



DOAN BROOK WATERSHED ACTION PLAN

DOAN BROOK WATERSHED PARTNERSHIP

March 2013



DOAN BROOK WATERSHED ACTION PLAN TABLE OF CONTENTS

I.	Introduction	6
	A. Defining the Watershed	6
	B. Administrative Boundaries	8
	C. Demographics	11
	D. Geographic Locators	15
	E. Previous Watershed Management Activities	15
II.	Watershed Plan Development	16
	A. Doan Brook Watershed Partnership	16
	B. General Plan Contents	21
	C. Endorsement & Adoption of Plan	21
	D. Public Outreach During Plan Development	22
III.	Watershed Inventory	23
	A. Description of Watershed	23
	1. Geology	24
	a. Topography	24
	b. Geology	26
	c. Soils	26
	d. Glacial History	30
	2. Biological Features	30
	a. Landscape Types	30
	b. Wildlife	33
	c. Birds	33
	d. Fish	33
	e. Rare, Endangered and Threatened Species	34
	f. Invasive Non-Native Species	35
	3. Water Resources	36
	a. Climate and Precipitation	36
	b. Surface Water	37
	Wetlands	37
	Stream Use Designations	38
	Descriptions of Subwatersheds	39
	c. Ground Water Resources	48
	Source Water Assessment Plan	48
	Groundwater Pollution Potential	48
	4. Land Use	48
	a. Land Cover Description	48
	b. Protected Lands	56
	c. New Development Trends	57
	B. Cultural Resources	58
	1. History of Doan Brook Watershed	58
	2. Archaeological Sites	60
	3. Historic Landmarks & Districts	61

C.	Previous & Complementary Efforts	62
D.	Physical Attributes	63
1.	Early Settlement Conditions	63
2.	Channel & Floodplain Conditions	64
3.	Streambank Stability & Erosion	66
4.	Hydrology & Flooding	67
5.	Forested Riparian Corridor Assessment	70
6.	Dams	72
7.	Channelization	72
8.	Floodplain Connectivity	72
9.	Entrenchment	73
10.	Status of New Impacts	73
E.	Water Resource Quality	73
1.	Attainment Status	74
2.	Causes & Sources of Impairment	83
3.	Point Sources	85
4.	Non-Point Sources	88
5.	Status and Trends	89
IV.	Watershed Impairments	90
A.	Pollutant Load Allocations	90
B.	Habitat Conditions	91
C.	Cuyahoga RAP AOC Beneficial Use Impairments	91
V.	Watershed Restoration and Protections Goals	93
VI.	Implementation	100
VII.	Ohio Coastal Non-Point Pollution Control Plan	100
VIII.	Evaluation	104
A.	Annual Work Plan	104
B.	Water Quality Monitoring	104
C.	Plan Update & Revision	105
IX.	References	106
X.	Appendices	107
A.	Water Quality Data	108
B.	Historic Sites	111
C.	Schools	112
D.	Plants & Animals	113
E.	Doan Brook Watershed Partnership Bylaws	131
F.	Sample DBWP Newsletter	139
G.	Resolutions of Support (when approved)	143

TABLES AND FIGURES

Tables

1. Population in Watershed	11
2. Population Distribution by Age	11
3. Population by Race	12
4. Population Change 2000-2007	12
5. Educational Attainment	14
6. Land Distribution by Municipality	15
7. Soils Classification	27
8. Use Designations	38
9. Land Use	49
10. Traffic Counts of Major Roadways	52
11. Impervious Cover Types	54
12. Impervious Cover by Municipality	54
13. Lake Physical Characteristics	56
14. Stream Characterizations & Classifications	65
15. Dams	72
16. Use Attainment	75
17. Selected Chemistry Results	76
18. Probable Historical Fish in Doan Brook	78
19. Qualitative Habitat Evaluation Index Summary	82
20. Combined Sewer Overflows in Doan Brook	87
21. NPDES Permits in Doan Brook	88
22. Major Culverts	89
23. Pollutant Load Land Use Data	90
24. Step L Model Results	91
25. Beneficial Use Impairments Cuyahoga AOC	91
26. Beneficial Use Impairments Performance Criteria	92

Figures

1. Watershed Location	7
2. Doan Brook Watershed	8
3. Coastal Zone Boundary	10
4. Population Density	13
5. Median Household Income	14
6. Topographic Elevation Change	25
7. Soils Map	28
8. Hydric Soils	29
9. Hydrologic Soils	30
10. Vegetation Classification	32
11. Invasive Vegetation	36
12. Wetlands	38
13. Sub-Watersheds	39
14. Dike 14 Concept Plan	41

15. Rockefeller Park Sub-watershed	42
16. Stream Restoration Cross-Section Concept	43
17. Land Use	49
18. Residential Housing Age	50
19. Regulated Sites	53
20. Impervious Cover	55
21. Buried Streams	60
22. Archeological Sites	61
23. Historic Places & Districts	62
24. Historic and Current Watershed Boundaries	64
25. Stream Profile	66
26. Stream Stability	67
27. Floodplain Lower Watershed	68
28. Floodplain Upper Watershed	69
29. Woodlands in Doan Brook Riparian Corridor	71
30. NEORSD Sampling Locations	74
31. Fish Community IBI Scores	79
32. Macroinvertebrate Community ICI Scores	80
33. Habitat QHEI Scores	81
34. Combined Sewer Overflows	86

Acknowledgements

Thanks to the many partners that made this report possible, particularly the Doan Brook Watershed Partnership board and staff, the Northeast Ohio Regional Sewer District, the Cities of Cleveland, Shaker Heights, and Cleveland Heights, the Nature Center at Shaker Lakes, the Cuyahoga County Planning Commission, Laura Gooch, Lynn Garrity, Julie West, and the members of the various technical advisory committees (see page 22 for more details).

I. Introduction

The Doan Brook watershed sits on the southern boundary of Lake Erie in the City of Cleveland and its adjacent communities, in one of the most urbanized areas in the Great Lakes. The Brook's urban setting allows for the engagement of a large human population in stewarding water resources and in generating innovative solutions for watershed restoration and stormwater management in Cleveland, Cleveland Heights and Shaker Heights.

The Doan Brook Watershed Partnership (DBWP) was formed in 2001 to coordinate restoration and stewardship activities in the watershed and continues to organize comprehensive strategies for the watershed today.

The Doan Brook watershed has been studied over the years by technical experts in fields such as habitat restoration, lake management, urban stormwater, and wastewater best management practices. These studies provide a solid baseline of information that will be valuable in advancing and implementing sustainable strategies toward a clean water economy.

The purpose of the Watershed Action Plan is to compile the studies and work conducted over the years into a comprehensive document. The Plan initiates the process of identifying key priorities, strategies and specific actions that will not only improve the Doan Brook but that will ultimately create new benchmarks in urban watershed restoration and demonstrate practices that will be of benefit across the nation. To learn more about Doan Brook watershed history and its ecological and social profile, visit the Doan Brook Watershed Partnership website at www.doanBrookpartnership.org.

A. Defining the Watershed

Doan Brook stretches nearly 11.3 miles in the eastern part of Cleveland and the adjacent inner-ring suburbs of Shaker Heights, Cleveland Heights and a small portion of Beachwood, all of which are incorporated municipalities in Cuyahoga County, Ohio. Its watershed encompasses 11.9 square miles and is one of six tributaries between the Cuyahoga and Chagrin Rivers that drain directly into Lake Erie. Its stream network is comprised of three branches that originate in Shaker Heights and flow west and northwest through Shaker Heights, Cleveland Heights and Cleveland. Doan Brook is notable for four man-made lakes located on its upstream tributaries: Horseshoe Lake, Green Lake, Marshall Lake and Lower Shaker Lake. Additionally, the watershed holds two lagoons, Wade Park Lagoon and the Rockefeller Park Lagoon in University Circle which fill with city tap water and drain into the Doan Brook. All communities in the watershed have Phase II NPDES stormwater permits, while the Northeast Ohio Regional Sewer District holds all NPDES permits for wastewater treatment and Combined Sewer Overflows.

The watershed has notable sites including, the Cleveland Lakefront Nature Preserve, Rockefeller Park, University Circle, the Shaker Lakes and Parklands, and the Doan Brook gorge each providing its own distinct contribution and impact to the watershed and its water quality.

