Culvert repair, lining, or replacement maintaining the same line, grade and hydraulic capacity. Must comply with Section 401 Water Quality Certification and USACE's Section 404 Regulatory Program.

The final determination of whether a project qualifies for the routine maintenance exclusion will be made by DPC Environmental Services personnel and documented in the log contained in **Appendix G.**

4.2.3 Use of Regional, Off-Site, In-Lieu Fee and Local PCBMPs

The CGP specifies that development areas may be treated via an "off-site" PCBMP ("off-site mitigation") if water quality volume treatment is provided at a ratio of 1.5:1, or the WQv at the point of retrofit, whichever is greater. DPC received clarification from Ohio EPA on the definition of "regional" versus "off-site" treatment in a February 9, 2015 letter. The following excerpt is taken from the letter:

> *"Ohio EPA interprets "regional" to mean a post-construction BMP located outside the footprint of the project but within the same drainage area as the project. Thus, a regional post-construction BMP is typically not contiguous to the project area, but runoff from the project area must first pass through the regional BMP before it is discharged to a water of the state. "Off-site" refers to post-construction BMPs located off property or outside the drainage area associated with the project area. For example, if CAS located a post-construction BMP in the River Edge Parking Lot off Old Grayton Road to meet requirements for a construction located within the airfield, CAS would be expected to treat 1.5 times the WQv [water quality volume] or the WQv at the point of retrofit, whichever is greater, at the River Edge Parking Lot. Although both the parking lot and the airfield are on CLE property, the runoff from the airfield is not tributary to this parking lot and thus, Ohio EPA would consider the BMP location to be off-site."*

Based on this interpretation, DPC is able to meet CGP post-construction treatment requirements for airport development by treating the WQv at a 1:1 in regional PCBMPs that receive stormwater from those development sites. For example, all areas within the Outfall 012 drainage area that drain to the CDB require a 1:1 treatment of the WQv in the CDB. If additional area from other drainage basins is permanently diverted to drain to the CDB, the water quality volumes for those areas may also be treated in the CDB at a ratio of 1:1. The use of on-site regional PCBMPs is the preferred approach for addressing post-construction treatment requirements for development at CLE as it makes use of existing PCBMPs with available capacity while complying with FAA safety regulations and helps to minimize project and airfield impacts. Available capacities of existing PCBMPs have been reevaluated as described in Section 4.4, which are further tracked as described in Section 4.5.

DPC may also pursue meeting treatment requirements for select development areas within an “off-site” PCBMP that has available capacity to provide treatment at a 1.5:1 ratio. This scenario may apply where there is development that is planned to occur in an area that is unable to physically drain to a regional PCBMP (whether new or existing) within the same CLE outfall drainage area. For example, areas that are unable to physically drain to the CDB or have constraints that prevent new PCBMP installation may still have their water quality volume treatment requirements met within the CDB by reserving a volume equivalent to 1.5 times the required water quality volume. DPC views this as an agreeable approach to protect the Rocky River watershed, within which CLE is a located. This approach will require that off-site treatment areas are carefully tracked so that capacity within a regional PCBMP is not double-counted toward both on-site (within the same drainage area) and off-site (within a separate drainage area) development areas. PCBMPs used to perform off-site mitigation must also be located within the same HUC 14 watershed unit as the project.

The following guidelines shall be followed when considering the use of a regional PCBMP to meet water quality treatment requirements for a project or portion of a project:

- The regional PCBMP must have sufficient available capacity to treat the WQv at a 1:1 ratio for portions of the project requiring treatment that are directly draining to the PCBMP.
- The regional PCBMP must have sufficient available capacity to treat the WQv at a 1.5:1 mitigation ratio for portions of the project requiring treatment that are being mitigated off-site (not physically draining to the PCBMP).
- The sum of the above sizing requirements is to be compared to the WQv at the point of retrofit (based on imperviousness and total contributing drainage area once the project is complete), including project areas as well as all areas that are tributary to the PCBMP.
- The PCBMP sizing requirement will be based on the larger of the two numbers above (sum of off-site and on-site WQv requirements vs. the WQv at the point of retrofit).

In cases where on-site regional and off-site PCBMP options are not available for a particular development project, DPC will assess whether to implement a new PCBMP that is specific to the development site. The use of a standalone PCBMP within a development project is referred to as “local” treatment. This approach involves the same treatment requirements as regional treatment (i.e., treatment of WQv at a 1:1 ratio), as long as the development area is physically draining to the PCBMP. If local PCBMPs are required to be implemented, DPC will consider if there are opportunities or drivers for implementing a new regional PCBMP, which would involve incorporating additional capacity to serve other potential future development projects within the area.

Figure 4-2 provides an illustration of the process that may be followed on a project to determine whether a regional, off-site, or local PCBMP may be appropriate to meet WQv requirements.

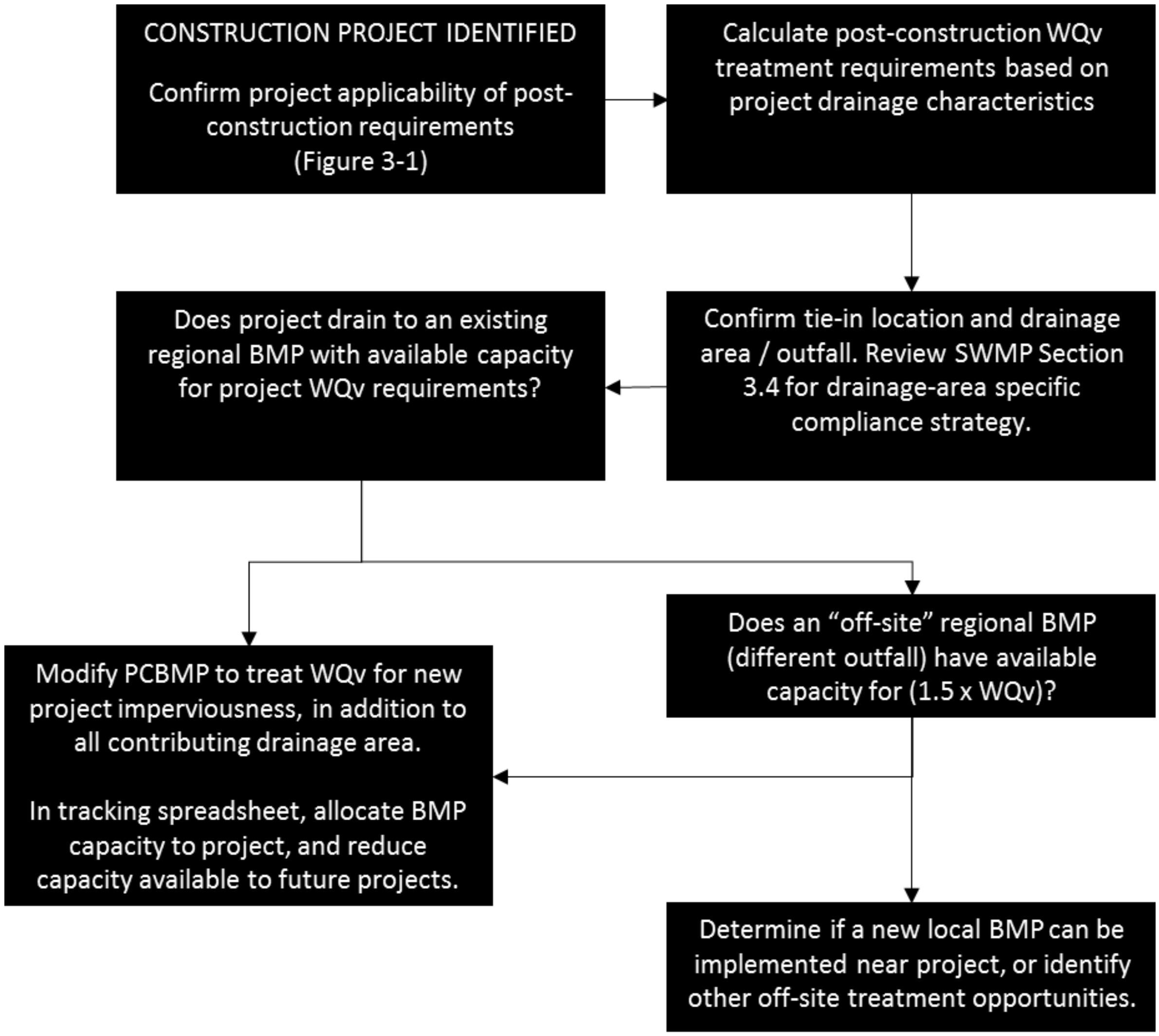

Figure 4-2 Flow Chart for the Selection of a Regional, Off-Site, or Local PCBMP

An in-lieu fee approach for off-site PCBMPs may be an available alternative option for future CLE projects that cannot be accomplished locally, regionally, or off-site as described above. This approach would involve performing off-site mitigation on property not owned or operated by DPC, and paying an in-lieu fee to the property owner for maintenance of the PCBMP. This approach would only be considered if it is infeasible to perform treatment on property that is owned or operated by DPC. An example of this approach is an airfield construction project in a drainage basin with too many safety constraints to accommodate a PCBMP and existing CLE regional PCBMPs without capacity to accommodate "offsite" mitigation. CLE would partner with a nearby entity to install and/or modify a PCBMP that is maintained by the other entity or CLE and fees are paid by CLE for the PCBMP and maintenance. CLE envisions using a Memorandum of

Understanding (MOU) to document rationale for implementing in-lieu fees, the responsible parties, location(s) of the PCBMP, inspection and maintenance as specified in the CGP Part III.G.2.e. CLE will utilize a tracking mechanism to document maintenance as well as a process to assign and assess costs associated with the type of in-lieu fee being considered. In participation, CLE would also be able to receive in-lieu fees to utilize capacity in its PCBMPs for entities faced with PCBMP constraints and authorized to use an in-lieu fee approach. DPC will work with legal counsel to ensure that agreements for BMP installation and maintenance are legally-binding and enforceable to ensure proper installation and long-term maintenance.

In cases where this approach is considered, CLE will develop the following information to assess and approve the alternative:

- CLE will document rationale as to why existing PCBMPs are not feasible for the project being assessed. The development of the document is the responsibility of the design firm. Document requirements include – project information – drainage where project is located, impervious area of basin, documentation of calculations performed to verify feasibility issues associated with available PCBMPs, these include costs, available space or space limitations, supporting infrastructure. CLE will develop a methodology to assess and develop an in-lieu fee structure that will include:

    - Operations and maintenance.
    - Design costs based on mitigation area and area that needs to have post-construction controls.
    - MS4 reporting requirements.
    - Administrative needs to manage the tracking and fee payments.

4.2.4 Redevelopment Sites

Redevelopment sites where no PCBMPs were installed shall either ensure a 20 percent net reduction of the site impervious area, provide for treatment of at least 20 percent of the WQv, or a combination of the two. Where projects are a combination of new development and redevelopment, the total WQv shall be a weighted average based on acreage, with the new development at 100 percent WQv and redevelopment at 20 percent WQv.

4.3 Green Infrastructure Opportunities

As a component of LID, green infrastructure (GI) can be applied to new development and redevelopment projects to reduce runoff, increase infiltration and mimic pre-development hydrologic conditions. *Ohio's Rainwater and Land Development* manual published by the Ohio Department of Natural Resources (ODNR) includes an overview of the application of GI site design practices for managing stormwater at its source. While many GI strategies have the potential to attract wildlife, conflict with FAA regulations, or conflict with airport operations, some techniques may be applicable to the land-side areas of the airport. DPC has already installed several bioretention cells that include plants that are not attractive to wildlife. The consideration of GI and other types of LID to reduce and improve runoff collected for treatment is being incorporated into the existing design process for DPC.

CLE realizes the effectiveness, from a preservation standpoint, to treat stormwater on a small-scale at the source rather than collecting it and treating it in large facilities and that LID practices increase the cost of initial installation but have been shown to reduce stormwater management costs over the long term[4]. CLE will use LID and GI when feasible (i.e. does not conflict with safety initiatives).