Figure 1. Doan Brook Watershed Location

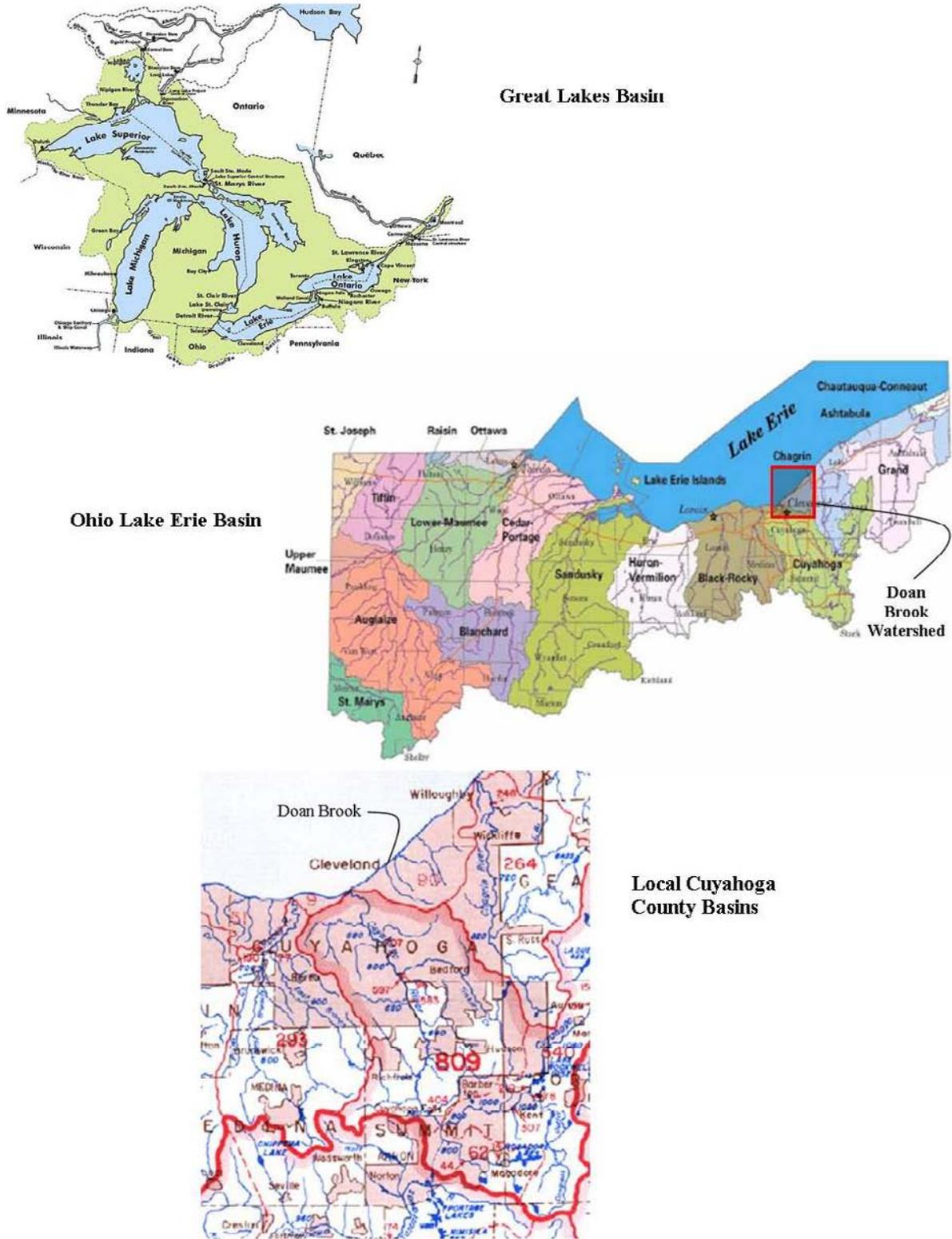
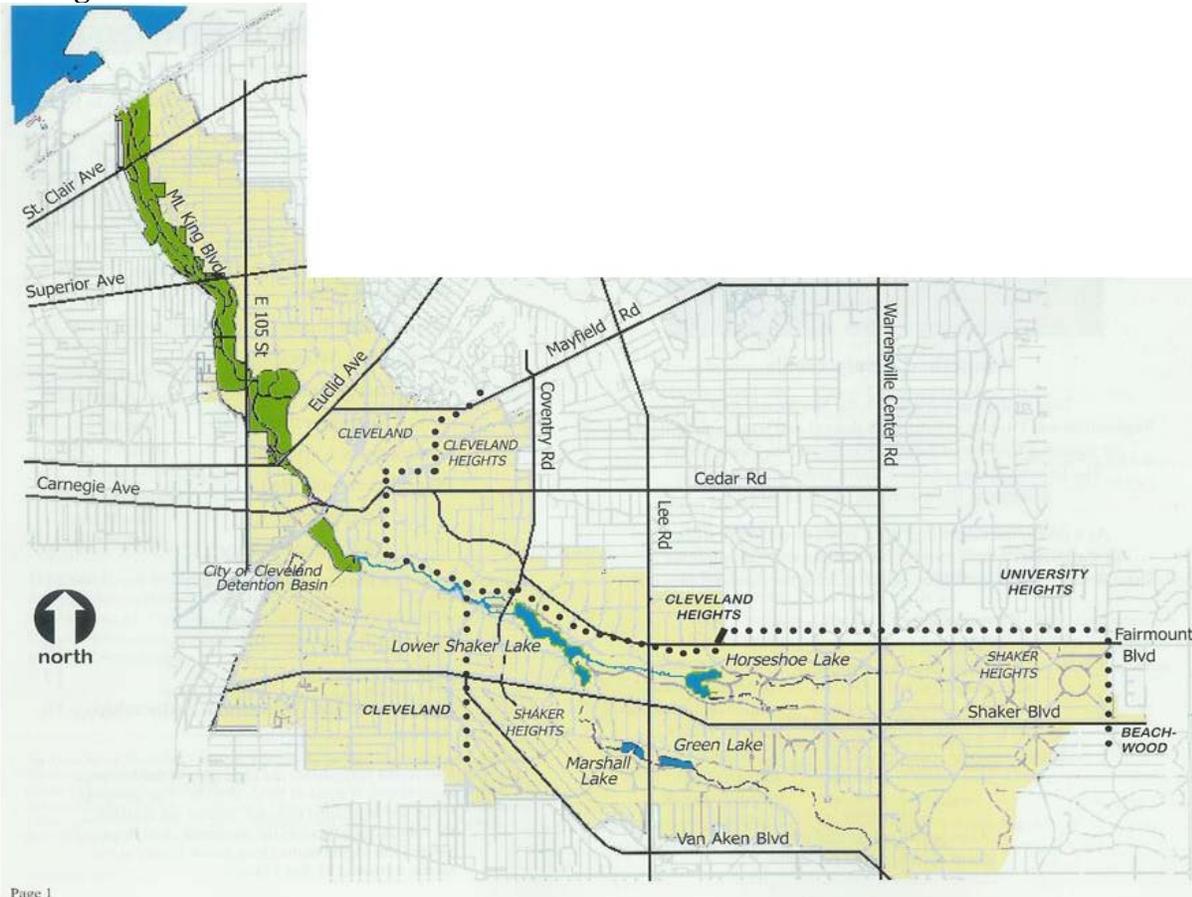


Figure 2. Doan Brook Watershed



B. Administrative Boundaries

Special Districts

The watershed contains several special districts that administer programs and services for the municipalities. The list below identifies these districts and their purpose.

Northeast Ohio Regional Sewer District

The Northeast Ohio Regional Sewer District (NEORS) provides regional sanitary sewer services within the Doan Brook watershed. In the past ten years, The Sewer District has produced a number of plans that target watershed improvements related to reduction of point source pollution and storm water management. These studies include the Regional Intercommunity Drainage Evaluation (RIDE Study), Easterly CSO Control Facilities Plan and the Doan Brook Watershed Study. The Sewer District is also in the process of implementing a Stormwater Management Program for its service area, which will initiate projects and allocate funding for regional stormwater drainage improvements. The Program is expected to be implemented in 2013.

Northeast Ohio Areawide Coordinating Agency

The Northeast Ohio Areawide Coordinating Agency (NOACA) is the federally designated Metropolitan Planning Organization (MPO) for five counties of Northeast Ohio, which include Greater Cleveland and the Lorain area. Its chief functions are to perform long- and short-range transportation planning, transportation-related air quality planning, and areawide water quality management planning, as defined by federal and Ohio mandates. NOACA also administered and prepares the 208 Water Quality Plans for the five county region.

ODOT District 12

The Ohio Department of Transportation Local District provides maintenance, upgrades and engineering studies on the watershed's major roadways, highways and bridges.

Ohio Department of Natural Resources

The State of Ohio Division of Parks manages the Cleveland Lakefront State Park system which includes land at the mouth of and adjacent to Doan Brook.

Ohio EPA Northeast District

Ohio EPA provides sampling and regulatory review of permits within the watershed that pertain to NPDES, Phase II Stormwater, air, and surface water including wetlands and streams. The Ohio EPA also conducts monitoring within the watershed to evaluate water quality conditions.

Cuyahoga Soil & Water Conservation District

The SWCD leads conservation and education activities for aquatic and land resource stewardship within the watershed and throughout Cuyahoga County.

Cuyahoga County

Various county agencies provide services and administration for a variety of programs related to watershed health and community development. These programs address the needs of local municipalities and their residents. The following agencies provide services related to these issues:

- County Board of Health
- County Department of Development
- County Engineer
- County Planning Commission
- County Solid Waste District

All of these agencies and districts will continue to work closely with the DBWP, its partners and the watershed municipalities to ensure that watershed stewardship considerations are reflected in their programs and services.

Schools

The Doan Brook watershed includes three major school districts, Cleveland, Cleveland Heights-University Heights and Shaker Heights along with several private schools. A listing and map of all of the schools located within the watershed is included in the Appendix C of this report.

Audubon Important Bird Area

Three locations in the Doan Brook have been recognized by Audubon's Important Bird Area designation program for exceptional bird habitat. Doan Brook's sites include the Cleveland Lakefront State Park Nature Preserve, Gordon Park and the Shaker Lakes.

Shaker Lakes Nature Center Environmental Education Landmark Designation

In 1971 the National Park Service of the United States Department of the Interior named the Nature Center at Shaker Lakes a National Environmental Education Landmark, one of the first organizations to be recognized by the Park Service. In addition, the Park Service designated the Nature Center a National Environmental Study Area, noting the unique educational opportunities offered by the diverse habitats found in such an urban setting. The parklands are also registered on the Register of National Historic Sites. (Source: www.shakerlakes.org)

Lake Erie Coastal National Scenic Byway

The Lake Erie Coastal National Scenic Byway travels across the lower Doan Brook watershed along Lakeshore Boulevard to Martin Luther King Boulevard and onto Interstate 90.

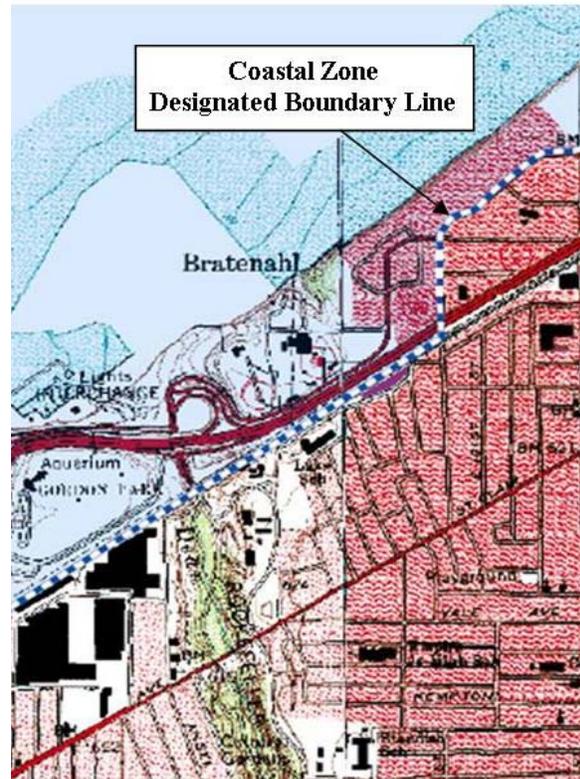
Ohio & Erie Canal National Heritage Corridor

As part of the Management Plan established in 2000, the lower Doan Brook watershed is part of the nationally designated Ohio & Erie Canal National Heritage Corridor.

Ohio Coastal Management Zone Area

The lower portion of the watershed is within the state and federally designated Coastal Zone Management Area boundary as established by the Ohio Coastal Management Program administered through the Ohio Department of Natural Resources and established by the Coastal Zone Management Act of 1972. The Coastal Program outlines management objectives to sustain and protect the coastal zone. Also, the Doan Brook watershed is within the Coastal Nonpoint Source Pollution Control Area administered by ODNR. Figure 3 presents the Coastal Zone boundary for Doan Brook. This plan will outline the goals to meet the objectives of the Coastal non-point pollution control priorities.

Figure 3. Coastal Zone Boundary



Source: ODNR, Office of Coastal Management.

International Joint Commission Designated Area of Concern

As directed by the International Joint Commission and the Great Lakes Water Quality Agreement (GLWQA) established in 1987, Doan Brook has been designated as part of the Cuyahoga Area of Concern (AOC). As defined in Annex 2 of the GLWQA an “Area of Concern means a geographic area that fails to meet the General or Specific Objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use or of the area’s ability to support aquatic life.” The Agreement outlines fourteen beneficial uses to meet water quality standards of the Great Lakes. This plan will outline implementation strategies to address the beneficial use impairments in Doan Brook to assist in meeting the objectives of the Great Lakes Water Quality Agreement.

Stormwater Regulatory Compliance

All of the municipalities within the Doan watershed are considered Municipal Separate Storm Sewer System (MS4) communities and are required to meet the USEPA NPDES Phase II Stormwater Compliance program objectives.

C. Demographics

Population

The Doan Brook watershed has approximately 63,920 people residing within its boundaries according to the U.S. Census 2010. The population is distributed among the communities as follows:

Table 1. Population residing within the Doan Brook Watershed, 2010

City	Population
Beachwood	594
Cleveland	37,406
Cleveland Heights	9,866
Shaker Heights	16,054

Source, U.S. Census Bureau 2010, Cuyahoga County Planning Commission

Table 2. Population Distribution by Age in the Doan Brook Watershed, 2005-2009

Age	Population
Under 5 yrs old	5,718
Age 5 to 17	13,358
Age 18-21	6,666
Age 22-29	10,417
Age 30-39	9,621
Age 40-49	11,552
Age 50-64	13,735
Age 65 and up	10,547

Source: U.S. Census Bureau, 2005-2009 American Community Survey; Cuy. Co. Planning Comm.

Table 3. Population by Race within the Doan Brook Watershed, 2010

Race	Population
White	26,173
Non-White	37,747

Source: U.S. Census Bureau 2010, Cuyahoga County Planning Commission

The population of the Doan Brook watershed reflects patterns typical of Cuyahoga County but also shows the diversity that makes the Doan Brook watershed a desirable place to live and work. The percentage of non-white population is 38% which reflects the cultural and ethnic diversity within the Doan Brook watershed. In fact, the watershed contains people who represent both extremes of the socio-economic spectrum. From an economic perspective, some the wealthiest and poorest residents in the State live in the watershed.

Population projections for Cuyahoga County issued by the Ohio Department of Development reflect the continuing decline in population in Cuyahoga County with estimates of 1,356,860 in 2005 to 1,309,640 projected for 2015. The communities in Doan Brook are not immune to this estimated decline, but due to their large base of institutions and good housing stock, it will have less impact.

Table 4. Population Change in the Doan Brook Watershed, 2000-2010

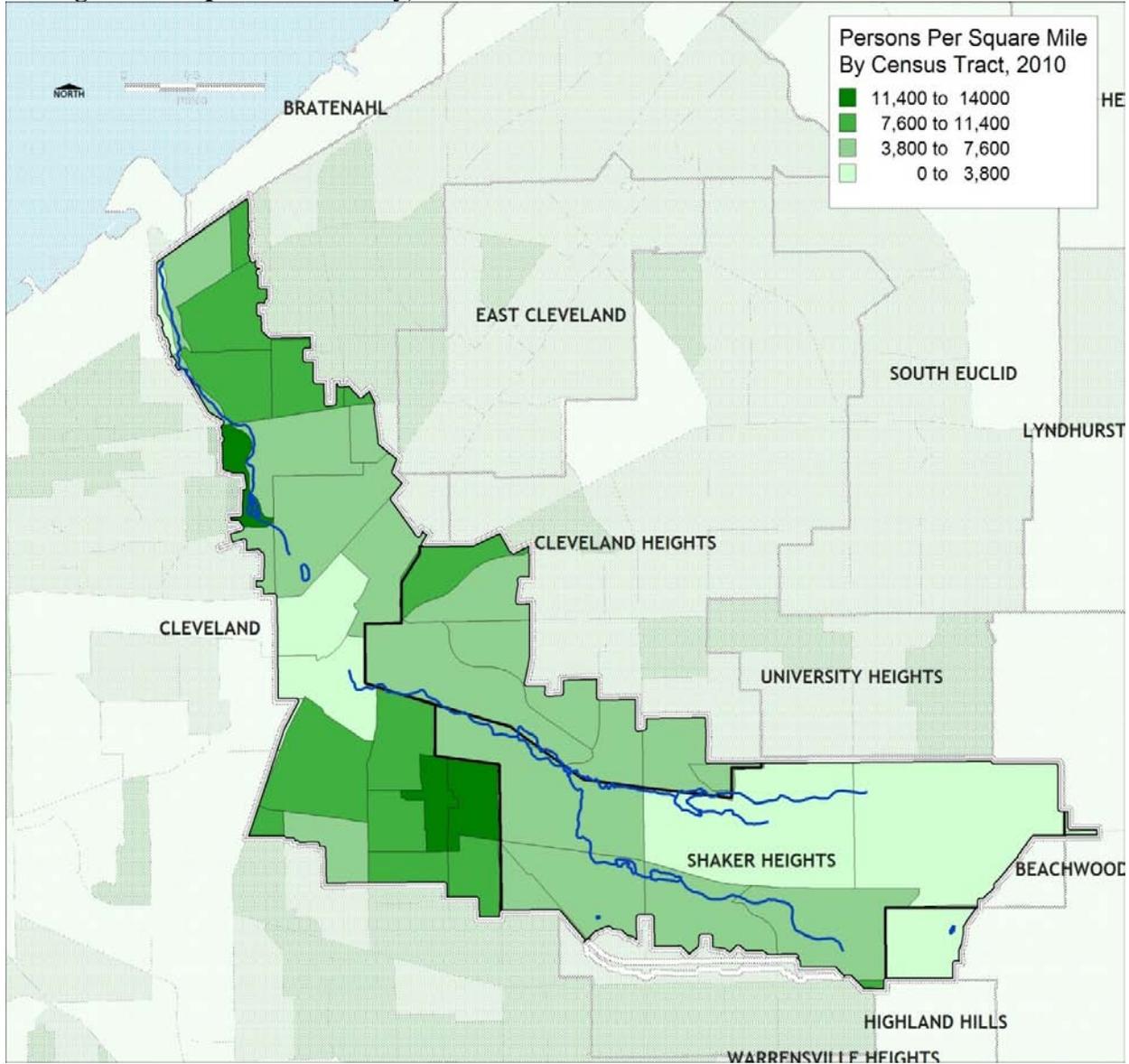
City	Population Change 2000-2010
Beachwood	1.0%
Cleveland	-25.7%
Cleveland Heights	10.0%
Shaker Heights	-3.4%

Source: U.S. Census Bureau 2010, Cuyahoga County Planning Commission

Population Density

The population density within this small area contributes to urban stormwater issues that have a significant deleterious impact on the Doan Brook and eventually on Lake Erie. The density ranges from zero to 13,310 people per square mile in the watershed with an average of 5,376 persons per square mile. This is one of the densest human populations within any watershed of the Lake Erie Basin. Comparing it to other Ohio Lake Erie watersheds, the Old Woman Creek Watershed of 27 square miles has an estimated 127 persons per square mile and the Chagrin River Watershed has 621 people per square mile. Hence the restoration and best management practice approach will represent a redesign of urban settings to rebuild impaired ecosystem services.

Figure 4 . Population Density, 2010



Source: Cuyahoga County Planning Commission

Economic Patterns, Income and Education

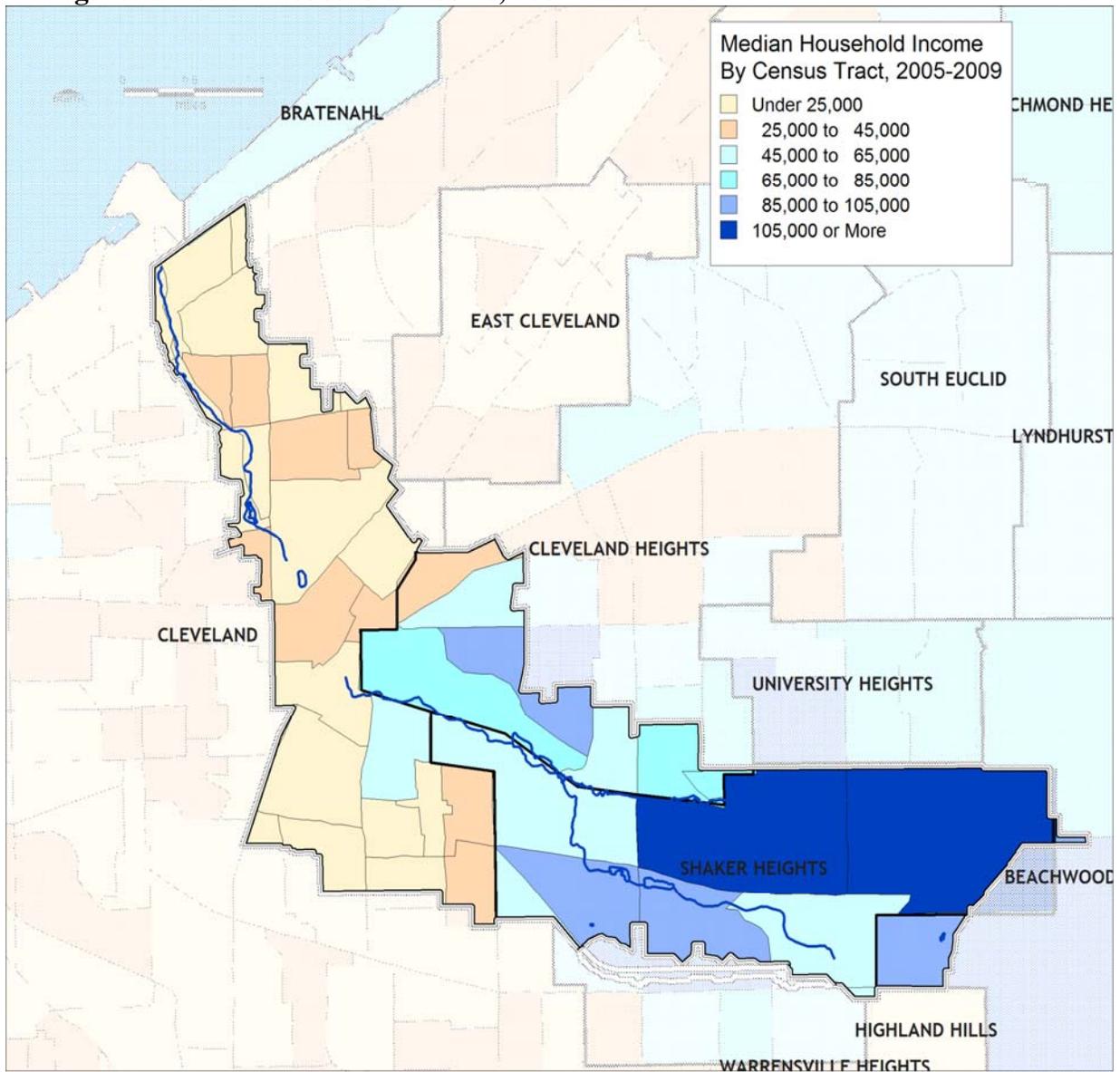
The Doan Brook watershed has a diversity of household incomes from the lower watershed to the upper watershed as shown in Figure 5. Education levels of the residents of Doan Brook reflect a high number of college graduates with over 50% of the watershed population holding professional degrees. Table 5 shows the distribution of educational attainment within the population over 25 years of age in the watershed.

Table 5. Educational Attainment, Doan Brook Watershed, 2000

Persons aged 25 and over	52,374	100%
Persons with <9 th grade education	1,234	2.4%
Persons with 9 th -12 th grade education	5,879	11.2%
Persons with high school degree	11,223	21.4%
Persons with some college	8,875	16.9%
Persons with associates degree	2,577	4.9%
Persons with bachelors degree	10,142	19.4%
Persons with graduate professional degree	12,444	23.8%

Source: U.S. Census Bureau, 2005-2009 American Community Survey; Cuy. Co. Planning Comm.

Figure 5. Median Household Income, 2005-2009



Source: Cuyahoga County Planning Commission

Watershed Work Force

The Doan Brook watershed is home to a large and robust work force. It will be important to engage the professional and commercial sectors in watershed stewardship, even though some may reside outside of the Doan Brook watershed. The activities of a work day often have as great an impact on local water quality as activities associated with being at home. It is estimated that there are 42,956 employees and 2,042 businesses in the watershed. (Source: Applied Geographic Solutions, 2009)

Locations of Growth

As an urbanized watershed, no additional new development growth will likely occur. However, redevelopment growth is highly anticipated and discussed in the land use section of this report (p. 48).

D. Geographic Locators

The Doan Brook watershed is located in Cuyahoga County, Ohio and is considered a direct Lake Erie tributary. It travels primarily through three cities, Cleveland, Cleveland Heights and Shaker Heights. As part of Ohio EPA’s 2010 Integrated Report, the Doan Brook watershed is part of the hydrologic unit (HUC) 04110003 05 04, which is titled “Doan Brook-Frontal Lake Erie.”