In addition to managing the quantity of runoff, select forms of GI are pre-approved by Ohio EPA for use as PCBMPs, in accordance with CGP requirements. For more information on PCBMP options for CLE, including GI BMPs and BMPs approved by Ohio EPA for post-construction, please refer to Section 6 of this SWMP.

DPC will also evaluate opportunities to reduce existing impervious areas within the same drainage basins where development is occurring. As noted in Section 4.2.4, PCBMP requirements for redevelopment projects may be met by treating 20% of the WQv, removing 20% of site impervious area, or some combination of the two. Impervious area changes will be tracked by DPC within tracking spreadsheet described in Section 4.5, and these activities will be evaluated for applicability toward meeting CGP PCBMP requirements for individual redevelopment projects. Additional LID and GI strategies that may be considered for applicability on a project-by-project

[4] *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, EPA Publication Number EPA 841-F-07-006, December 2007.

basis include green roofs and rainwater harvesting. These practices can be counted toward impervious area reduction, and applied to redevelopment PCBMP requirements.

Figure 4-3 below provides an overview of DPC's process for considering the applicability of LID and GI strategies on individual projects.

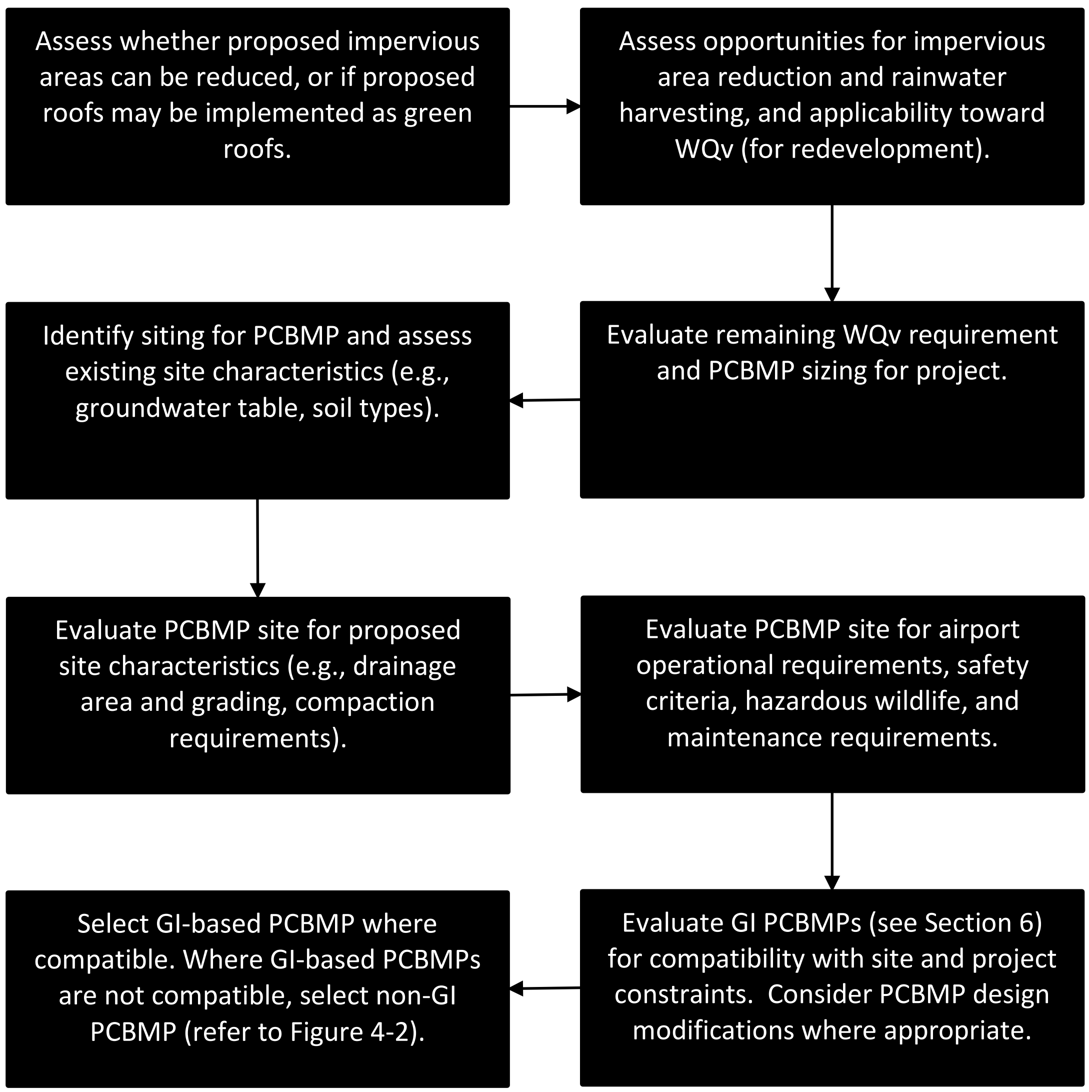

Figure 4-3 Flow Chart for Consideration of LID / GI on Projects

4.4 Stormwater Management Strategies by Outfall

Each outfall drainage area at CLE was analyzed to determine possible stormwater management improvements to meet DPC's capital improvement objectives. A summary of findings is provided below.

4.4.1 Outfall 012 Drainage Area

The CDB is the regional PCBMP for the Outfall 012 drainage area. A hydrologic and hydraulic analysis was completed to confirm the ability of the CDB to meet CGP post-construction requirements for planned development and stormwater fee credits in accordance with NEORSD's Stormwater Management Program. A copy of the March 2013 report documenting the analysis is included in the *Reference* folder on the enclosed DVD. Stormwater quantity calculations were performed to determine peak flows by utilizing the Ohio Critical Storm Method. Calculations for WQv and associated drawdown time, as prescribed in the CGP, were also performed. Bentley Pondpack V8i software was used for hydraulic modeling of stormwater quantity and quality calculations. The analysis for the CDB revealed that the basin was designed based on guidelines that are more stringent than the design standards of the Ohio Critical Storm Method. The existing configuration of the outlet structure requires modification to meet the CGP under the current conditions and for post-development conditions. The analysis concluded that the CDB has the capacity to store and treat stormwater runoff for the proposed airfield projects in accordance with the CGP once the outlet structure is modified. The report also contains the basis of design and a detail for a modified outlet structure. Further analysis should occur as part of the basin modification design to manage stormwater retention times and identify routine maintenance requirements (e.g., debris removal to address clogging).

4.4.2 Outfalls 003 and 013 Drainage Areas

The South Retention Basin (SRB) was constructed to meet PCBMP requirements for the South Cargo Apron Reconstruction Project. The retention basin was sized to store and treat stormwater that was redirected from a portion of the Outfall 003 drainage area to the basin. The drainage area for the new SRB was named Outfall 013 and is monitored as part of the CLE Industrial NPDES permit. The basin and stormwater collection system was designed such that the basin could be expanded to redirect additional stormwater from Outfall 003 and portions of Outfall 012 as the area develops.

A capacity analysis of the SRB was performed and is summarized in the March 2013 *Hydrologic and Hydraulic Report for the Outfall 003 Retention Basin*. A copy of the March 2013 report is provided in the *Reference* folder on the enclosed DVD. The analysis included a conceptual design for the expanded retention basin to provide capacity for future projects. The basin was also evaluated for stormwater quality treatment capabilities. Calculations using Bentley Pondpack V8i software indicate that the existing circular orifice on the outlet control structure would require a smaller orifice once the basin is expanded to meet the 24 hour drawdown time criteria for the future build-out condition.

The SRB was designed to retain water and has attracted wildlife. This basin was developed based on a compromise between conflicting regulations, most notably conflicting Ohio EPA and FAA criteria for open water drawdown times. It serves as an example of the need for this SWMP so that designers have a prescribed method of implementing stormwater management that is compliant with FAA and Ohio EPA regulations and airport operations.

4.4.3 Outfalls 001, 002, and 008 Drainage Areas

Outfalls 001 and 002 Drainage Areas

Outfalls 001 and 002 drainage areas were modified during the Runway 10-28 Runway Safety Area Project; Outfall 001 was reduced in size while Outfall 002 was increased. Outfall 001 is approximately 58.7 acres and is predominately grass. Outfall 001 combines with Brookpark Road and I-480 flows and discharges to Silver Creek. During significant rain events, excessive stormwater flowing to Outfall 002 overflows a 48" tall wall, flows through a low area north of Runway 10-28 on CLE property to Outfall 001. The low area was originally designed to be a stormwater control facility but was not built in favor of retrofitting the NDB to meet the CGP requirements. Outfall 002 drainage area is approximately 187.7 acres; this value includes parts of Brookpark Road drainage. Outfall 002 drainage area discharges to the NDB which discharges to Silver Creek. Due to FAA regulatory restrictions, open water and plants that attract wildlife are prohibited in these drainage basins on and near the airfield. Because the NDB was retrofitted to meet the current CGP, and there is no proposed increase in impervious areas for Outfalls 001 and 002, no additional PCBMPs are recommended for this planning period.

The NDB was sized to provide WQv at the point of retrofit as part of the Runway 10-28 Safety Area Improvement project and the WQv for a portion of the Taxiway Q and Hold Pad project. Because the Runway 10-28 Safety Area Improvement project was a redevelopment project, the

NDB has capacity to accommodate some future development in the drainage basin or be utilized for off-site mitigation. DPC will consider counting the extra capacity as off-site mitigation for development areas that are not served by a PCBMP (applying the required off-site mitigation ratio of 1.5:1 times the WQv). DPC intends to credit the WQv for the Taxiway Q and Hold Pad Project back to the NDB once the CDB is upgraded to meet the requirements in the current CGP.

Outfall 008 Drainage Area

The Outfall 008 drainage area was also changed as a result of the Runway 10-28 Runway Safety Area Project. New piping was added along the northwest corner of the airport adding 11.1 acres to the drainage area. The total drainage area for Outfall 008 is 98.1 acres. Stormwater from Outfall 008 drainage area is routed to the northwest and discharges directly into Rocky River.

The feasibility of rerouting stormwater runoff from the Outfall 008 drainage area to an existing regional PCBMP at CLE is low. This portion of the airport is low in elevation and naturally slopes to the northwest. Several alternatives to reroute stormwater from this basin were evaluated. One alternative evaluated was the feasibility of piping stormwater from this area to the south to merge with Outfall 006 in the piping run connecting inlets C26 and C25. However, invert and ground elevations would not allow gravity flow to this location. One option that can be explored further is the possibility of moving the oil/water separator located between Outfall 008 and 010. With the relocation of the oil/water separator and some grade adjustments, it may be possible to divert the runoff from Outfall 008 down the west side of the airport to the CDB. The 2012 ALP does not show any proposed improvements to occur in this drainage area through 2035. It may be more feasible to consider a new PCBMP to serve this drainage area or “off-site” stormwater mitigation strategies for development in the Outfall 008 drainage area than to reroute the stormwater to another area of the airport. Outfall 008 currently has limited land available and too many restrictions to install a regional PCBMP like a detention basin.

4.4.4 Outfalls 006, 010, 011 Drainage Areas

Stormwater from Outfalls 006, 010, and 011 drainage areas do not flow through a PCBMP prior to discharge. While future projects shown on the ALP do not show major improvements occurring in these areas through 2035, it is likely that pavement rehabilitation or other improvements may trigger the requirement for PCBMPs. Based on the hydrologic and hydraulic analysis of the CDB and the NDB, stormwater from these outfalls could be diverted to either basin. One strategy for stormwater management at CLE is to fully utilize existing PCBMPs before adding new ones, to minimize maintenance costs, disturbance to aircraft operations associated with PCBMP maintenance, and potential wildlife hazards. The following section summarizes the feasibility analysis for diverting runoff from Outfalls 006, 010, and 011 drainage areas to the CDB or the NDB. Rerouting to the detention basins also removes co-mingled flows with NASA and allows for future industrial stormwater BMPs to be more easily incorporated, as necessary.