The longitude and latitude at the mouth of Doan Brook at Lake Erie, are -81° 38’ 41.00” and 41° 32’ 32.00” respectively.

Table 6. Land Distribution by Municipality

City	Square Miles	Percentage of Watershed
Beachwood	0.31	2.6%
Cleveland	5.03	42.3%
Cleveland Heights	1.94	16.3%
Shaker Heights	4.61	38.8%
Total Watershed	11.89	100.0%

Source: Cuyahoga County Planning Commission

E. Previous Watershed Management Activities

The Doan Brook watershed is fortunate to have had many committed stewards, grassroots advocates and scientists work to understand and protect it. The networks and data that have accumulated throughout the years of focus provide an opportunity to create a more thorough Watershed Action Plan than has existed up to this point. The Northeast Ohio Regional Sewer District, the City of Cleveland and the Doan Brook Watershed Partnership have conducted numerous assessments and studies of watershed conditions in order to identify its priorities and further community awareness and stewardship. Two significant studies include the *Doan Brook Watershed Study*, conducted by the Northeast Ohio Regional Sewer District in 2001, and the *Doan Brook Handbook*, authored by Laura Gooch (2001), both of which were used as sources in

compiling this Watershed Action Plan. The Watershed Study includes segmented stream reach assessments and site specific plans for restoration, best management practices and community outreach. Other past studies include the *Upper Shaker Lakes Drainage Basin Study*, and *Non-Point Source Pollution Control Plan: South Branch Doan Brook and Green and Marshall Lakes*.

Community-wide planning efforts, led by partners and other institutions, need to be understood and, where appropriate, incorporated into the Doan Brook Watershed Action Plan. Several planning projects currently underway include the development of the Northeast Ohio Regional Sewer District's Stormwater Management and Green Infrastructure Programs, the Rockefeller Park Strategic Master Plan, the Dike 14 Concept Plan, the Cleveland-Cuyahoga Port Authority Port Relocation Plan, the Reconfiguration of the East 105th-Martin Luther King Intersection, the Lake to Lake Bike Trail, the Glenville Strategic Investment Initiative, Transportation for Livable Communities Plan and the ReImagining Cleveland Land Re-Utilization Plan. Each of these plans potentially shapes the future of Doan Brook.

In addition to the studies and planning activities, the Doan Brook Watershed Partnership has completed three stream restoration projects since 2005. These include 500 feet of degraded stream channel at Shaker Heights Country Club and 400 feet at the Shaker Schools Campus that were bio-engineered to regain natural stream functions, including a stable stage-two channel with riffle/run sequences, meanders and floodplain access. In addition, 70 feet of eroded streambank were re-vegetated and stabilized at Southerly Park, along the South Branch. These projects successfully brought the DBWP, local property owners, and other community partners together with Ohio EPA and other funding sources. In 2010 the City of Shaker Heights incorporated 62 feet of stream restoration into a repair of an eroding stream bank along South Park Boulevard. To learn more about past projects and view photo galleries, visit the Doan Brook Watershed Partnership website at www.doanBrookpartnership.org.

II. Watershed Plan Development

A. Doan Brook Watershed Partnership

The Doan Brook Watershed Partnership (DBWP) has built and benefited from an extensive network of community alliances. Our extended network includes the Cuyahoga Soil and Water Conservation District, Cleveland State University, Case Western Reserve University, John Carroll University, scores of local grade and high schools, the Holden Parks Trust, Earth Day Coalition, Rockefeller Park Greenhouse, Cultural Gardens Federation, Dike 14 Committee, Glenville Development Corporation, Famicos, St. Clair Superior Development Corporation, Parkworks, Cuyahoga County Planning Commission, the County Board of Health, EcoCity Cleveland, Environmental Health Watch, the Holden Arboretum, the North Union Farmer's Market, Ohio Prairie Nursery, Busy Bee Tree Company, and countless local businesses and citizen volunteers.

It is important to underscore the invaluable contribution that citizen volunteers have made to the protection of the Doan Brook watershed. The collection of individuals who have stepped forward to dedicate time, expertise and financial support is undoubtedly the backbone of the

DBWP. A great diversity of people, representing both extremes of the socio-economic spectrum, the age spectrum and the expertise spectrum have restored vegetation, bagged trash, collected data, advocated, educated, painted, written, performed, hiked, biked, marched etc., to guide the Doan Brook towards health.

Doan Brook Watershed Partnership

Mission: The Doan Brook Watershed Partnership is a multi-stakeholder non-profit organization protecting and restoring Doan Brook and its watershed.

Vision: The Doan Brook and its watershed will be regionally sustainable from an environmental and financial perspective and will be viewed as major community assets.

Focus Areas: Goal 1) Dynamically increase public awareness of, and serve as a collective voice for, Doan Brook and its constituencies. Goal 2) Facilitate and support restoration projects, with an eye towards environmental justice, which is documented through the creation of a watershed information clearing-house. Goal 3) In order to work towards goals 1 and 2, develop solid infrastructure – board, committees, volunteers, staff, and operating procedures to support the work of the organization.

The DBWP “Grand Vision”

The Doan Brook Watershed Partnership celebrates the beauty and function of the Doan Brook watershed. The culturally rich history that evolved along the Doan Brook demonstrates its important influence in shaping the character of our community.

Because the Doan Brook Watershed drains to the globally unique and valuable Lake Erie and Great Lakes Watersheds, the DBWP commits to protect and restore the Brook. The Doan Brook Watershed supports our local, communal health as well as the entire Great Lakes system.

As the region works to preserve the bio-diverse, fresh-water resources of Lake Erie as an underpinning of regional revitalization; the DBWP will focus on restoring ecosystem services within the Doan Brook Watershed to further local sustainability goals. Specifically, the DBWP encourages watershed activities, which will celebrate and quantify the Brook’s critical role in culture, economics and individual well-being. It is hoped that DBWP activities will imbue people with a sense of place, connect them to our local hydrology, and inspire them towards stewardship of abundant, clean water.

Structure/Organization/Administration

The DBWP was formed in March, 2002 and granted 501c3 non-profit status in April, 2003 for the purpose of coordinating and advocating for the protection and restoration of Doan Brook, its riparian parklands and surrounding watershed. In addition to the three Doan Brook watershed cities, Cleveland, Cleveland Heights, and Shaker Heights, the organization’s leadership consisted of representatives from community organizations and the general public. From its inception, the DBWP Board leadership has grown to include additional community partners.

During its first several years, the work of the DBWP was guided by its “*Action Plan for the Doan Brook watershed for the Period May, 2003 – April, 2006*”. The bulk of the plan endeavored to fulfill twelve restoration and education goals of an ambitious EPA 319 grant. At the close of the three year Action Plan period, the DBWP Board held a planning retreat in June,

2006 to update the Action Plan for the future. The work of the retreat revealed, however, that with the imminent departure of the DBWP's first Executive Director and the imminent completion of the 319 grant, it was an important moment to re-examine the mission, vision, operating structure and overall role of the partnership in the community. Thanks to generous funding from the Cleveland Foundation, DBWP retained the services of Janus Small to develop a strategic planning process with the Board.

Over the course of a year (November 2006-February 2008), the DBWP planning process included six planning Team sessions with the full DBWP Board. Between sessions, the Board gathered external information, interviewed fifteen regional watershed groups, and worked in sub-committees to re-examine every element of the organization's past vision and operations.

In March 2008, the Board approved the new vision, grand vision, set of goals, and board structure below:

Board Composition: A total of sixteen representatives now serve on the DBWP board, up from eleven. The representation from government and regional planning include two representatives from each of the three cities and one from the NEORS. Four citizen representatives were selected based on their commitment to the DBWP mission. All citizen representatives reside in the watershed, with equal distribution between lower and upper sections. One representative from each of the following partner organizations also serve on the DBWP: Cleveland Museum of Natural History (CMNH), Cleveland Botanical Garden (CBG), Cuyahoga Remedial Action Plan (RAP), Nature Center at Shaker Lakes (NCSL) and University Circle Incorporated (UCI).

Operations, Staffing and Membership:

- Board meets six times per year.
- Executive Committee meets six times per year (made up of the five officers: Chair, President, Vice-President, Secretary, and Treasurer).
- Executive Director prepares program & budget plan mid-year for the following year and reports to DBWP board; specifically to the President and Executive Committee.
- NCSL Support: Efficiencies are gained through an operational arrangement between the DBWP and the NCSL. In addition to an office, parking and access to meeting space, administrative, IT, facility maintenance, payroll and bookkeeping support will be available to DBWP through a Memorandum of Understanding (MOU) with the NCSL. Watershed planning, education and restoration expertise are available to the NCSL through DBWP staff. Outside of the terms of the MOU, the NCSL and the DBWP are enthusiastic about opportunities to combine marketing, grant-writing and watershed projects when appropriate.
- The DBWP membership list is approximately 5000 individuals, though this is expanded to the Nature Center's 15,000 member database through shared e-blasts and newsletter opportunities. The DBWP endeavors to reach out to memberships of the institutions represented on its Board.

Committees:

- The DBWP Board and the Executive Director have formed working committees that are suited to the needs of individual projects. Over the years these have included a Technical Committee, a Lower Doan Brook Committee, an Awareness Committee, a Parklands Management Committee and a Grants Management Committee.

The Partnership has an Executive Director, Victoria Mills, who manages the day to day activities for the DBWP and administers the watershed work plan. The DBWP contact information is: 2600 South Park Blvd., Cleveland, OH 44120, www.doanBrookpartnership.org, 216.321.5935 x234.

List of Board Members, 2012

Darnell Brown, City of Cleveland, Chair *
Nancy Moore, Councilwoman City of Shaker Heights, President *
Karen Knittel, City of Cleveland Heights, Vice President *
David Beach, Green City Blue Lake Institute, Cleveland Museum of Natural History, Secretary *
Laura Gooch, At-Large Citizen Representative, Treasurer *
Dorothy Adams, At-Large Citizen Representative
William Boag, City of Shaker Heights
Chris Bongorno, University Circle, Inc
Bonnie Caplan, Councilwoman, City of Cleveland Heights
Kay Carlson, Nature Center at Shaker Lakes
Nancy Deitrich, At-Large Citizen Representative
Jeff Johnson, Councilman, City of Cleveland
Stacey Polk, At-Large Citizen Representative
Geri Unger, Cleveland Botanical Garden
Jane Goodman, Cuyahoga River Community Planning Organization
Betsy Yingling, Northeast Ohio Regional Sewer District
Victoria Mills, Executive Director, Doan Brook Watershed Partnership
* Executive Committee

Public Outreach Activities

The Joint Committee on Doan Brook, with their sustained focus on Doan Brook between 1960 and 1990, encouraged the Nature Center at Shaker Lakes to incorporate the Brook into its curricula. In 1997, to accompany the NEORSD's Doan Brook Study, the NCSL created the "Year of the Brook," an awareness campaign to educate the public about their local "ecological address", the watershed. Throughout 1997 citizens participated in a Doan Brook press conference, two visioning sessions, a four-evening technical course on the Doan, a Watershed Tour and Ice Cream Social, a Hike-A-Thon, multiple Brook walks along the entire length of the stream, volunteer restoration projects, and several special events such as Parade the Circle, EarthFest '98, Shaker Heights Regatta, and the Glenville Festival.

Since the Year of the Brook, the Nature Center at Shaker Lakes and the DBWP have continued and developed Doan Brook public outreach and education. Watershed citizens have participated in a non-point source Sustainable Backyard Program, an annual symposium on sustainable

landscaping, an annual State of the Watershed presentation, storm drain stenciling, volunteer stream monitoring, stream clean-ups, and restoration activities such as planting and rain-garden construction. The DBWP posted “Brook crossing” signs along the Doan Brook and writes articles for various media outlets. DBWP publishes a semiannual newsletter, entitled Brooknotes, and actively updates the www.doanBrookpartnership.org website and Facebook page. The DBWP has been recognized throughout its constituent communities for hosting several annual events. The Spring Stream Sweep and Family Fishing Derby in Rockefeller Park are central to community engagement and attract large crowds every year. For all of its events, the DBWP engages community partner organizations, like the Cleveland Botanical Garden, the Cleveland Museum of Natural History, University Circle Inc., the Northeast Ohio Regional Sewer District, the Cuyahoga RAP, the Community Development Corporations and the aforementioned Nature Center at Shaker Lakes.

Future Funding and Sustainability Strategy

The Doan Brook Watershed Partnership’s future vision was examined by its staff and Board through strategic planning activities, both in 2001 and in 2009. The strategic plans for the DBWP’s organizational structure, technical, programmatic and financial goals were outlined to keep the small non-profit strong and effective. The Partnership recognizes the need to diversify its funding. To achieve a diversified financial portfolio, the Partnership has established the following strategies:

The Partnership has a well-established financial support agreement with the three primary communities, Cleveland, Cleveland Heights, and Shaker Heights. In 2010 it began what is hoped to be a long-term funding relationship with the Northeast Ohio Regional Sewer District. NEORS has a Watershed Operating Support Grants program that supports operating expenses of local watershed groups within its service district. The DBWP successfully applied to this grant funding source for 2010 and 2011, and will apply again in 2012.

The Nature Center at Shaker Lakes and the DBWP enjoy a particularly close working relationship. Not only do the two organizations consistently provide programming together, but they have formalized their collaboration with a Memorandum of Understanding (MOU). Through the MOU, each organization has agreed to independent reciprocal roles of support.

The last aspect of the Partnership’s financial sustainability is its pursuit of foundation and government grants at the local, state and federal levels. The Great Lakes Restoration Initiative provides an unprecedented opportunity for Great Lakes Watersheds with projects that address water quality, habitat restoration and best management practices. By early identification of projects and partnerships in the watershed, the Doan Brook Watershed Partnership looks to pursue grants and support and leverage grants written by partner organizations within the watershed.

Community foundation support will continually be sought to help the Partnership fulfill its mission. DBWP will target community foundations that best align with Doan Brook goals and objectives.

The Doan Brook Watershed Partnership has established itself over the past five years as a financially responsible and valued watershed service provider that will work to advance its potential for financial sustainability in the future.

B. General Plan Contents

The Doan Brook Watershed Action Plan provides a description of the watershed, its impairments and their causes and sources, as required by the ODNR Appendix 8 guidelines. The Plan then establishes the concept approach and activities to fulfill the mission to restore, protect and manage the watershed for future generations.

Outline of the Plan

Watershed Inventory: This section assesses and examines the social, cultural, recreational and environmental conditions of Doan Brook that influence the water resource quality and its stewardship. To better organize the status and goals of the watershed, it was divided into seven sub-watersheds.

Impairments: This section provides the results of the Inventory Assessment, past watershed studies and the review of Beneficial Use attainment as determined by the Great Lakes Water Quality Agreement.

Water Restoration & Protection Goals: This section outlines targeted goals for Doan Brook to work toward to meet water quality standards based upon the Inventory and Impairment findings.

Implementation: This section outlines the recommended actions, both short term and long term, to implement the goals and objectives established for the watershed. These actions identify funding, lead stakeholders, estimated timelines and estimated targeted measurable water quality benefits. Additionally, this section outlines the Coastal Non-Point Source Pollution Prevention Goals and the Beneficial Uses Goals as part of the Cuyahoga River's Area of Concern.

C. Endorsement and Adoption of Plan

The Doan Brook WAP is the product of significant efforts by many individuals, organizations and communities, which commit to improve the health of the Doan Brook and its watershed, year in and year out. Data, ideas, reviews and guidance were given freely and were critical to creating the strong strategy articulated by this plan. For this reason, it is important that our contributing partners formally support the Doan Brook WAP. Resolutions of Support will be requested from the City of Cleveland, the City of Cleveland Heights, the City of Shaker Heights, the Northeast Ohio Regional Sewer District, the Cleveland Museum of Natural History, the Nature Center at Shaker Lakes, the Cleveland Botanical Garden, the Cuyahoga RAP, and University Circle Inc. The DBWP will pursue the adoption of Resolutions when the WAP is submitted to the State of Ohio for approval.

In many regards, this Draft WAP has been informally adopted since the DBWP's inception and is implemented through the myriad of policy, education and restoration activities, that are both already completed and in progress. The WAP has honed the focus of our work and that of our community partners. With the completion of this WAP, the DBWP has a better way to communicate our work and mission to the public. As we execute the WAP, we will update the public through outreach events and our communication outlets, such as online social media, the DBWP website and our newsletter.

D. Public Outreach During Plan Development

Throughout the development of the Doan Brook Watershed Action Plan, the DBWP authors sought feedback from four primary groups. Three of the groups, whose members are listed below, are considered Technical Advisory Committees (TACs), including the Professional Peer TAC, the Northeast Ohio Regional Sewer District TAC, and the DBWP TAC. The public comprised the fourth group to comment and provide input to the many draft stages of the WAP. The consistent input from each of these diverse groups inserted important ideas, concerns and questions.

The DBWP TAC was updated on the WAP development bi-monthly at Board meetings, with approximately two working meetings per year devoted to refining WAP goals. The Professional Peer TAC met once a year for three years. And the NEORSR staff reviewed drafts twice throughout the writing process. WAP drafts and updates were presented to the general public, annually, at the DBWP Annual Meeting. Every meeting included a public comment and discussion period. In addition the public was invited to read and comment on the WAP via the BrookNotes newsletter, a flier that was distributed at public events, annual appeal letters and the DBWP website, www.doanBrookwatershed.org.

Professional Peer TAC:

Jared Bartley, Cuyahoga Soil and Water Conservation District
Amy Holthouse Brennan, Chagrin River Watershed Partners
Sarah Cech, Nature Center at Shaker Lakes
Mike McNutt, Cuyahoga County Board of Health
Dr. Mike Nichols, John Carroll University
Dana Oleskiewicz, Ohio State Extension (only attended the first TAC meeting)
Claire Posius, Cuyahoga Soil and Water Conservation District
Colby Sattler, West Creek Preservation Committee
Dr. Mike Walton, Cleveland State University
Dr. Peter Whiting, Case Western Reserve University
Bill Zawiski, Ohio Environmental Protection Agency

Northeast Ohio Regional Sewer District TAC:

Technical staff at the NEORSR, including the Water Quality and Industrial Surveillance and the Watershed Programs Departments

Doan Brook Watershed Partnership TAC:

Dorothy Adams, Cleveland resident
David Beach, Cleveland Museum of Natural History
Bill Boag, City of Shaker Heights
Chris Bongorno, University Circle Inc.
Darnell Brown, City of Cleveland
Bonnie Caplan, City of Cleveland Heights
Kay Carlson, Nature Center at Shaker Lakes
Nancy Dietrich, Cleveland Heights resident
Laura Gooch, Cleveland Heights resident
Jane Goodman, Cuyahoga River RAP
Jeff Johnson, City of Cleveland
Karen Knittel, City of Cleveland Heights
Victoria Mills, Doan Brook Watershed Partnership
Nancy Moore, City of Shaker Heights
Stacey Polk, Cleveland resident
Geri Unger, Cleveland Botanical Garden
Betsy Yingling, NEORSD

III. Watershed Inventory

A. Description of Watershed

Doan Brook is a direct tributary draining highly urbanized eastern Cuyahoga County, Ohio. It originally drained approximately 9.7 square miles of land and now with the addition of sewers, it drains 11.9 square miles. In fact, Doan Brook is often referred to as a sewershed rather than a watershed. In reality, it is a combination of the two. A sewershed is the area of land that is drained by a storm sewer system. A watershed is the area of land drained as a result of the topography of the land. Doan Brook has a watershed and sewershed that contribute to its water sources. Doan Brook's waterway stretches, across the landscape, with over 9.4 miles along its North Branch. Total stream length, with both branches, is 11.3 miles. Due to the small size of the watershed and the general consistency of land uses, the inventory is presented for the entire watershed unless noted otherwise.

The watershed is situated along the Ohio Lake Erie coast between the major river systems of the Cuyahoga and Chagrin Rivers. It sits adjacent to its sister tributaries of Dugway Brook, Nine Mile Creek and Euclid Creek to the east.

The Brook's Journey through the Landscape

Doan Brook travels through portions of three cities, Cleveland Heights, Shaker Heights and Cleveland before reaching its destination at Lake Erie. Generally, Doan Brook flows northwest along North Park Boulevard from Horseshoe Lake and continues along North Park until North Park merges with Martin Luther King Boulevard. The stream then follows MLK all the way to

Lake Erie passing through two major culverts under University Circle and the Cleveland Lakefront Nature Preserve, as well as several smaller culverts.

Doan Brook is comprised of a sole mainstem branch in the lower watershed and three branches, North, Middle and South in the upper watershed. The North and Middle branches flow in from the east to form Horseshoe Lake, which was created as a mill pond by the Shakers. The North branch begins south of Shelburne Road near Green Road and travels along Shelburne Road. The Middle branch travels along South Park Boulevard after resurfacing at the intersection of South Park and Warrensville Center Road.

Downstream from Horseshoe Lake, the North and Middle branches converge and flow through a wooded corridor that has been designated as a wildlife preserve. Just upstream from the Lower Shaker Lake at the Nature Center at Shaker Lakes marsh, the main stem is joined by the stream's South branch.

Doan Brook's south branch first surfaces from storm-sewer pipes on the Canterbury Golf Club property east of the intersection of South Woodland Road and Belvoir Boulevard. It flows southwest along the west edge of the golf course and then enters into a culvert at the Van Aken Shopping Center. The South Branch is above ground again, starting at the Shaker Country Club until it enters Green Lake southeast of the intersection of South Woodland and Lee Roads. From Green Lake, the South branch continues west into Marshall Lake, then turns north between South Park and West Park Boulevards through Southerly Park and the forest at the Nature Center at Shaker Lakes.

After the North and South branch join at the Nature Center marsh, Doan Brook passes through the Lower Shaker Lake and parallels North Park Boulevard until it flows under MLK Boulevard. The gorge, located just south of North Park, is the most pristine section of the watershed. At the bottom of MLK Blvd., also known as Fairhill, the Brook enters the University Circle culvert and is hidden underground for almost a mile through the Case Western Reserve University campus and Wade Oval. Doan Brook emerges from the culvert just west of the Cleveland Museum of Art, near the intersection of East Boulevard and East 105th Street. The Brook criss-crosses MLK Boulevard through the entire length of Rockefeller Park to I-90. Here the Brook enters a final culvert for a half-mile under the Dike 14 site until it reaches Lake Erie. (Gooch, pp. 19-20)

1. Geology of Doan Brook

a. Topography

The Doan Brook watershed is very similar to its adjacent watersheds, comprised of three main physiographic features that define its topography: the Lake Plains, the Escarpment and the Plateau. The elevation at its final daylight at I-90 is 600 feet and reaches to 1,180 feet near Canterbury Country Club.

Lake Plains

The lower watershed is shaped by the Lake Plain which is the relatively flat area between Lake Erie and Cedar Hill. Its elevation through this section begins at the Lake at 600 feet above sea level and ends at University Circle at an elevation of approximately 680 feet.