Outfall 006 Drainage Area

The drainage area for Outfall 006 is a 19.5 acre plot of land located on the west side of airport property. This area currently is collected and piped through NASA property and discharges to Abram Creek. A small building was constructed in 2014 including a bioretention cell (4,400 sf). While meeting the needs of this building project as a local PCBMP, it does not fully meet the potential needs of the drainage area. Two feasible alternatives to reroute stormwater to the CDB and eliminate this outfall was investigated. Outfall 006 ultimately ends up at a junction manhole designated MH80. If this manhole was connected to a run of pipe located just outside Outfall 006, within Outfall 012, then the rerouting would be complete. Two inlets, C26 and C25, appear to be possible tie-in locations. If manhole MH80 was rerouted to discharge in either one of these catch basins then all of the runoff from Outfall 006 would ultimately flow to the CDB. Outfall 006 currently has limited land and too many restrictions to install a regional PCBMP like a detention basin. Rerouting 006 to the CDB is the preferred approach.

Outfall 010 Drainage Area

Most of Outfall 010 is grass covered. There are only a few structures within it and a minimal amount of pavement. The Outfall 010 drainage area is 18.7 acres. There was also a large removal and abandonment of stormwater pipes that once brought flow to Outfall 010. The current pipes within Outfall 010 are larger than necessary and are sloped at an angle that is not optimal to connect to the CDB. Therefore, the best course of action to eliminate Outfall 010 would be to reconstruct the piping network.

If a new piping network was installed, it is recommended that the system be configured to allow for drainage into an adjacent pipe run that discharges to the CDB. Because of ground elevations, the new system could not connect to a structure immediately adjacent to Outfall 010, such as inlets C29 or C28. However, if a new pipe was installed parallel to Runway 6L-24R, it could connect to inlet C22. The catch basin is at a much lower invert and would allow for all of Outfall

010 to drain to the CDB. This course of action would require a significant amount of pipe but would eliminate the Outfall 010 drainage area.

Outfall 011 Drainage Area

Outfall 011 is comprised of two separate, but connected drainage areas. There is a 35.1 acre plot of Outfall 011 (primarily the Concourse B aircraft ramp) that is separated by Outfall 002. This drainage area is piped under Outfall 002 and connects to 108.4 acres of Outfall 011 on the west side of the airport. Outfall 011 stormwater flows beneath NASA and discharges to Rocky River. There is an oil/water separator located near Concourse B. Stormwater north of Outfall 011 is directed primarily to the NDB and stormwater south of Outfall 011 is diverted primarily to the CDB. The Outfall 011 drainage area is located in a highly active part of the airport that is 69% impervious; therefore, it is not feasible to install a PCBMP which complies with the CGP. Based on the findings of the SWMM model and Pond Pack analysis, it is understood that the CDB and NDB could accommodate additional stormwater. Therefore, rerouting Outfall 011 and eliminating this drainage area to the north or south was investigated. Based on review of the existing storm sewer network, routing Outfall 011 to the north was not feasible due to pipe elevations. However, routing at least a portion of the drainage to the CDB appeared to be a reasonable solution. Knowing that Runway 6R-24L is in the early planning stages for rehabilitation, and assuming the storm sewers have likely reached their service life, it was determined that a new storm sewer running parallel to Runway 6R-24L could be constructed as part of this project.

4.5 Tracking of Regional PCBMP Capacity and Allocation to Development Projects

As described in Section 4.4, regional PCBMPs at CLE have been assessed for total capacity and ability to provide required treatment for the long-term CLE development plan. As the long-term development plan is implemented and evolves over time, DPC will continue to track allocation of available PCBMP treatment capacity toward ongoing development, as well as track remaining PCBMP capacity and remaining future treatment needs. **Figure 4-4** provides an illustration of the process that will be followed on an ongoing basis as development occurs. DPC is using a spreadsheet to track the WQv of the regional PCBMPs, new projects that are identified as having PCBMP requirements, and the selection of BMPs or allocation of BMP capacity toward these projects. Information being tracked in the spreadsheet will facilitate transition of project and PCBMP information between DPC staff as needed. The spreadsheet is maintained electronically by DPC, and a hard copy will be maintained with the SWMP, as included in **Appendix G**. A hard copy of the spreadsheet will also be included in the post-construction of each project SWP3 and submitted to the SWP3 review authority for concurrence (currently SWCD).

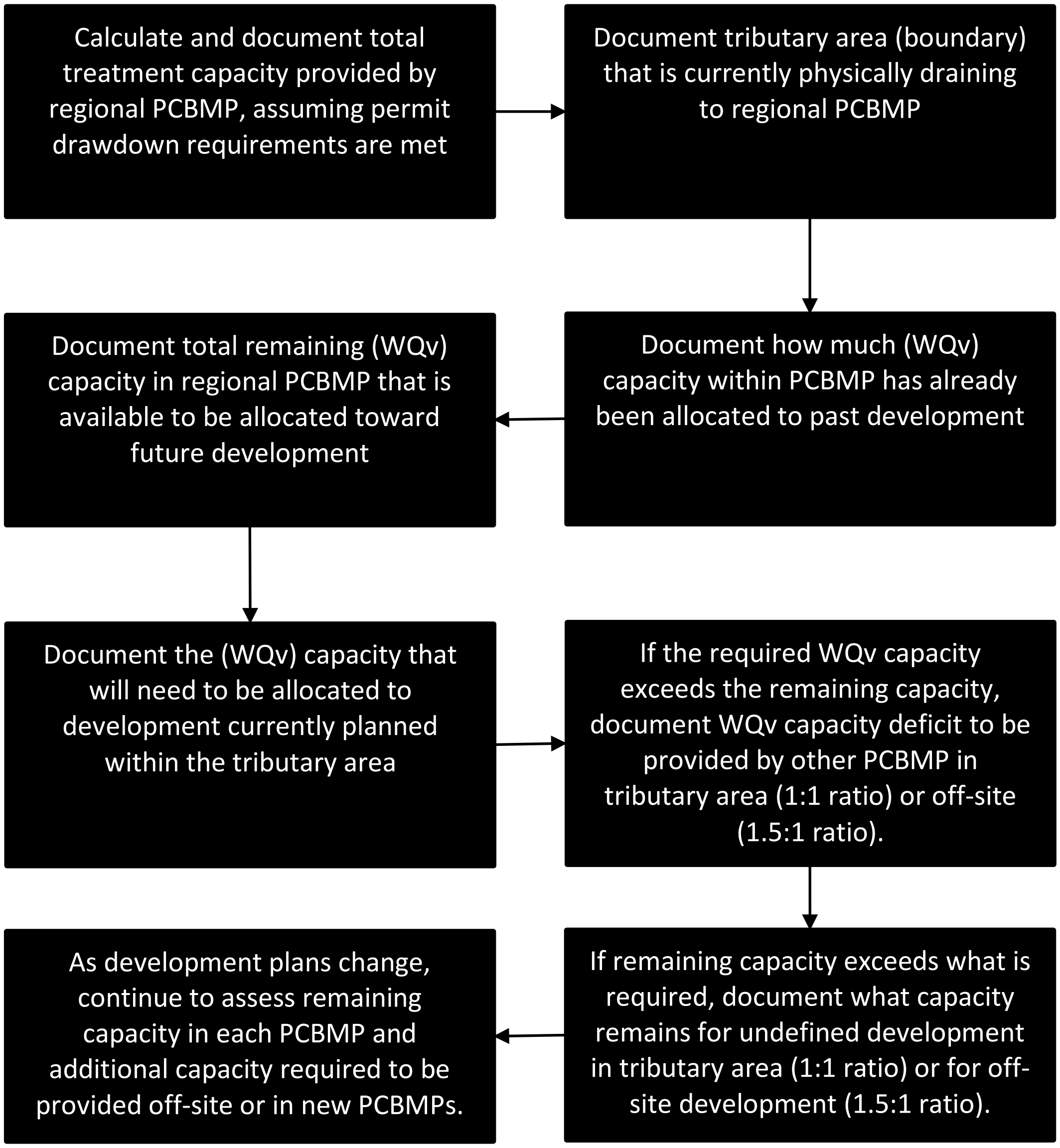

Figure 4-4 Flow Chart for Tracking Regional PCBMP Capacity Allocation

5.0 STORMWATER ANALYSIS

The analysis to characterize stormwater issues in both existing conditions (2012) and future conditions (2035) is presented in this section. The analysis includes an assessment of the performance of detention basins for various design storms. This analysis does not include any assessment of potential flooding either locally to a specific area on the airfield or on an outfall drainage basin-wide basis. The objective of this analysis was to provide information on whether the existing detention/retention basins can meet the storage and water quality requirements that Ohio EPA may impose. For areas not currently served by a PCBMP, this analysis provides some recommendations for future improvements.

Knowledge of existing stormwater issues is intended to inform the decision-making process for implementing future stormwater improvement projects. The results of this analysis are also intended to inform future development projects that may have an impact on stormwater management at CLE. The methodologies for developing the existing conditions are consistent with standard practices.

5.1 Model Description

The technical basis for analysis of the existing CLE stormwater system was a simulation model of the CLE drainage system. Representations of the surface topography of CLE, as well as the CLE storm sewer system, were created within the model based on the storm sewer inventory data. Results from two flow monitoring periods were used to adjust the hydrologic inputs to the model, to the extent needed to support the analysis of outfall discharges and regional PCBMP performance.

A SWMM-based computer simulation model was used to perform hydrologic (runoff) and hydraulic (transport/conveyance) analyses for the CLE stormwater drainage system. *SSA™*, an enhanced version of the U.S. EPA SWMM software, is an urban flow routing software supported by Autodesk.

SWMM was selected to model the CLE drainage system because it has a dynamic routing program that can simulate open and closed conduits, runoff, conveyance, tailwater, backwards flow, and surface ponding. The software also allows for model-simulated flows to be calibrated to actual site flow measurements in the future, enhancing the site-specific accuracy of each model.

SWMM has been widely used at other airports. The SWMM model in general is also widely accepted by regulators. SWMM*,* as used in the CLE model development, consists of two primary modules:

- *Runoff Module* – for generating surface runoff hydrographs (flow rate vs. time graphs) from precipitation falling into specific drainage areas; and
- *Hydraulic Module* – for routing of surface runoff through the airport's storm sewers generally greater than 30-inches in diameter and channels.

5.2 Modeling Assumptions

Modeling assumptions and details pertaining to hydrologic and hydraulic analyses are described in the subsections below.

5.2.1 Hydrologic (Runoff) Analyses

Hydrologic calculations were performed within the Runoff module of SWMM. The hydrologic method used was the SWMM Non-Linear Runoff Routing method. In general, rainfall hydrographs were applied to a network of subbasins (drainage basins within CLE outfall drainage basins), which were treated as nonlinear reservoirs. A water balance was performed over each reservoir to track rainfall input and output to infiltration into the soils based on subbasin characteristics. A portion of the water was retained in the form of surface detention and ponding, up to a maximum depression storage depth. The remaining stormwater became runoff to storm sewer inlets or collector channels.

Subbasin Areas

Drainage Basins areas were delineated for the runoff segment of the SWMM model using CLE Base maps, topography maps, CLE drainage information, and site photographs. The airport is divided into nine primary drainage basins (Outfalls 001, 002, 003, 006, 008, 010, 011, 012 and 013) as shown in Table 2-1, based on the estimated tributary area draining to each major stormwater outfall.

Each of the nine drainage basins was divided into multiple subbasins based on inlet locations and land use. Within each subbasin, pervious and impervious areas were measured using the airport base map, aerial photography, and the impervious surface CAD drawing included in Appendix A.

Other drainage characteristics were identified for each subbasin for input to the SWMM model, including subbasin area and width, Manning's roughness coefficient for overland flow, and slope.

Rainfall

The SWMM model was driven by rain events. For evaluation of design storms, the rainfall was derived from standard rainfall distribution curves. Storms were set up using a SCS Type II rainfall distribution curve and varying 24-hour rainfall volumes. A summary of the design storms is located in **Table 5-1**.

Table 5-1

Design Storm Depths

DESIGN STORM	DURATION (HRS)	PRECIPITATION DEPTH (INCHES)
5-year	24	2.92
10-year	24	3.40
25-year	24	4.09
100-year	24	5.30

Infiltration

Horton's Equation was selected to model infiltration within drainage subbasins. Parameters were defined for each subbasin to characterize the infiltration of rainfall to the upper soil zone of pervious areas. The Horton method requires values to be defined for the maximum and minimum infiltration rate, decay constant for the Horton's Equation curve, and maximum infiltration volume. Soil borings were used to identify subbasin soil types, and appropriate parameter values were selected from soil characteristics tables in SWMM documentation. The soils at CLE are not very suitable for infiltration, and this is reflected in the modeled infiltration characteristics.

Surface Runoff

Rainfall that is not evaporated or infiltrated into pervious areas and exceeds the maximum depression storage becomes surface runoff. Parameters such as drainage area, width, roughness, and slope define the total volume of runoff as well as the time of concentration for runoff to reach the airport drainage system. The runoff hydrograph from each subbasin is routed into the airport drainage system at a node which corresponds to a storm sewer inlet or the upstream end of a drainage channel. The hydraulic module of SWMM accepts the runoff hydrograph as an input at the selected node, and performs hydraulic computations for routing the flow through the airport drainage system.

5.2.2 Hydraulic Assumptions

Hydraulic analyses and flow routing were performed within the hydraulic module of SWMM. The hydraulic module uses St. Venant's Equation and the energy equation to route stormwater flows through a series of links and nodes that represent the pipes and drainage structures of the airport's stormwater system.

Model Structure

The Hydraulic Module structure involves a network of links and nodes. Within this module, nodes represent stormwater structures such as catch basins, manholes, outfalls, vaults, and detention basins. Links connect nodes and may represent either open channels, pipes, pumps, weirs, or other conveyance structures.

Drainage Network

Airport stormwater structures were entered as nodes and used to develop the base model by directly importing the provided CAD stormwater structures and pipes into SWMM. A review of the data showed several locations with missing or incorrect data. This data was reviewed and revised information was included in the base model.

Inlets

Stormwater inlets within the hydraulic module are the starting point for stormwater hydraulic flow routing. Each inlet receives as input the contributing subbasins' runoff hydrograph, as previously calculated in the Runoff Module. Inflow to the inlet is restricted by hydraulic constraints such as inlet dimensions, structure storage, and downstream pipe flow. Any portion of the runoff hydrograph that exceeds the hydraulic capacity of the inlet is stored aboveground as surface flooding. Flow that backs up into this reservoir will drain into the inlet as capacity becomes available.

Above Ground Flood Storage

Pervious infield areas between CLE runways, taxiways, and aprons were modeled within SWMM as storage areas. As modeled, runoff drains into storm sewer inlets until pipe capacity is met, at which point runoff is stored above the inlets until capacity frees up.

5.2.3 Detention/Retention Basin Assumptions

CLE currently has two surface detention basins and one retention basin that receive water from the airfield: Central Detention Basin (CDB), South Retention Basin (SRB), and North Detention Basin (NDB). A second retention basin, the North Area Drainage Basin (NADB) drains to the NDB and was included in the model to assess the NDB but is not related to CLE drainage otherwise.

The CDB is located in the southern end of the airfield and can store up to 27.8 million cubic feet of stormwater. The CDB is a dry pond with no standing water. The basin has a low flow orifice at the bottom of the basin and a weir overflow about 7 feet above the basin bottom. It was modeled as constructed in the field with a low flow orifice and weir overflow. The CDB controls stormwater releases to Abram Creek for approximately 985 acres of airfield in existing conditions. In the future modeling condition, additional sub basins from Outfalls 006 and Outfalls 010 and 011 could be diverted to the CDB.

The SRB is located south of the CLE Cargo Ramp and west of State Highway 237 on CLE property. The outlet structure includes a 3.5 inch diameter low flow orifice, a weir located 2 feet above the low flow orifice and an overflow weir 10.5 feet above the low flow orifice according to record drawings. In addition, the SRB has an emergency overflow about 6-inches above the weir overflow. It was generally modeled following the design drawings. Due to model limitations, the weir in the structure was modeled as a bottom outlet orifice. In the future condition model, additional sub basins from Outfall 003 will be diverted to the SRB.

The NDB is located to the north of Interstate 480 adjacent to the Consolidated Car Rental Facility (CCRF) and is a wet basin with standing water at the southeast inlets and at the outlet structure. The outlet for this basin was reconstructed and includes two fiberglass structures and a concrete structure. Each of the fiberglass structures has a 4-inch diameter low flow outlets and a fiberglass weir overflows about 5 feet above that low flow outlet. These fiberglass structures discharge into the concrete structure through two 36-inch openings. The concrete structure also includes a weir located about 19 feet above the low flow outlets. In addition, the NDB includes an overflow to Silver Creek about 2 feet above the weir. Due to the complexity of the outlet structure, the 4-inch low flow orifices, the fiberglass weirs and the 36-inch openings were modeled as a rating curve. The concrete structure overflow weir and basin overflow were modeled independently.

The North Area Drainage Basin (NADB) appears to collect water from the Sysco Facility drainage area. A 16-inch diameter pipe allows flows to leave the NADB and connects to a 60-inch diameter pipe that flows into the NDB. The only outlet from this basin appears to be this 16-inch pipe and the model includes only the 16-inch pipe with invert elevations from as-built drawings.

5.3 Modeling Results

5.3.1 CDB Results

CDB Existing Conditions

The existing CDB has a maximum bank elevation of 754 feet with a maximum storage volume of 27.8 million cubic feet. The results for the modeled five storm events are shown in **Table 5-2**. The basin reduces peak outflows significantly for all storms evaluated. Each storm evaluated drained within the FAA required 48 hours.

Table 5-2

Modeled Storm Events for the CDB -Existing Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
Central Detention Basin								
WQ Event	144.0	17.4	5.3	728.3	15.6	498,400	50.6	35.0
5-Year	1027.5	132.0	10.6	733.6	13.8	2,905,500	53.1	39.3
10-Year	1280.7	172.0	11.4	734.4	13.7	3,585,300	53.8	40.1
25-Year	1653.3	226.5	12.5	735.5	13.7	4,606,100	54.8	41.1
100-Year	2282.8	263.9	14.4	737.4	14.0	6,508,200	56.3	42.3

Notes:

1. “Hour When Basin Empty” represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. “Elapsed Drain Time” represents the time that elapses between peak storage in the basin (“Peak Storage Hour”) and when the basin has fully drained (“Time to Empty”).

CDB Future Conditions

Under future conditions analyses, some of the flow from Outfalls 006 and Outfalls 010 and 011 were routed to the CDB. In addition, supporting impervious areas were calculated based on the future development scenario. The results for the modeled five storm events are shown in **Table 5-3**. The basin continues to reduce peak outflows significantly for all storms evaluated and each storm evaluated drained within the FAA required 48 hours.

Table 5-3

Modeled Storm Events for the CDB - Future Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
Central Detention Basin								
WQ Event	196.7	19.3	6.4	729.4	16.4	761,400	57.2	40.8
5-Year	1366.4	184.5	11.6	734.6	13.8	3,817,300	59.4	45.6
10-Year	1685.2	228.0	12.5	735.5	13.8	4,635,000	59.6	45.8
25-Year	2105.6	256.1	13.8	736.8	13.8	5,914,500	59.8	46.0
100-Year	2864.4	281.7	16.1	739.1	14.0	8,352,200	60.2	46.2

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

CDB Conclusions

While the CDB drains in the required 48 hours, future regulations are likely that CLE will need to further reduce the discharge rate. A potential discharge limit would be the peak flow from 5-year existing condition of 132 cfs. If the 5-year discharge rate is applied, the CDB will not drain within 48 hours. To remedy the drain time, outlet structure modification is needed, and a floating orifice would allow CLE to maximize the release rate at 132 cfs and reduce the drain time to less than 48 hours. Note that the performance of a floating orifice during freezing conditions will need to be considered during design.

5.3.2 NDB Results

NDB Existing Conditions

The NDB has a maximum bank elevation of 755 feet with a maximum storage volume of 0.6 million cubic feet. This basin has some unique characteristics because it has non-airport drainage areas that are controlled by the basin and results in larger than expected discharges leaving the NDB. The results for the modeled five storm events are shown in **Table 5-4**. The basin reduces peak outflows for the storms evaluated and drains within 48 hours.

Table 5-4

Modeled Storm Events for the NDB - Existing Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
North Detention Basin								
WQ Event	77.5	66.1	9.1	740.1	12.5	107,300	44.8	32.3
5-Year	312.1	213.2	12.3	743.3	12.6	263,400	47.0	34.4
10-Year	359.5	225.0	13.4	744.4	12.6	324,700	47.2	34.6
25-Year	428.2	268.0	14.9	745.9	12.7	421,400	47.4	34.7
100-Year	552.7	293.4	17.4	748.4	12.3	594,600	48.0	35.7

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

NDB Future Conditions

For the future condition analysis, additional impervious areas were added based on the future development scenario. The results for the modeled five storm events are shown in **Table 5-5**.

Table 5-5

Modeled Storm Events for the NDB - Existing Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
North Detention Basin								
WQ Event	83.9	73.8	9.2	740.2	12.5	110,300	52.0	39.5
5-Year	340.8	225.0	13.4	744.4	12.7	325,000	54.8	42.1
10-Year	395.5	239.0	14.7	745.7	12.8	407,200	55.0	42.2
25-Year	476.1	257.5	16.6	747.6	12.8	536,600	55.3	42.5
100-Year	623.3	405.5	17.9	748.9	12.5	638,200	55.8	43.3

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.

2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

NDB Conclusions

While the NDB drains within 48 hours, future regulations are likely to drive a change resulting in a further reduction in discharge rate. A potential discharge limit would be the peak flow from 5-year existing condition of 213 cfs. If this discharge rate is applied, the NDB will not drain within 48 hours and the outlet structure would need to be modified. A floating orifice would allow CLE to maximize the release rate at 213 cfs and reduce the drain time to less than 48 hours.

5.3.3 SRB Results

SRB Existing Conditions

The SRB has a maximum bank elevation of 788 feet with a maximum storage volume of 0.4 million cubic feet. The results for the modeled five storm events are shown in **Table 5-6**. The basin reduces peak outflows significantly and drains within 48 hours for each storm.

Table 5-6

Modeled Storm Events for the SRB - Existing Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
South Retention Basin								
WQ Event	4.9	0.7	9.0	774.0	15.9	70,000	43.4	27.5
5-Year	38.4	6.1	11.5	776.5	13.1	128,100	55.7	42.6
10-Year	48.2	7.1	12.0	777.0	13.1	145,800	56.0	42.9
25-Year	61.5	8.3	12.8	777.8	13.1	172,600	56.4	43.3
100-Year	77.4	9.9	14.0	779.0	13.3	217,600	57.0	43.7

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

SRB Future Conditions

For the future condition analysis, discharges from Outfall 003 were routed to the SRB. In addition, impervious area was added based on the future development scenario. The results for the modeled five storm events are shown in **Table 5-7**. For the 100-year storm condition, the basin drains in slightly longer than 48 hours.

Table 5-7

Modeled Storm Events for the SRB - Future Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
South Retention Basin								
WQ Event	12.7	2.4	10.0	775.0	13.7	88,100	55.2	41.5
5-Year	90.2	10.3	14.3	779.3	13.8	231,200	58.7	44.9
10-Year	114.7	11.4	15.3	780.3	13.3	274,300	59.2	45.9
25-Year	135.0	12.6	16.5	781.5	13.4	333,000	60.2	46.8
100-Year	168.2	14.2	18.4	783.4	13.6	431,800	62.0	48.4

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

SRB Conclusions

While the SRB drains within 48 hours, future regulations are likely that CLE will need to further reduce the discharge rate. A potential outflow limit would be the peak flow from 5-year existing condition of 6.1 cfs. If this discharge rate is applied, the SRB will not drain within 48 hours and outlet structure modification would be needed. A floating orifice would allow CLE to maximize the release rate at 6.1 cfs and reduce the drain time to less than 48 hours. During the 100-year storm the emergency overflow would function with a peak flow of less than 1 cfs.