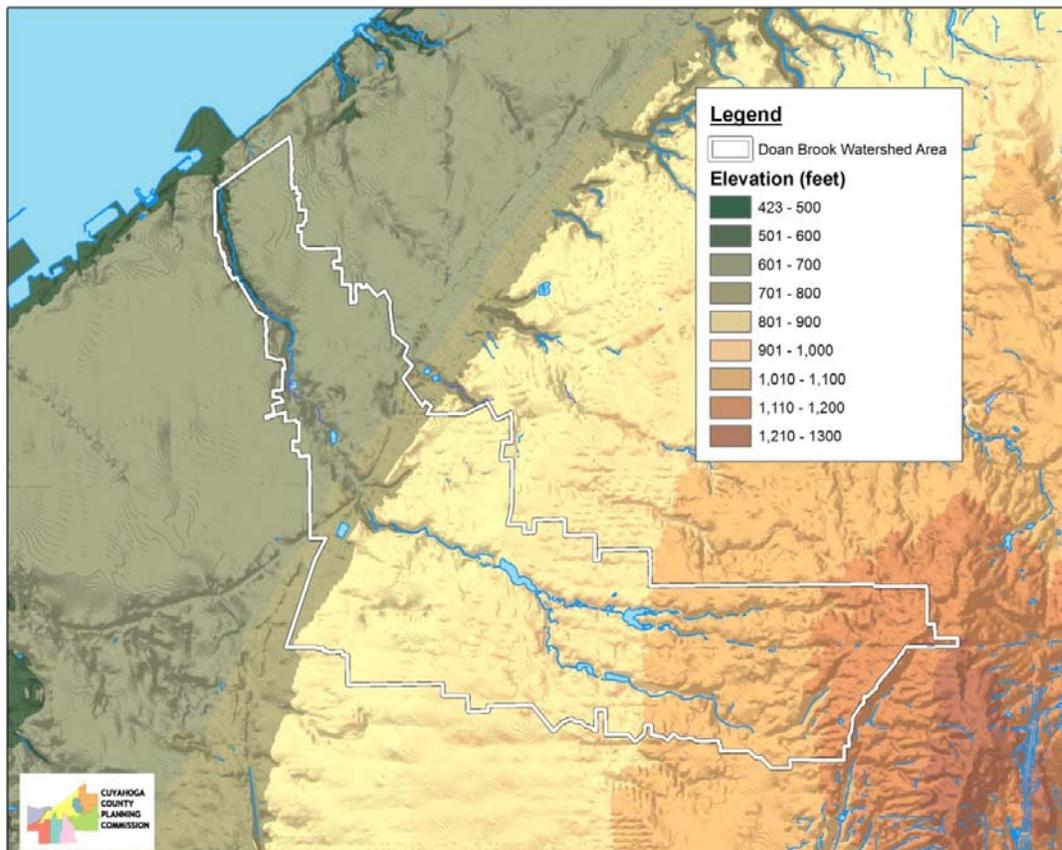
Escarpment

At the southeastern edge of the Lake Plain, the Escarpment begins. The Escarpment extends south and east from the base of escarpment incline, known locally as the bottom of Fairhill, Mayfield and Cedar Roads. Roads at the top of the incline or escarpment include Harcourt Dr., Overlook Rd. and East 124th St. The slope of the land in the upper part of the Escarpment is relatively gentle and long, while steeper and shorter slopes are found as the stream nears the base of the escarpment. The soils along the Escarpment are generally thin tills or silty clay with shale or sandstone bedrock exposed in many places where the stream cuts down through the rock to form a steep and narrow gorge.

Plateau

The Plateau includes the entire upper watershed, upstream of the Escarpment's highest ridge line. The Plateau is the northwest margin of the Appalachian Plateau and is characterized by rolling topography and thin clay, silt, and glacial till soils. Bedrock is generally shale with some sandstone. The boundary between the Escarpment and the Plateau runs northeast and southwest from the intersection of Harcourt Dr. and North Park Blvd. in Cleveland Heights. The Plateau is steeper than in the Lake Plain, but the slopes are gentle enough that the Brook cuts a winding channel through its broad, shallow floodplain (Gooch, p. 27).

Figure 6. Topographic Elevation Change



Source: Ohio Department of Natural Resources, 10-meter Digital Elevation Model, circa 2004.

Source: Cuyahoga County Planning Commission and ODNR

b. Geology

The geology of the Doan Brook watershed is similar to other Lake Erie tributaries in northeastern Ohio. The upper reaches of the watershed lie in the glacial tills that thinly coat the sedimentary bedrock of the Appalachian Plateau's western margin. The sedimentary layer consists of Meadville Shale, Sharpsville Sandstone and Orangeville Shale that were laid down beneath the ancient sea about 330 million years ago.

Toward the western part of the upper watershed, downstream from the Lower Shaker Lake where the Escarpment begins, the land becomes steeper, causing the Brook to cut a narrow gorge through older rock units and expose the watershed's shales. Orangeville Shale, Berea Sandstone, Bedford Shale, including Euclid Sandstone, Cleveland Shale, and Chagrin Shale are all exposed as Doan Brook flows toward Lake Erie.

The Lake Plain section of the watershed, downstream from the Escarpment changes from silty-clay till to layered silts, clays, sands and gravels that were deposited at the bottom of an ancient and larger Lake Erie. The total thickness of these deposits in the lower watershed varies from a few feet to as much as 600 feet near the mouth of the Brook. As Lake Erie receded across the Lake Plain during the glacial period, deposits of till were left (Gooch, pp. 25-26).

c. Soils

Soils found in the upper Doan Brook watershed consist almost entirely of glacial tills. In the lower watershed, soils are primarily composed of intermixed layers of lacustrine silts, clays and fine sands deposited by the ancient glacial Lake Erie. The presence of lacustrine materials that are intermingled with sand and till indicates that the Lake Erie periodically fluctuated between retreat and glacial advancement.

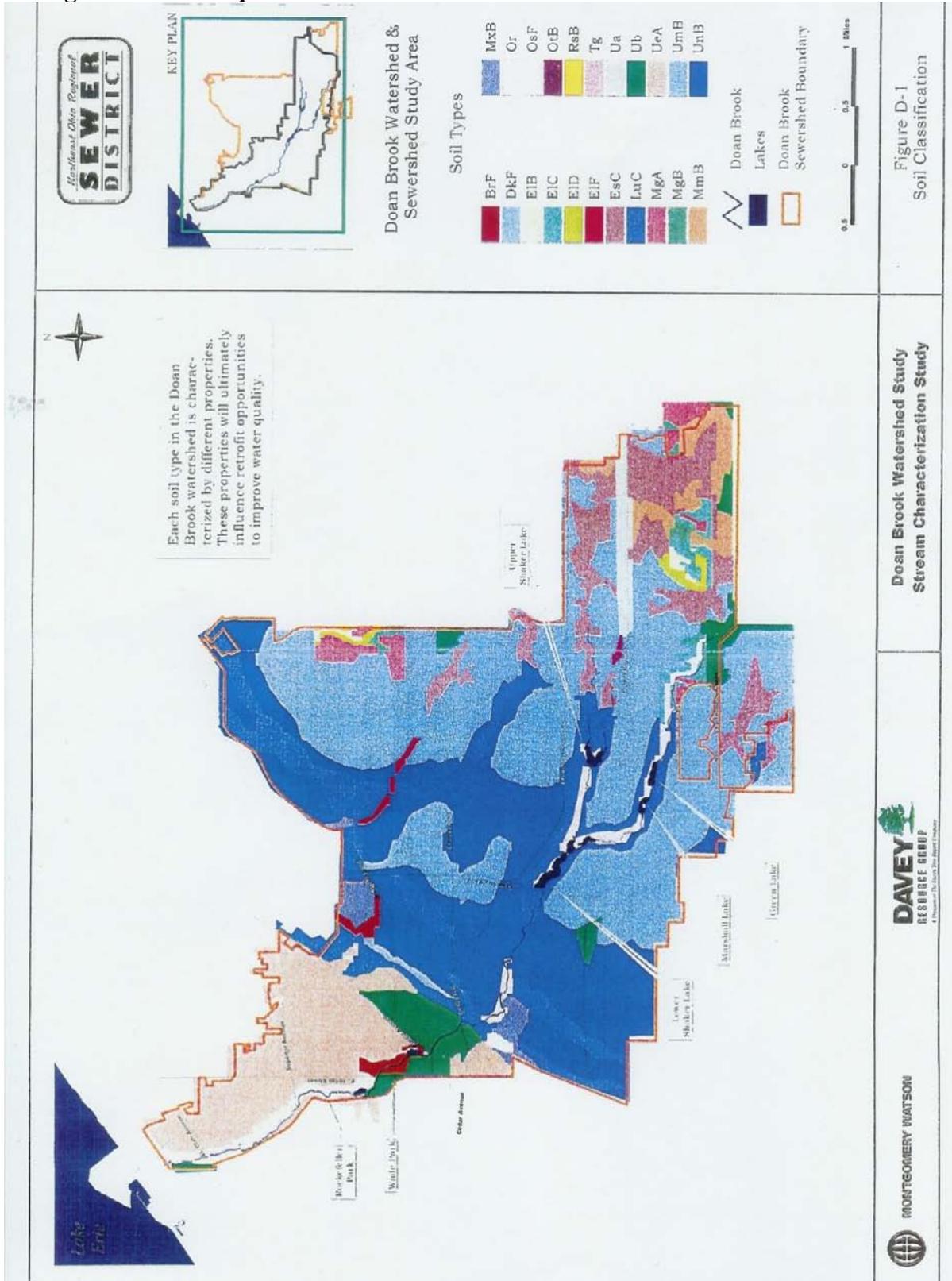
Soils identified within the Doan Brook watershed include the following: Brecksville, Dekalb, Ellsworth, Loudonville, Mahoning, Mitiwanga, Orrville, Oshtemo, Rittman, Tioga, Udorthents and Urban Land. Five soils comprise 85 percent of the watershed: Urban Land-Mahoning Complex (35%), Urban Land-Mitiwanga complex, (21%), Urban Land-Elnora complex (11%), Loudonville-Urban land complex (11%) and Ellsworth-Urban land complex (7%) (NEORSD, Existing Conditions Inventory and Assessment Volume I, p.4.37).

Table 7. Soils Classification

Soil Description		Flooding		Shallow Water Table			Bedrock		Physical Properties			Water Management			Sewershed Area (12,955 acres land/ 76 acres water)	
Soil Series	Symbol	Slope (%)	Hydrologic Soil Group	Frequency	Duration (Months)	Type	Depth (ft)	Months	Depth (in)	Permeability (in/hr)	Runoff Rate	K (tons/acre)	Pond Reservoir Area Limitations	Drainage Limits/ Requirements	Area (acres)	% of Sewershed Area
Brecksville silt loam	BfF	25 - 70	C	none	n/a	n/a	> 6	n/a	20 - 40	0.05 - 2	rapid	0.43	slope; depth to rock; slippage	not needed	111	0.86
Dekalb - Loudonville complex	DfF	25 - 70	C	none	n/a	n/a	> 6	n/a	20 - 40	0.05 - 20	rapid	0.17 - 0.32	depth to rock; seepage; slope	not needed	64	0.49
Ellsworth silt loam	EfB	2 - 6	C	none	n/a	perched	2 - 3	Nov-May	> 60	0.05 - 2	medium	0.32 - 0.43	none (favorable)	parcs slowly	18	0.14
Ellsworth silt loam	EfC	6 - 12	C	none	n/a	perched	2 - 3	Nov-May	> 60	0.06 - 2	rapid	0.32 - 0.43	slope; parcs slowly	slope; parcs slowly	124	0.96
Ellsworth silt loam	EfD	12 - 18	C	none	n/a	perched	2 - 3	Nov-May	> 60	0.06 - 2	rapid	0.32 - 0.43	slope; slippage	slope; parcs slowly	85	0.59
Ellsworth silt loam	EfF	25 - 70	C	none	n/a	perched	2 - 3	Nov-May	> 60	0.06 - 2	very rapid	0.32 - 0.43	slope	slope; parcs slowly	9	0.07
Ellsworth - Urban land complex	EsC	6 - 18	C	none	n/a	perched	2 - 3	Nov-May	> 60	0.06 - 2	rapid to very rapid	0.32 - 0.43	slope	slope; parcs slowly	947	7.31
Loudonville - Urban land complex	LuC	n/a	C	none	n/a	perched	2 - 3	Nov-May	> 60	0.6 - 2	rapid to very rapid	0.32	slope; seepage; depth to bedrock	not needed	1,385	10.69
Mahoning silt loam	MgA	0 - 2	D	none	n/a	perched	1 - 2.5	Nov-Jun	> 60	0.2 - 2	slow	0.32 - 0.43	none (favorable)	parcs slowly	197	1.52
Mahoning silt loam	MgB	2 - 6	D	none	n/a	perched	1 - 2.5	Nov-Jun	> 60	0.2 - 2	slow to very slow	0.32 - 0.43	none (favorable)	slope; parcs slowly	78	0.60
Mahoning - Urban land complex	MnB	0 - 6	D	none	n/a	perched	1 - 2.5	Nov-Jun	> 60	0.2 - 2	slow to medium	0.32 - 0.43	none (favorable)	slope; parcs slowly	262	2.02
Milwanga - Urban land complex	MxB	0 - 6	C	none	n/a	perched	1 - 2.5	Nov-Jun	> 60	0.6 - 6	slow to medium	0.32	depth to rock; seepage	depth to rock; frost action	157	1.21
Orville silt loam	Or	0 - 2	C	frequent	brief (Nov-May)	apparent	1 - 2.5	Nov-Jun	> 60	0.6 - 6	slow	0.32	seepage	foods; frost action	31	0.24
Oshimo sandy loam	OsF	25 - 55	B	none	n/a	n/a	> 6	n/a	> 60	2 - 20	rapid	0.10 - 0.24	slope; seepage; slippage	not needed	38	0.29
Oshimo-Urban land complex	OsB	2 - 8	B	none	n/a	n/a	> 6	n/a	> 60	2 - 20	n/a	0.10 - 0.24	seepage	not needed	1	0.01
Rijman silt loam	RaB	2 - 6	C	none	n/a	perched	2 - 3.5	Nov-May	> 60	0.06 - 2	medium	0.43	none (favorable)	parcs slowly; frost action	1	0.01
Troga loam	Tg	0 - 2	B	frequent	brief (Nov-May)	apparent	3 - 6	Feb-Apr	> 60	0.6 - 20	slow	0.37 - 0.49	seepage	not needed	282	2.18
Udorthents, loamy	Ua	0 - 6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	variable	n/a	n/a	n/a	150	1.16
Urban land	Ub	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	493	3.81
Urban land - Elnora complex	UeA	n/a	B	none	n/a	apparent	1.5 - 2	Feb-May	> 60	2 - 20	slow	0.24	seepage	favorable	1,373	10.60
Urban land - Mahoning complex	UmB	0 - 6	D	none	n/a	perched	1 - 2.5	Nov-Jun	> 60	0.2 - 2	slow to medium	0.32 - 0.43	none (favorable)	slope; parcs slowly	4,465	34.70
Urban land - Milwanga complex	UnB	0 - 6	C	none	n/a	perched	1 - 2.5	Nov-Jun	20 - 40	0.6 - 6	n/a	0.32	depth to rock; seepage	depth to rock; frost action	2,674	20.64

Source: NEORS, Existing Conditions Inventory and Assessment Volume I, October 1999

Figure 7. Soils Map

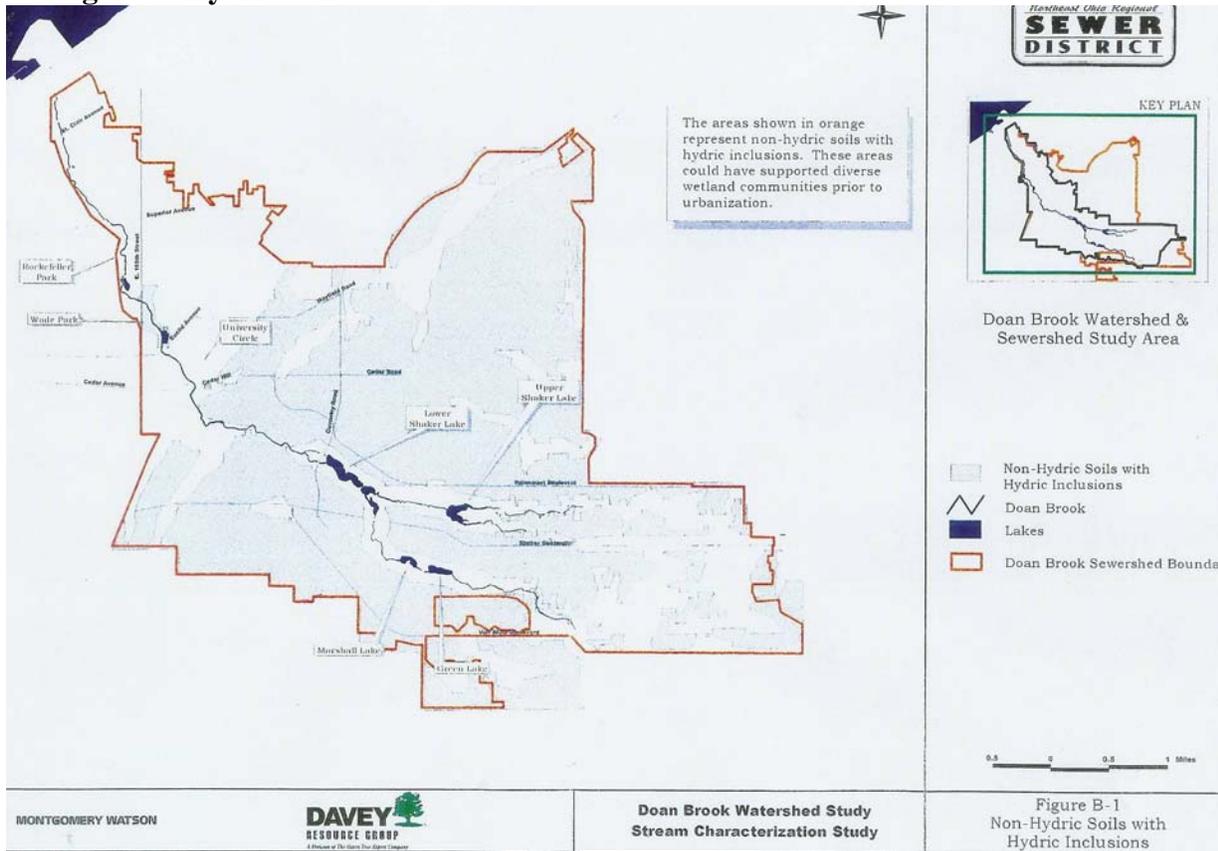


Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

Hydric Soils

Urbanization has decimated most of the hydric soil conditions that once existed in the Doan Brook watershed. However, characteristics of hydric soils are still present in specific areas of the watershed through the presence of non-hydric soils with hydric inclusions. These areas, identified in the Northeast Ohio Regional Sewer District's 1999 watershed assessment, provide opportunities to restore hydric soil functions which could benefit the entire watershed system.

Figure 8. Hydric Soils



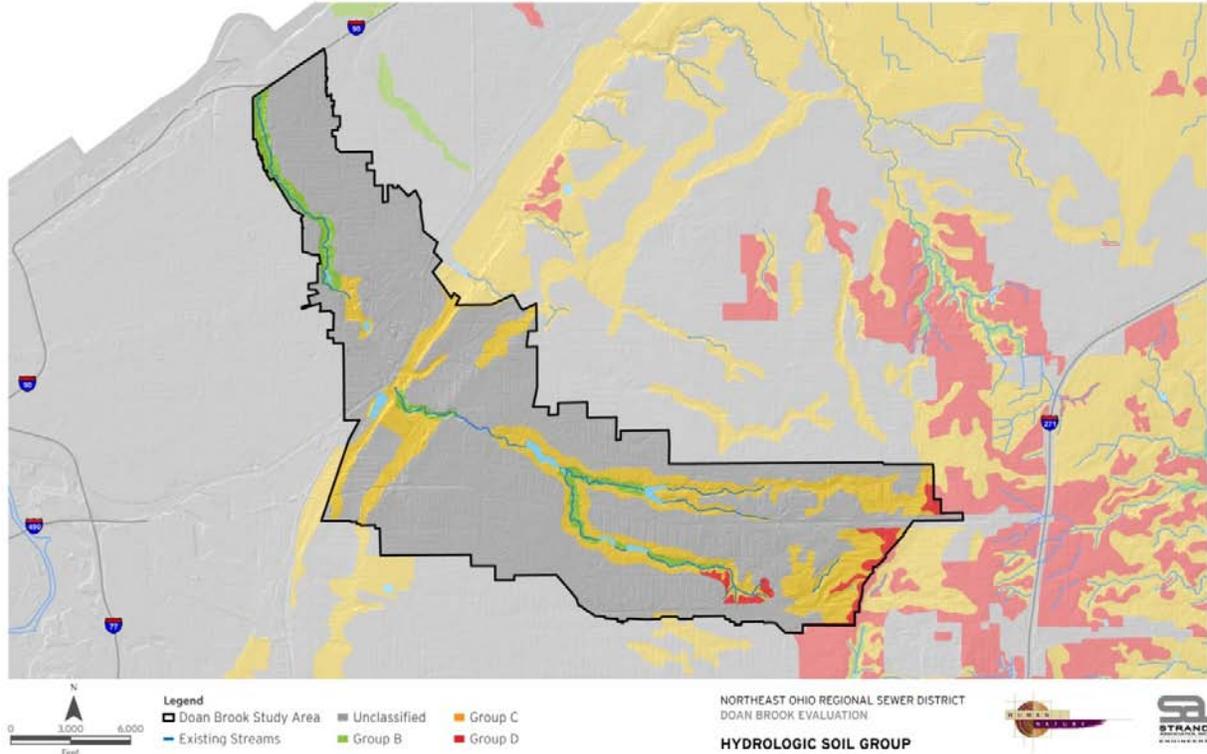
Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

Hydrologic Soils

The hydrologic component of these soils provides information about the watershed's infiltration characteristics, to aid in choosing best management practices and green infrastructure solutions during re-development.

A/B hydrologic class soils are characteristically well drained, sandy material. C and D soils tend to be less well to poorly drained, clay material. Figure 9 shows where B, C and D hydrologic soils have been identified in the Doan Brook Watershed.

Figure 9. Hydrologic Soil Conditions



Source: NEORSD 2011

d. Glacial History

When glaciers finally retreated from Northeast Ohio, about 15,000 years ago, they left a layer of jumbled clay, silt and sand called glacial till on the surface of the Plateau's shale and sandstone. This glacial till forms the soil and shallow subsurface material of the Doan Brook's upper watershed. An ancestor of current-day Lake Erie was trapped between retreating glaciers and the edge of the Appalachian Mountains to the south. The ancient lake, much larger than today's Lake Erie, carved a series of cliffs into the edge of the Appalachian Plateau, the topographic region that is now called the Escarpment.