5.3.4 NADB Results

NADB Existing Conditions

The NADB has a maximum bank elevation of 773 feet with a maximum storage volume of 0.3 million cubic feet and is located north of the NDB. The results for the modeled five storm events are shown in **Table 5-8**. The basin reduces peak outflows significantly and drains within 48 hours for each storm.

Table 5-8

Modeled Storm Events for the NADB - Existing Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
North Area Detention Basin (Sysco)								
WQ Event	12.3	9.2	4.5	760.5	12.3	32,900	29.8	17.5
5-Year	76.5	17.7	9.4	765.4	12.7	112,800	31.5	18.8
10-Year	93.7	18.4	10.6	766.6	12.8	140,300	31.6	18.8
25-Year	119.3	19.3	12.2	768.2	12.9	182,800	31.8	18.9
100-Year	166.5	20.7	14.8	770.8	13.1	264,100	32.0	18.9

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

<u>NADB Future Conditions</u>

For the future condition analysis, impervious area was added based on the future development scenario. The results for the modeled five storm events are shown in **Table 5-9**.

Table 5-9

Modeled Storm Events for the NADB - Future Conditions

Storm Event	Peak Inflow (cfs)	Peak Basin Outflow (cfs)	Max Depth (ft)	Max Elevation	Peak Storage Hour	Max Vol (cf)	Hour When Basin Empty[1]	Elapsed Drain Time (hrs)[2]
North Area Detention Basin (Sysco)								
WQ Event	13.9	10.8	4.6	760.6	12.3	33,900	31.5	19.2
5-Year	89.1	18.4	10.6	766.6	12.8	139,900	33.6	20.8
10-Year	108.8	19.1	11.9	767.9	12.9	172,400	33.7	20.8
25-Year	138.0	20.0	13.5	769.5	13.0	221,000	33.9	20.9
100-Year	190.9	21.4	16.1	772.1	13.1	310,800	34.2	21.1

Notes:

1. "Hour When Basin Empty" represents the hour of the 24-hour storm event (assuming that rainfall starts at Hour 0) when the detention basin fully drains and is empty.
2. "Elapsed Drain Time" represents the time that elapses between peak storage in the basin ("Peak Storage Hour") and when the basin has fully drained ("Time to Empty").

NADB Conclusions

Because no data is available and CLE is not responsible for this basin, no additional analyses were conducted. If needed to be characterized in further detail at a later date, the model for this basin may be updated with additional data regarding basin design and operation.

5.3.5 Results for Other Drainage Areas

Other Drainage Areas Existing Conditions

A summary of the modeled output for drainage areas without detention facilities (003, 006, 010/011 and 001) and the combined outfall of drainage areas 001 and 002 are shown in **Table 5-10** for the existing conditions. The drainage area for Outfall 008 also does not have a detention facility; however, as discussed on Section 4.4.3, there are no planned improvements in this area and therefore this area was not modeled.

Table 5-10

Modeled Storm Events for Other Drainage Areas - Existing Conditions

Storm Event	Peak Basin Outflow (cfs)	Max Vol (cf)
Outfall 003		
WQ Event	10.6	68,600
5-Year	68.9	301,200
10-Year	84.8	358,700
25-Year	107.1	442,700
100-Year	139.6	593,500
Outfall 006		
WQ Event	19.6	97,500
5-Year	67.9	437,200
10-Year	77.8	515,000
25-Year	91.1	626,100
100-Year	118.5	826,100
Outfall 010/011		
WQ Event	44.2	272,200
5-Year	282.0	1,234,100
10-Year	343.5	1,473,600
25-Year	415.6	1,823,400
100-Year	475.8	2,494,800
Outfall 001		
WQ Event	14.2	51,700
5-Year	89.6	458,400
10-Year	110.4	618,400
25-Year	156.3	856,900
100-Year	225.4	1,283,900
Outfall 001 & 002		
WQ Event	70.3	630,600
5-Year	292.4	2,861,300
10-Year	332.7	3,439,500
25-Year	394.2	4,287,700
100-Year	491.8	5,821,900
Total of Above Outfalls		
WQ Event	158.9	1,120,600
5-Year	800.8	5,292,200
10-Year	949.2	6,405,200
25-Year	1164.3	8,036,800
100-Year	1451.1	11,020,200

Other Drainage Areas Future Conditions

A summary of the modeled output for drainage areas without detention facilities (003, 006, 010/011, and 001) and the combined outfall of basins 001 and 002 are shown in **Table 5-11** for the future conditions. The drainage area for Outfall 008 also does not have a detention facility; however, as discussed on Section 4.4.3, there are no planned improvements in this area and therefore this area was not modeled.

Table 5-11

Modeled Storm Events for Other Drainage Areas - Future Conditions

Storm Event	Peak Basin Outflow (cfs)	Max Vol (cf)
Outfall 003		
WQ Event	4.9	36,200
5-Year	32.8	154,200
10-Year	40.2	181,400
25-Year	51.0	220,900
100-Year	69.9	290,800
Outfall 006		
WQ Event	13.5	60,500
5-Year	65.2	262,200
10-Year	75.0	309,000
25-Year	91.0	383,100
100-Year	117.8	503,000
Outfall 010/011		
WQ Event	25.6	135,000
5-Year	158.6	618,000
10-Year	194.6	739,400
25-Year	244.9	916,400
100-Year	341.0	1,244,000
Outfall 001		
WQ Event	16.6	62,600
5-Year	96.3	504,100
10-Year	127.4	674,200
25-Year	157.7	917,200
100-Year	230.5	1,362,300
Outfalls 001 & 002		
WQ Event	79.3	767,300
5-Year	304.0	3,413,700
10-Year	358.4	4,077,600
25-Year	408.9	5,033,000
100-Year	610.9	6,750,600
Total of Above Outfalls		
WQ Event	139.9	1,061,600
5-Year	656.9	4,952,200
10-Year	795.6	5,981,600
25-Year	953.5	7,470,600
100-Year	1370.1	10,150,700

Other Drainage Areas Conclusions

Drainage areas 003, 006 and 010/011 all experienced a decrease in both Peak Flow and Total Volume caused by the removal of sub drainage areas being rerouted to the CDB and SRB. Drainage area 001 and the combination of drainage areas 001 and 002 experienced an increase in both peak flow and total volume, due to the increased impervious areas in the future conditions. These results are shown in **Table 5-12**.

Table 5-12

Modeled Storm Events for Other Drainage Areas – Conclusions

Storm Event	Peak Basin Outflow Change (cfs)	Volume Change from Existing (cf)
Outfall 003		
WQ Event	5.7	32,400
5-Year	36.1	147,000
10-Year	44.6	177,300
25-Year	56.1	221,800
100-Year	69.7	302,700
Outfall 006		
WQ Event	6.1	37,000
5-Year	2.7	175,000
10-Year	2.8	206,000
25-Year	0.1	243,000
100-Year	0.7	323,100
Outfall 010/011)		
WQ Event	18.6	137,200
5-Year	123.4	616,100
10-Year	148.9	734,200
25-Year	170.7	907,000
100-Year	134.8	1,250,800
Outfall 001		
WQ Event	-2.4	-10,900
5-Year	-6.7	-45,700
10-Year	-17.0	-55,800
25-Year	-1.4	-60,300
100-Year	-5.1	-78,400
Outfalls 001 & 002		
WQ Event	-9.0	-136,700
5-Year	-11.6	-552,400
10-Year	-25.7	-638,100
25-Year	-14.7	-745,300
100-Year	-119.1	-928,700
Total of Above Outfalls		
WQ Event	19.0	59,000
5-Year	143.9	340,000
10-Year	153.6	423,600
25-Year	210.8	566,200
100-Year	81.0	869,500

6.0 SWP3 PREPARATION AND IMPLEMENTATION OF THE CGP PERMIT

6.1 Overview

The CGP establishes requirements for the preparation of a Stormwater Pollution Prevention Plan (SWP3) to identify potential sources of pollution associated with stormwater runoff from construction activities, as well as pollution prevention measures. Designers may use DPC's SWP3 template provided in **Appendix H** to develop the SWP3. Although the CGP only requires a SWP3 to be developed for projects disturbing an area of one acre or more, DPC also requires an abbreviated SWP3 be developed for projects disturbing less than one acre. Part III of the CGP, which is included in Appendix E, defines required SWP3 components. A SWP3 checklist prepared by DPC for use in preparing construction SWP3s is included in Appendix H. The SWP3 shall meet the following objectives (the abbreviated SWP3 shall also meet objectives below, except where noted otherwise):

- Identify potential sources of pollution which may reasonably be expected to affect the quality of stormwater discharges associated with construction activity;
- Develop a program of construction (POC) (i.e., SWP3 implementation schedule) which describes the sequence of major construction operations and implementation of erosion, sediment, and stormwater practices to be employed during each phase of the project. Designers will be required to meet with the construction contractor after construction contract award to revise the design SWP3 to ensure the design and construction approaches coincide. The design contractor is responsible for preparing the POC and the updates to the SWP3 as needed;
- Select and ensure the implementation of erosion and sediment control BMPs to be used during construction to reduce pollutants in stormwater discharges;
- Select and ensure the proper implementation of PCBMPs in accordance with Part III of the CGP and this SWMP including preparation of maintenance plans for each PCBMP (not required in the abbreviated SWP3 required for projects disturbing less than one acre);
- Plans to handle the storage and disposal of solid, sanitary and toxic wastes, including dumpster areas, areas designated for cement truck washout, and vehicle fueling;
- Maintain complete records including POCs, inspection forms, etc. (not required in abbreviated SWP3 required for projects disturbing less than one area); and

- Designers should review the SWP3 with the construction contractor after contract award and update the plans based on the contractor's construction plan and approach to ensure SWP3 constructability and compliance.
- Designers shall make a statement in the SWP3 narrative report describing how the project demonstrates compliance with the Master Plan, including the selection of PCBMPs.

6.2 General PCBMP Design Guidance

There are a number of guidance manuals available for designing BMPs. A few of the most widely used and applicable references include:

Ohio Department of Natural Resources (ODNR). *Rainwater and Land Development, Ohio's Standards for Stormwater Management Land Development and Urban Stream Protection. Third Edition*. 2006.
http://soilandwater.ohiodnr.gov/water-conservation/stormwater-management

Ohio Department of Transportation (ODOT). *Location and Design Manual, Volume 2. Third Edition*. 2014.
http://www.dot.state.oh.us/Divisions/Engineering/Hydraulics/Location%20and%20Design%20Volume%202/Pages/LandD-Vol-2.aspx

North Carolina Department of Environment and Natural Resources. *Stormwater BMP Manual, Chapter 4.* Revised 12-05-12.
http://portal.ncdenr.org/web/lr/bmp-manual

Atlanta Regional Commission. *Georgia Stormwater Management Manual*. August 2001.
http://www.atlantaregional.com/environment/georgia-stormwater-manual

The sections below provide general design considerations for PCBMPs applicable for use at CLE.

6.3 Potential Sources of Pollution

Stormwater pollutants at airports include nitrogen, phosphorous, hydrocarbons, heavy metals, deicing chemicals, and sediment. Nitrogen and phosphorus from impervious surfaces are generally derived from atmospheric deposition or from wind-blown dust that settles on the surfaces. Both nitrogen and phosphorus are also found in fertilizers during vegetation establishment.[5] Hydrocarbons in stormwater runoff are usually the result of oil or fuel leaks, especially around fuel pumps and hangars. Avgas (used primarily to power small aircraft) contains

[5] North Carolina Department of Environment and Natural Resources. BMP Toolbox for Public Airports. April 8, 2014.

lead and is the only remaining lead-containing transportation fuel.[6] Another source of heavy metals is brake wear which can be found at runway ends where touchdowns occur and on busy aprons with service vehicles. DPC and its tenants uses several deicing chemicals to ensure the safety of airport operations during freezing temperatures. DPC has installed extensive infrastructure and implemented best management practices to limit discharges from deicers. Sources of sediment in stormwater include erosion of poorly vegetated areas and runoff from exposed soil during construction activities. The proper use of construction-phased BMPs and implementation of PCBMPs are approaches to minimize sediment laden runoff.

Additional potential sources of pollution include impacted soils and contaminated groundwater (trenchwater) associated with ground-disturbing projects. DPC has identified best management practices for controlling the release of pollutants from these potential sources, as described in Specification Item MC-031 “Control of Impacted and Solid Waste Material”.

6.4 Program of Construction (POC)

Prior to construction, the contractor shall design a program of construction (POC) to limit both the area and duration of bare soil exposed, and provide a schedule for installation of temporary BMPs, soil management procedures, and other pollution prevention measures as necessary for the project. The POC shall be designed in accordance with the approved SWP3, the CGP, and the latest version of Ohio’s *Rainwater and Land Development Manual*. The POC shall be updated weekly and submitted to DPC along with the completed weekly and storm event SWP3 inspection forms. At a minimum the POC shall include the following:

- Schedule showing proposed installation date of BMPs and stabilization;
- Phasing of bare soil exposed including a calculation of the bare area and methods for temporary and permanent stabilization;
- Measures for dust control;
- Location and controls for soil and other material stockpiles, staging areas, and haul routes (if deviations from the SWP3 are needed);
- Location of construction entrances (if deviations from the SWP3 are needed):
- Protocol for temporary waste storage and disposal (e.g. dumpsters);

[6] Federal Aviation Administration. Aviation Gasoline, https://www.faa.gov/about/initiatives/avgas/.

- Location of any fuel storage tanks or other hazardous material including type of container, volume, and material;
- Red-lined SWP3 to communicate to DPC;
- Copies of completed weekly and storm event SWP3 inspection forms; and
- Schedule of maintenance and corrective actions for items noted on SWP3 inspection form.

The POC and POC updates shall be maintained with the SWP3.

6.5 BMPs Used During Construction

This section provides a list of generally accepted BMPs and some design considerations for use at CLE. Other BMPs may be used, as appropriate, if approved by DPC. Appropriate temporary erosion and sediment controls shall be selected and designed in accordance with Ohio's *Rainwater and Land Development* manual and good engineering judgement. Note that selecting BMPs for use on airports generally have more constrains than selecting BMPs for other industrial or commercial sites. BMPs that pond water for long periods of time, use plants that attract wildlife, and have the potential to become friable must be avoided. The use of straw mulch and silt fence is prohibited in the air operations area. DPC has developed specifications for erosion and sediment control protocols and BMPs based on FAA standards and site-specific conditions and include the following:

Item MC-006	Rock Construction Entrance
Item MC-010	Filter Sock
Item MC-013	Excavation Support and Dewatering
Item MC-031	Control of Impacted and Solid Waste Material
Item MC-035	Matting
Item P-156	Temporary Air and Water Pollution, Flooding, Soil Erosion, and Siltation Control
Item D-753	Rock Channel Protection
Item T-901	Seeding
Item T-904	Sodding
Item T-905	Topsoiling
Item T-908	Mulching

Examples of these specifications are included in the *Reference* folder on the enclosed DVD.

6.5.1 Sediment Basin

A sediment basin is a temporary pond designed to detain captured stormwater to allow sediment to settle out and release the detained water at a controlled rate. The pond is created by constructing a dam or embankment, a main and emergency spillway, and a dewatering device or skimmer. The structure may be removed when construction is complete and the drainage area is stabilized or converted into a detention basin for use as a PCBMP.

Design considerations include the following:

- Consider installing a sediment basin in drainage areas that are too large for sediment traps (greater than five acres) or filter controls (i.e. filter socks) to be effective;
- Refer to Ohio's Rainwater and Land Development manual for guidance on pond/basin design;
- Stabilize embankments with vegetation as soon as it is practical to do so;
- Ensure the location of the sediment trap is accessible to equipment for sediment removal;
- Ensure that the pond is located such that in the event of failure it would not result in the loss of life, damage to homes or buildings, wetlands, Metroparks, or interruption of air service;
- Install warning signs and place safety fence around the trap ; and
- Facilitate maintenance access for the removal of accumulated sediment, cleaning of clogged skimmers, trash removal, repair of eroded side slopes, etc.

Additionally, sediment basins are required to comply with the detailed requirements noted in Part III.G.2.d.ii of the CGP, including the following:

- If feasible, dewatering shall be performed at the pond surface using a skimmer or equivalent device.
- Sediment settling pond volume shall consist of both a dewatering zone and a sediment storage zone.
    - The volume of the dewatering zone shall be a minimum of 1800 cubic feet (ft^3) per acre of drainage (67 yd^3/acre) with a minimum 48-hour drain time for sediment basins serving a drainage area over 5 acres.

  - The volume of the sediment storage zone shall be 1000 ft^3 per disturbed acre within the watershed of the basin or the volume necessary to store the sediment as calculated with RUSLE or a similar generally accepted erosion prediction model.
- The depth of the dewatering zone shall be less than or equal to five feet.
- The length to width ratio shall be at least 2:1, but 4:1 is recommended where feasible.
- The design shall consider public safety, and alternative sediment controls shall be used where site limitations would preclude a safe design.

6.5.2 Sediment Trap

A sediment trap is a temporary settling pond formed by constructing an embankment or excavating with a stone weir outlet. Filter sock may also be used to form a berm. Sediment traps are constructed to detain sediment-laden runoff from small disturbed drainage areas for a period of time to allow the sediment to settle out.

Design considerations include the following:

- Design to serve a drainage area less than five acres;
- Refer to Ohio's *Rainwater and Land Development* manual for guidance on pond design;
- Stabilize embankments with vegetation as soon as it is practical to do so;
- Ensure the location of the sediment trap is accessible to equipment for sediment removal;
- Ensure that the sediment trap is located such that in the event of failure it would not result in the loss of life, damage to homes or buildings, wetlands, Metroparks, or interruption of air service;
- Install warning signs and place safety fence around the trap; and
- Facilitate maintenance access for the removal of accumulated sediment, trash removal, repair of eroded side slopes, etc.

6.5.3 Filter Sock (Perimeter Control, Inlet Protection, Check Dams, Concrete Washout Berms, Slope Interruption, Runoff Diversion, and Sediment Traps)

DPC is currently coordinating with Ohio EPA to develop an acceptable approach for the use of filter socks at CLE. Filter socks are constructed of a flexible mesh containment tube filled with compost or proprietary materials designed to remove sediment and pollutants through filtration and deposition. Filter socks can also be used to slow runoff velocities on sloped surfaces thus reducing erosion. Filter socks can be used for perimeter control, inlet protection, check dams, concrete washout berms, slope interruption, runoff diversion, and sediment traps. Design considerations include the following:

- When used as a perimeter control, place filter sock on a level contour of the land so that flows are dissipated into uniform sheet flow;
- When possible, place filter socks five feet or greater distance away from the tow of the slopes when used for perimeter control;
- Turn ends of filter sock upslope to prevent water from flowing around the ends;
- Generally filter socks are limited to ¼ to ½ acre drainage areas per 100 foot of the sediment barrier;
- Sock shall be secured to the ground with stakes that are spaced a maximum of 18 inches apart. Stake spacing decreases likelihood of water flowing underneath the sock and the sock floating;
- When used for inlet protection, overlap sock ends tightly a minimum of 3 feet and stake each end;
- When used for inlet protection, stack socks on top of each other (double stack). Additional measures such as triangular stack (i.e. two concentric wraps with the third stacked on top of the two lower socks) may be used. Staking is required for each additional sock. Other methods include installing stone on the up-gradient side and combining sediment sock with other sediment control methods.
- If flow is concentrated (i.e. in a channel before the inlet) install socks up-gradient with ends turned up-slope as check dams to slow water velocity and reduce sediment content;
- Installation on pavement shall include weights such as concrete blocks placed on top of the sock with a maximum of 18 inches between block ends. Blocks need to be secured to the sock to prevent the blocks from being knocked off. Stone shall be installed on both sides of the sock to help secure the sock. Additional stone check dams may be installed up-gradient of the sediment sock to slow water velocity;
- Refer to manufactures recommendations for product-specific design parameters, staking, and applications;
- Remove sediments collected at the base of the filter sock when they reach 1/3 of the exposed height or sooner; and
- Repair or replace filter socks that have deteriorated or punctured.

- Sock content may be removed from the sock fabric and stabilized (i.e. seeded) for use onsite.

6.5.4 Rock Construction Entrance

A construction entrance is a stone apron located at the ingress and egress of the construction site. Construction entrances are typically placed where construction vehicles enter and exit the site from paved or otherwise stabilized roads and traverse bare soil. The construction entrance is constructed of 1.5 to 2.5 inch (ODOT #2) stone and is underlain with geotextile. The purpose of construction entrances is to reduce the amount of soil tracked off-site and is often used in conjunction with road sweeping.

Design considerations include the following:

- The area of the entrance must be cleared of all vegetation, roots, and other objectionable material before installing geotextile and stone;
- The dimensions of the stone pad shall be at least the size shown in *Rainwater and Land Development* manual (70 feet long by 14 feet wide);
- Include a culvert if needed to allow the passage of clean stormwater;
- Include water bars, diversions berms, or filter socks, to prevent sediment laden stormwater from running onto the construction entrance and channeling onto main roads;
- The use of water trucks without the use of vacuum trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted;
- After frequent use the stone will become clogged and will require top dressing or washing/reworking existing stone, as needed; and
- Consider installing wheel wash areas if there are sensitive traffic situations on adjacent roads. A sediment pond or trap will be required to capture wash water.

6.5.5 Concrete Washout Area

A designated concrete washout area can be a lined pit constructed on-site or a pre-fabricated leak-proof container. Concrete wash water generated from washing out ready-mix trucks, chutes, equipment, drums, pumps, etc. shall be contained. Concrete wash water is toxic to fish and aquatic life and can contaminate drinking water supplies.

Design considerations include the following:

- Washout areas should not be placed within 50 feet of storm drains, open ditches, or water bodies;
- Consider more than one washout area to allow convenient access for concrete trucks and based on demand for storage capacity;
- Below-grade washout pits must be sized to contain all liquid and solid waste expected to be generated between cleanout periods. Pits generally should be at least 10 feet wide by 10 feet long and 1 foot of freeboard. Line the pit with plastic sheeting of at least 10-mil thickness that has no holes or tears to prevent leaching onto the ground;
- Above-grade washout pits must be sized to contain all liquid and solid waste expected to be generated between cleanout periods. Containment areas shall be at least 10 feet wide by 10 feet long with 1 foot of freeboard. Berms may be constructed with straw bales (if located outside of the air operations area) or sandbags. Line the containment area with plastic sheeting of at least 10-mil thickness that has no holes or tears to prevent leaching onto the ground.
- When the washout pit is near capacity, dispose of the waste material in an approved manner. Do not discharge liquids into waterways, storm drains, or on the ground. Do not discharge to the sanitary sewer without approval from NEORSD and do not discharge to the storm sewers.; and
- Clean out washout pits before predicted storms to prevent overflows.

6.5.6 Soil Stabilization (Temporary/Permanent)

Soil stabilization shall include minimizing disturbed areas and establishing temporary or permanent vegetation as soon as possible. The use of erosion control matting is recommended in swales and on steep slopes to anchor the seed and mulch. Soil stabilization is the most effective way to minimize erosion and off-site sediment from developed sites. Existing vegetation shall be maintained as much as possible. Designers and contractors shall be aware of wetlands on airport property so that these areas can be protected from disturbance and stormwater pollution.

Design considerations include the following:

- Areas not to be disturbed must be shown on construction plans and clearly marked in the field;
- Phase construction activity to minimize the amount of disturbed soil and stabilize soil before moving on to subsequent phases;
- Temporary seeding shall be used in between construction operations when exposed soil will be idle. A schedule for temporary seeding shall be included in the SWP3 in accordance with the CGP;
- Specify seed mixes recommended by the US Department of Agriculture for use on airports to minimize attraction to wildlife (select high endophytic grass mix). Project specifications provided by DPC detail seed mix and application rates;
- Provide sufficient topsoil, properly till, apply lime and/or fertilize if needed, mulch, and water to encourage seed germination. Additional top soil and amendments may be required for effective seed germination;
- Straw may not be used as mulch within the air operations area to reduce the risk of FOD. Because straw mulch is not permitted within the AOA, soils are primarily clay with low nutrients and moisture retention, and high endophyte grasses such as tall fescues fill in slowly soil amendments and covers such as compost shall be considered to promote seed germination. The cost of reapplying seed and redressing erosion often outweighs the cost of the compost amendments; and
- Stabilize runway and taxiway pavement with sod for the first 20 feet measured from the edge of pavement.

Temporary and permanent soil stabilization shall be performed in accordance with the requirements of Part II.B. of the CGP, and shall be performed in accordance with the time frames indicated in **Tables 6-1 and 6-2** below (excerpted from the CGP).

Table 6-1

Permanent Soil Stabilization

AREA REQUIRING PERMANENT STABILIZATION	TIME FRAME TO APPLY EROSION CONTROLS
Any areas that will lie dormant for one year or more	Within seven days of the most recent disturbance
Any areas within 50 feet of a surface water of the state and at final grade	Within two days of reaching final grade
Any other areas at final grade	Within seven days of reaching final grade within that area

Table 6-2

Temporary Soil Stabilization

AREA REQUIRING TEMPORARY STABILIZATION	TIME FRAME TO APPLY EROSION CONTROLS
Any disturbed areas within 50 feet of a surface water of the state and not at final grade	Within two days of the most recent disturbance if the area will remain idle for more than 14 days.
For all construction activities, any disturbed areas that will be dormant for more than 14 days but less than one year, and not within 50 feet of a surface water of the state	Within seven days of the most recent disturbance within the area. For residential subdivisions, disturbed areas must be stabilized at least seven days prior to transfer of permit coverage for the individual lot(s).
Disturbed areas that will be idle over winter	Prior to the onset of winter weather

6.6 Rationale for Selection of Post-Construction BMPs

This section provides general guidance on how to assess, select and design new PCBMPs for development projects at CLE. The approach to managing stormwater at airports is different from other industrial sites in that many PCBMPs have standing water and attract wildlife that can be hazardous to aircraft. There is no one PCBMP that is suitable for every project site. Each site has unique aspects such as space constraints, restricted access to airfield areas, potential conflicts with safe and efficient airport operations, and variable soil conditions.

Safety is the number one factor in selecting the type and location of a PCBMP. Many PCBMPs can provide food, shelter, and a travel corridor for wildlife and shall not be permitted for use on or in the vicinity of airfields. FAA AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near*

Airports states; “For all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport’s AOA [Air Operations Area] and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.” Many PCBMPs listed in the CGP have the potential to attract wildlife and are not applicable for use on or in the vicinity of the airport without proper controls to mitigate wildlife risks. Additionally, many PCBMPs conflict with the FAA AC 150/5300-13A, *Airport Design for Taxiway/Taxilane Safety Areas (grass infields).*

Other key factors to take into consideration when selecting a PCBMP include soil type, where the PCBMP will be located, and the cost of installation and maintenance. The soil underlying the airport is generally poorly draining silty-clay. Additional details on soils at the airport is provided in Section 2.2. BMPs shall be located in areas that are accessible to maintenance personnel without disruption to normal airport operations. For example, it shouldn’t be necessary to temporarily close a runway or taxiways to mow a BMP. The cost of installing and maintaining BMPs vary with each type and will be evaluated and discussed with DPC as part of the selection process.

Since CLE maintains an individual permit allowing discharges of stormwater from industrial activity areas (e.g., fueling and deicing), coordination with DPC is needed. While existing post-construction and stormwater quantity control basins at CLE are not currently designed purposefully for compliance with the industrial permit, overlaps with compliance obligations do exist. For example, deicer-impacted runoff does discharge through the existing detention basins. Should a future industrial permit requirement result in the need for additional or a change in existing controls, any of the existing basins could be considered a part of the solution for those controls. Therefore, contractor and/or designers of projects at CLE need to carefully consider both construction and industrial stormwater impacts and associated quantity and quality control requirements when planning to utilize existing stormwater basins.

Table 6-3 lists potential PCBMPs, provides a summary of advantages and disadvantages of each of the stormwater controls, and can be used as a general guide in the decision-making process. **Table 6-4** incorporates other key factors DPC and DPC’s contractors can refer to during the design process. As shown in Table 6-4, several BMPs are not applicable and should not be constructed at or in the vicinity of CLE. BMPs not suitable for use at CLE within the airfield safety areas include wet extended detention basins, constructed wetlands, and pocket wetlands. As

DPC encourages the implementation of GI PCBMPs where feasible, the BMPs that are considered to be GI are also noted in Table 6-3. These BMPs may be used to promote stormwater volume reduction, where appropriate.

Table 6-3

Summary of Advantages and Disadvantages of Potential PCBMPs

BEST MANAGEMENT PRACTICE[1]	DRAIN TIME of WQv[1]	BMP DESCRIPTION[2]	ADVANTAGES[2]	DISADVANTAGES AND SITE CONSTRAINTS[2]
Infiltration Basin or Trench	48 hrs	- Rock-filled trench that receives stormwater runoff - Stormwater is allowed to infiltrate into the ground - Provides temporary underground storage - Considered to be a form of green infrastructure (GI)	- Minimal wildlife attractant - Suitable for sites with space constraints - Most efficient PCBMP for removal of stormwater pollutants - Groundwater recharge	- Need to be carefully constructed to work - High long-term maintenance costs (clogging) - Need permeable soil or underdrain system - Not practical for sites larger than 5 acres - Can act as a conduit to groundwater and cause groundwater contamination if a chemical spill enters the trench - May need to increase volume to account for snow melt - Not suitable for site with high water tables
Permeable Pavement - Infiltration	48 hrs	- Porous paving materials such as asphalt, concrete, or paver stones allows stormwater to filter into base materials and infiltrate into underlying soil - Considered to be a form of GI	- Minimal wildlife attractant - Suitable for sites with space constraints - Suitable for light vehicle traffic such as passenger car parking lots - Moderates water temperatures compared to traditional pavements	- Not suitable for heavy loading areas such as airfield pavement - Avoid using in areas such as chemical storage areas or fueling stations in case of spill which can contaminate groundwater. - Should be used in conjunction with infiltration trench to remove bulk of sediment to minimize clogging - Avoid using on unstable or steep slopes
Permeable Pavement - Extended Detention	24 hrs	- Porous paving materials such as asphalt, concrete, or paver stones allows stormwater to filter into base materials which store the water quality volume in a "reservoir" which typically is conveyed to an outlet control structure - Considered to be a form of GI	- Minimal wildlife attractant - Suitable for sites with space constraints - Suitable for light vehicle traffic such as passenger car parking lots or walkways - Moderates water temperatures compared to traditional pavements	- Not suitable for heavy loading areas such as airfield pavement - Avoid using in areas such as chemical storage areas or fueling stations in case of spill which can contaminate groundwater. - Should be used in conjunction with infiltration trench to remove bulk of sediment to minimize clogging - Avoid using on unstable or steep slopes
Dry Extended Detention Basin	48 hrs	- Basin that temporarily stores incoming stormwater, trapping suspended pollutants, and reduces the peak discharge from the site	- Suitable for large drainage areas - Effective in controlling peak runoff discharge rates	- Limited effectiveness in removing dissolved substances - Tends to have standing water which makes maintenance challenging - Debris can accumulate and clog outlets - Can attract children and become a safety hazard - Wildlife hazard

BEST MANAGEMENT PRACTICE[1]	DRAIN TIME of WQv[1]	BMP DESCRIPTION[2]	ADVANTAGES[2]	DISADVANTAGES AND SITE CONSTRAINTS[2]
Wet Extended Detention Basin	24 hrs	- Basin that has a permanent pool of water for removing pollutants and capacity for detaining stormwater runoff	- Suitable for large drainage areas - Provides good water quantity control	- Can create problems such as nuisance odor, algae blooms, etc. if not maintained - May contribute to thermal pollution - Wildlife hazard
Constructed Wetland (above permanent pool)	24 hrs	- Constructed systems that mimic the functions of natural wetlands - Considered to be a form of GI	- Good pollutant removal - Can be aesthetically pleasing	- Wildlife hazard - Uses more land than detention basin - If poorly maintained invasive plant species can take over native wetland plants - Can be a heat sink causing discharge of warm water
Sand & Other Media Filtration	24 hrs	- Surface or subsurface device that percolates stormwater down through a sand media where pollutants are filtered out	- Minimal wildlife attractant - Suitable for sites with space constraints - Highly effective at removing TSS, BOD, and fecal coliform - Can be placed underground	- Anoxic conditions can develop in the sand filter due to poor drainage - May not be effective at controlling peak discharges - Costly to construct and maintain
Bioretention Area/Cell	24 hrs	- The use of plants and soil for removal of pollutants by adsorption, filtration, etc. - Considered to be a form of GI	- Efficient removal of suspended solids, heavy metals - Integrates well with landscaping	- Possible wildlife hazard if seed-bearing plants are used - Surface soil layer may clog over time - Good for small drainage areas - Requires frequent maintenance of plant material and mulch layer
Pocket Wetland	24 hrs	- Constructed shallow marsh systems. - Considered to be a form of GI	- Good pollutant removal - Can be aesthetically pleasing	- High wildlife hazard - Needs reliable water source and usually requires excavation down to the water table - Can be a heat sink causing discharge of warm water
Vegetated Biofilter	N/A	- Graded shoulder, vegetated slope, and vegetated ditch - Considered to be a form of GI	- Appropriate for linear / airfield environments - Less attractive to wildlife - Low capital cost and maintenance - Compatible with CLE soil types	- Applicability requires that project or site meets criteria defined in Section 6.6.6.

1. Source: Ohio EPA Permit No.: OHC000004, page 21
2. Sources: Ohio Department of Natural Resources, Rainwater and Land Development Manual, Third Edition 2006. North Carolina Department of Environment and Natural Resources, Stormwater BMP Manual, Chapter 4, Revised 12-05-12.

Table 6-4

Summary of Key Decision Criteria When Selecting PCBMPs

BEST MANAGEMENT PRACTICE[1]	SPACE REQUIRED[2]	WORKS WITH POORLY DRAINED SOILS?[2]	CONSTRUCTION COST[2]	MAINTENANCE LEVEL[2]	SAFETY CONCERNS[2]	WILDLIFE HABITAT[2]
Infiltration Basin or Trench[3]	High	N	Med-High	Med	N	Low
Permeable Pavement - Infiltration	N/A	N	Med-High	High	N	N/A
Permeable Pavement - Extended Detention	N/A	Y	Med-High	High	N	N/A
Dry Extended Detention Basin	Med	Y	Low	Low-Med	Y	Med
Wet Extended Detention Basin[3]	High	Y	Med	Med	Y	High
Constructed Wetland (above permanent pool)[3]	High	Y	Med	Med	Y	High
Sand & Other Media Filtration	Low	Y	High	High	N	Low
Bioretention Area/Cell (Includes grassed linear bioretention)	High	Y	Med-High	Med-High	N	Med
Pocket Wetland[3]	High	Y	Med	Med	Y	High
Vegetated Biofilter	Low	Y	Low	Low	N	Low

1. Source: Ohio EPA Permit No.: OHC000004, page 21
2. Source: North Carolina Department of Environment and Natural Resources, Stormwater BMP Manual, Chapter 4, Revised 12-05-12.
3. Shaded cells are BMPs not suitable for use on or in the vicinity of CLE due soil type incompatibility and high potential to attract wildlife hazards.

6.6.1 Permeable Pavement – Extended Detention

Permeable pavement infiltrates stormwater through voids in the pavement and filters water through an underlying aggregate reservoir. Permeable pavements shall be designed to detain and release water to an outlet structure through an underdrain system because the underlying soil on airport property is not suitable for infiltration. Permeable pavement is not suitable for areas with traffic or heavy loading such as trucks or aircraft. Permeable pavement shall be considered for use in areas such as public and employee parking lots and rental car lots.

Design considerations include the following:

- Permeable pavement shall not be installed where chemicals are used such as maintenance and fueling areas.
- The seasonal high water table shall be at least two feet below the base of the aggregate storage layer.
- Permeable pavement areas shall be used in close proximity to building foundations and utilities.
- Permeable pavement shall not be used on steep sites.
- DPC shall review the proposed permeable pavement product for installation and maintenance considerations.

6.6.2 Dry-Extended Detention Basin

Dry-extended detention basins are typically large basins designed to store stormwater temporarily, reduce the peak discharge from a storm event and are dry between storm events. These systems are not ideal for use at airports due to wildlife attraction risks, but due to the temporary nature of ponding, the risks are less severe than those associated with BMPs with permanent water surfaces. Wildlife risks may be reduced through the use of wildlife risk mitigation techniques and wildlife deterrent design strategies, such as those listed below. Dry-extended detention basins are utilized at CLE in conjunction with wildlife controls and are used to mitigate peak flow as well as provide water quality treatment.

Design considerations include the following:

- Maximum 48-hr detention period;
- Drain completely dry between rainfalls;
- Minimize the potential for clogging of the outlet structure;
- Increase length to width ratio – a linearly shaped water detention minimizes wildlife habitat;
- Eliminate the small permanent pool near the outlet structure to reduce wildlife attraction.

- Select a grass appropriate for the region that minimizes the food source and habitat for birds and mammals;
- Install concrete or paved pad at the bottom to prevent vegetation growth and a nesting habitat; and
- Steep, rip-rap lined, narrow sides for linearly shaped water retention basins.

6.6.3 Sand and other Media Filtration

Stormwater runoff is directed through a sand filter to remove pollutants. Sand filters can be used in small, highly impervious watersheds where sufficient land prohibits other types of BMPs. The use of sand filters should be a last resort when no other BMP is feasible as they are costly to install and maintain compared to other types of BMPs. It should be noted that sand filters do not mitigate peak flows and must be used in conjunction with other BMPs. One benefit of sand filters is these systems could be located near snow disposal areas to treat snowmelt runoff. If sand filters are considered, methods for inspecting and cleaning the sand must be included with the design.

Design considerations include the following:

- Sand filter must completely drain within 40 hours or less. The CGP requires sand filters to drain in 24 hours;
- Seasonable high water table must be at least 1 foot below bottom of the filter or closed filter to prevent draining the water table and floatation;
- Check hydraulics to make sure there is enough depth to allow the required media thickness, ponding depth, and other appurtenances; and
- Sand filter designs must provide sufficient access to chambers to facilitate maintenance activities.

6.6.4 Bioretention Area/Cell

Bioretention cells are depressed areas in the landscape with engineered fill media designed to treat stormwater runoff. They must be placed outside of the runway and taxiway safety areas. If bioretention cells are placed on the airside, vegetation must be only grass with no mulch. Mulch can become foreign object debris (FOD) due to wind mobilization which is hazardous to aircraft. Mulch may be used in bioretention cells on landside. Vegetation selection will be reviewed by

DPC Environmental Services and based on the location of each cell and its proximity to the airfield.

Design considerations include:

- Ponded water shall drain into the soil within 24 hours;
- Maximum ponded depth should typically not exceed 12 inches. Water shall drain to a level of 24 inches below the soil surface within 48 hours;
- Media permeability of 1-6 in/hr is required, 1-2 in/hr is preferred;
- Bioretention cells shall not be used where slopes are greater than 20%;
- An underdrain shall be installed with clean-out pipes;
- Select non-seed and fruit bearing grasses and plants;
- Trees are not permitted;
- Erosion protection surrounding the bioretention cell during construction and after stabilization shall be included; and
- Installation methods and timing of bioretention soil installation must be specified.

6.6.5 Grassed Linear Bioretention

Grassed linear bioretention (i.e., enhanced water quality swale or grassed swale) is a shallow open-channel drainageway stabilized with grass or other vegetation to filter pollutants. Grassed swales can be an effective BMP for removing pollutants. Swales typically run parallel to runways and taxiways outside of the runway safety area limits. They need to be mowed to maintain a grass height of seven to 14 inches to reduce habitat.

Design considerations include:

- Consistent grade should be provided along the length of the swale to avoid low spots that could pond water. Maximum longitudinal slope shall be 5%.
- Design shall non-erosively pass the peak runoff rate for the 10-year storm.
- The swale shall be able to support airport mowing equipment.
- Select high endophytic grass mix.

6.6.6 Vegetated Biofilter

DPC has determined that vegetated biofilters have potential applicability for implementation at CLE as a PCBMP. Although this BMP is not explicitly listed in the CGP, it is included in the Ohio Department of Transportation's *Location and Design Manual, Volume 2* ("*ODOT L&D v2*"), and has been approved by Ohio EPA for use as a PCBMP in linear transportation environments. This BMP may also be implemented at CLE if implemented in accordance with *ODOT L&D v2* design criteria.

ODOT L&D v2 describes the vegetated biofilter as "*the vegetated portion of the graded shoulder, vegetated slope, and vegetated ditch"* alongside roadways. It performs water quality treatment by filtering stormwater through vegetation. At CLE, the vegetated biofilter may be implemented in linear applications such as alongside roadways or airfield pavements, including locations where other PCBMPs may be infeasible due to FAA requirements.

DPC plans to consider the implementation of vegetated biofilters as a PCBMP on future projects, where applicable, in accordance with *ODOT L&D v2* design and implementation criteria. Per Section 1115.3 of *ODOT L&D v2*, vegetated biofilters may be implemented to meet Ohio EPA PCBMP requirements on projects that are required to address water quality but are not required to address water quantity. For projects at CLE, projects meeting *any* of the following criteria are assumed to require water quality to be addressed but not water quantity (as adapted slightly from the criteria defined in *ODOT L&D v2,* Section 1115.3):

- Sites where one or less acre of new impervious area is created within new development area (area not previously developed, where the project does not qualify as *redevelopment*).
- Site is a redevelopment project where impervious surfaces had previously been developed and where the new land use will not increase the runoff coefficient.
- Sites which discharge directly to a large river (>100 square mile drainage area or fourth order or greater) or to a lake and where the development area is less than 5 percent of the watershed area upstream of the development site, unless known water quality problems exist in the receiving waters.

CLE Outfalls 008, 010, and 011 drain directly to Rocky River, which is a fourth order stream upstream of the airport and sixth order stream downstream of the airport. Projects within these drainage basins may qualify as requiring only water quality control as described in the criteria above. Additionally, projects within other watersheds would also not require quantity control if they qualify for one of the first two criteria above (redevelopment or less than one acre of new impervious area in a new development area).

In the future, DPC may decide to further investigate the water quality performance of existing grass infield areas, which already incorporate graded shoulders, vegetated slopes, and vegetated ditches, similar to the vegetated biofilter. These features may be compared to vegetated biofilter design criteria from the *ODOT L&D v2* and evaluated for applicability toward meeting PCBMP requirements, where applicable. DPC will coordinate with the Ohio EPA on an approach if it is decided to proceed with this evaluation.

6.6.7 BMPs in Series

The use of more than one BMP in a series can be an effective stormwater management strategy. For example, bioretention cells may be used for pollutant removal which discharges into a detention pond to reduce peak flows. This approach is already utilized in a few areas on airport property.

6.7 Solid, Sanitary, and Hazardous Wastes

All waste materials shall be collected and disposed of into trash dumpsters located in a designated area as shown on the SWP3. Dumpsters shall have a secure watertight lid and placed away from catch basins or other stormwater conveyances. Only trash and construction debris from the construction project will be deposited into the dumpster. Construction materials are not permitted to be buried on-site. Material that can be recycled shall be placed into a separate dumpster. The dumpsters shall be inspected as part of the weekly and storm event inspection requirement. Dumpsters will be emptied at a frequency adequate to prevent overflowing.

Hazardous waste materials such as oil filters, petroleum products, paints, and equipment maintenance fluids will be stored in structurally sound and sealed shipping containers within a hazardous materials storage area. All hazardous waste materials will be disposed of in accordance with Federal, state, and local regulations. Hazardous waste materials will not be disposed of into the on-site dumpsters.

6.8 SWP3 Inspections and Maintenance

General guidance for construction stormwater-related inspections and BMP maintenance during construction projects to facilitate compliance with the CGP is presented in this section.

The CGP requires periodic inspections of stormwater control structures and practices throughout each construction project. A DPC inspector or third party designee will inspect the Contractor's work. The inspection forms and performance standards are included in technical specification P-156 *Temporary Air and Water Pollution, Soil Erosion, and Siltation Control* as part of the Conformed to Contract project documents. A copy of the inspection form is provided in Appendix H. The Contractor is also required to perform inspections. The inspection schedule shall be performed in accordance with the CGP, which states that BMPs must be inspected every 7 days and within 24 hours of a storm event greater than 0.5 inches.

Technical specification P-156 establishes detailed performance standards for contractors, as summarized below:

> "*The Contractor shall maintain and inspect the sediment and erosion control practices for the duration of the contract. Weekly and storm event (as defined in the project SWP3 or other project document) inspections shall be completed by the Contractor and documented on a SWP3 Site Inspection Report (a copy of this form is attached to the specification) and submitted to the Resident Engineer with the POC. In addition, the Contractor shall update (e.g., red-line) the SWP3 whenever construction practices or pollution controls change. The updated SWP3 shall be submitted to the Resident Engineer monthly, by the end of the third calendar day, to document implementation of necessary erosion and sediment controls over the previous month. SWP3 updates and monthly submittals shall be paid as part of the Inspection of Pollution Control Practices Item. The Contractor's failure to update the SWP3, as required herein, to inspect the sediment and erosion control practices, and to continuously maintain these practices will not be tolerated and shall be cause for issuance of notices of violation, assessment of penalties (also contained in Item C-55), or termination of the contract. Therefore, the Contractor shall include in his proposed bid item inspection and maintenance of SWP3 control practices throughout the duration of the project. If the Contractor fails to provide these services, he will be notified of violations and assessed… penalties*.

Upon completion of work, the Contractor shall remove from the site and dispose of debris and waste material resulting from his work and shall thoroughly clean out basins, manholes, conduits and miscellaneous appurtenant structures to the satisfaction of the Owner. Before the work is accepted, the Contractor shall thoroughly clean all streets, roads, taxiways, and lawns from all debris and dirt accumulating from the construction and open all gutters and ditches so that free positive drainage may be obtained."

Refer to P-156 for details on specific penalties and how they are assessed to contractors.

6.9 Recordkeeping

The SWP3 shall be kept up to date. Each POC and inspection report must be signed and made part of the SWP3. The Contractor must maintain these records for a period of 3 years from the date construction has been completed, or 3 years after a NOT has been submitted to Ohio EPA, whichever is longer. DPC may request and maintain copies of these records as well.

7.0 REFERENCES

Federal Aviation Administration (FAA) 150/5300-13A. *Advisory Circular 150/5300-13A Airport Design*. September 2012.

Federal Aviation Administration (FAA) 150/5200-33B. *Advisory Circular 150/5200-33B Hazardous Wildlife Attractants on or near Airports*. 8/28/2007.

Federal Aviation Administration (FAA) 150/5320-5C. Advisory Circular 150/5320-5D Surface Drainage Design. 9/29/2006.

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Ohio Department of Natural Resources (ODNR) 2006. *Rainwater and Land Development, Ohio's Standards for Stormwater Management Land Development and Urban Stream Protection, Third Edition*. 2006.

Ohio EPA General Permit. *Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System (NPDES) Ohio EPA Permit No.: OHC000004*. Effective Date: April 21, 2013, Expiration Date April 20, 2018.

U.S. Department of Transportation (US DOT) HEC-22. *Urban Drainage Manual. Hydraulic Engineering Circular No. 22, Second Edition*. August 2001.

Washington State Department of Transportation. *Aviation Stormwater Design Manual. Managing Wildlife Hazards Near Airports*. December 2008.