As the Lake eroded at the edge of the Plateau, new sediments were carried from the uplands and deposited in the lake, forming the layers of silt, sand and clay that we now find beneath the lower watershed. Over time, the lake retreated toward its current shore, leaving the flat Lake Plain crossed by a series of ridges that attest to the locations of past shores and beaches. (Gooch, p. 27)

2. Biological Features

a. Landscape Types, Locations and Conditions

The Doan Brook watershed is made up of three distinct landscape types; the Lake Plain, the Escarpment, and the Plateau.

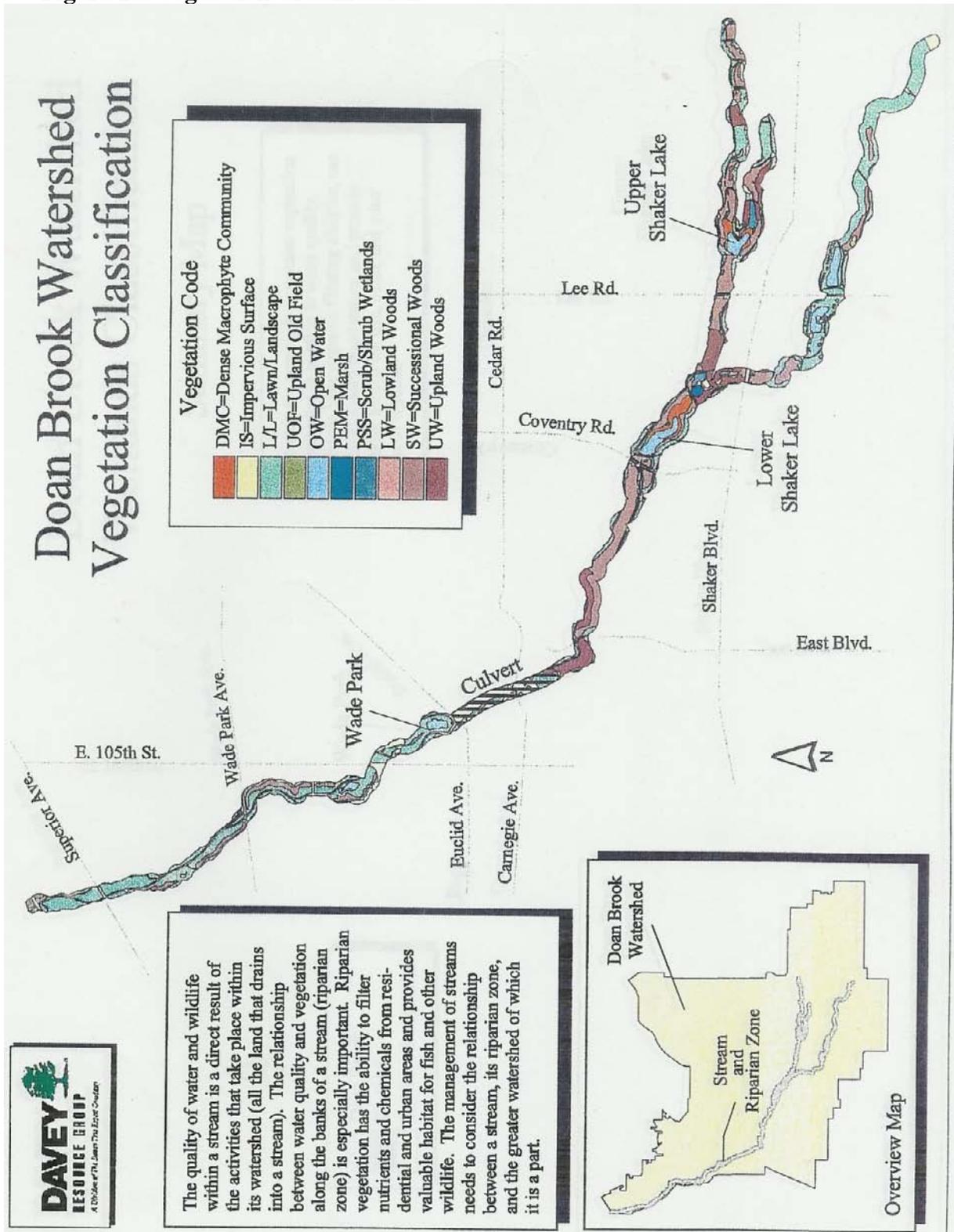
The lower watershed, or Lake Plain, is the relatively flat area that immediately adjoins Lake Erie, extending as far south as the hill just northwest of the Cleveland Museum of Art. The watershed here is generally level, with soils made up of layers of fine sands, silts, and clays. Although there are a number of native trees along the Brook in the lower watershed, Rockefeller Park has been heavily landscaped and planted since before 1900. As a result, there are many interesting non-native trees as well as remnant stands of native vegetation. Understory vegetation in the lower watershed consists of dogwoods, hornbeams, viburnums, rhododendrons, azaleas, and honeysuckles, as well as a number of other introduced plants. Non-native ground covers such as English ivy, myrtle, and pachysandra dominate the herbaceous vegetation.

The Escarpment is the sloped section of land that joins the Lake Plain with the higher ground to the south and east. Watershed slopes in the lower part of the Escarpment are relatively gentle, while steeper and longer slopes are found as you move farther up. The soils along the Escarpment are generally thin tills or silty clay, with shale or sandstone bedrock exposed in many places along the stream. The forest along the Doan Brook riparian corridor continues through the Escarpment, but the character of the vegetation changes. The increasing slopes and the ravine create two different environments for vegetation.

On the slopes and the sides of the ravine, runoff is rapid and the shallow soils have limited water-holding capacity. Here, the vegetation is characteristic of relatively dry environments. The forest is dominated by oaks, with understory saplings and shrubs of honeysuckles, viburnums, and cockspur thorn. By contrast, the heart of the Doan Brook gorge is cool and relatively moist. Maples dominate the forest, along with red oaks, tulip trees, cherries and yellow birches, and some remnants of hemlocks. Understory plants include dogwoods, hornbeams, buckthorn, cranberry, poison ivy, and similar species. Herbaceous plants are found mostly in the ravine and include nightshades, avens, asters, garlic mustard, jumpseed, jewelweeds, knotweeds, etc.

The Plateau includes the entire upper watershed above the uphill edge of the intersection of Bellfield Avenue (Roxboro School) and North Park Boulevard. This part of the watershed, which is the northwest margin of the Appalachian Plateau, is characterized by rolling topography and thin clayey silt glacial till soils. Bedrock is generally shale, with some sandstone. In this area, the Doan Brook riparian corridor is home to dense, tall-treed forest, the marshes associated with the Shaker Lakes, and the extensively planted areas around the lakes. In the upper, drier forests, oaks, beeches and sugar maples are the dominant trees. In the wet lowland forest such as the area immediately south of the Nature Center, silver maples, cottonwoods and pin oaks dominate. Understory trees and bushes throughout the Plateau include a variety of dogwoods, American hornbeams, hophornbeams, alders, blackberries, and viburnums. A wide range of wild flowers and other ground covers, and native plants such as poison ivy, jewelweed, hepatica, solomon's seal, spring beauty, and trillium can also be found. (Gooch, pp. 29-31)

Figure 10. Vegetation Classification



Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

b. Wildlife

The riparian corridor along Doan Brook provides a small haven of habitat within an urban setting for a variety of mammals, including opossum, raccoon, fox, squirrel, eastern chipmunk, skunk, and woodchuck. Of course many of these animals also utilize suburbia for food, water and shelter. In recent years, a population of white-tailed deer has made its home along the Brook. Three species of bat and several species of mole and shrew are also present, and occasionally a muskrat or a red fox are found. The red-backed salamander (*Plethodon cinereus*), is the most common amphibian in the Doan Brook watershed, where it is found in riparian forests. Conspicuous by their absence from the Doan Brook ecosystem are the semi-terrestrial streamside salamanders, such as the dusky salamander and the two-lined salamander. A large and healthy population of ring-necked snakes (*Diadophis punctatus*), are found throughout the gorge section of the Brook's corridor. (Gooch, p. 34)

c. Birds

Over 184 species of birds were documented along the upper Doan Brook between 1997 and 2009. An additional 26 species of birds were identified on 88 acres at Cleveland Lakefront Nature Preserve, which offers an even wider variety of birds documented there since 1980. Many species of birds use the Brook's riparian corridor as a migration stop during the spring and fall. Waterfowl ranging from the mallard to the wood duck, three species of merganser, gadwall, several species of grebe and an occasional loon utilize the Shaker Lakes in the early spring and late fall. Red tail hawks breed around the lakes. Other not unusual waterfowl include blue and green-winged teal, ruddy duck, and bufflehead. A bit more unusual are scaup, ring-necked duck, and northern shoveler.

Cooper's hawks breed around the lakes and more recently red-shouldered hawk nests have been found near-by. Ospreys are sited during migration, often carrying fish caught in Lower Lake. Occasionally caspian terns fish in Lower Lake during migration. Barred owls have nested around both Horseshoe and the Nature Center.

In recent years, green heron, killdeer, spotted sandpiper and belted kingfisher have bred at the Shaker Lakes. Woodpeckers nest in snags and dead trees left in the Brook corridor. Eastern wood peewee, greater crested flycatcher, and red-eyed vireo also nest in the more wooded areas. Carolina wren has joined the many song sparrows and red-winged blackbirds breeding in and around the marsh near the Nature Center at Shaker Lakes during the summer.

Baltimore oriole, warbling vireo, yellow warbler, eastern phoebe, eastern kingbird, and gray catbird (brushy areas) nest around the lakes and Brook, as do northern rough-winged swallows and barn swallows. The woodland birds also include wood thrush, blue-gray gnatcatcher, and scarlet tanager.

d. Fish

Surveys of Doan Brook's fish diversity have been limited, but with the available data, it has been concluded that an urban headwater stream like Doan Brook should have over a dozen more species than exist today. A survey conducted in 1998 as part of the Doan Brook Watershed Study showed green sunfish to be the dominant species within Doan Brook. Although this

species can tolerate degraded water quality conditions, its aggressive nature can also limit the re-establishment of other species.

A total number of 2,472 fish were collected by the Ohio EPA and NEORSD in the 1998 survey, representing 10 species and one hybrid. The most common fish by number were green sunfish (65.7%) and creek chub (26.2%). These species are considered pollution tolerant.

In August, 2010 a “Bio-Blitz” was performed in the marsh area near the Nature Center, in preparation for an invasive species elimination project. During that effort, stoneroller minnows, goldfish, green sunfish, blacknose dace, and creek chubs were found.

Improvements in the fish community have not occurred over time. Continued influences of land use are impacting biological community health and recovery. Figure 31 (page 79) presents results of the most recent fish community assessments (IBI score) for sites in the watershed. The scores for the IBI can range from 12 to 60. As is depicted in the figure, fish communities within the basin are demonstrating significant impairment.

Within the Doan Brook’s Hydrologic Unit Code or HUC (04110003 05 04), the Ohio EPA has listed the following causes of non attainment as “high magnitude”: organic enrichment/DO, flow alteration, combined sewer overflows and urban runoff/storm sewers.

e. Rare, Endangered, Threatened Species

The Doan Brook watershed contains unique features and remnants of the flora and fauna of pre-settlement times. The Ohio Department of Natural Resources Division of Natural Areas and Preserves (DNAP) maintains a database of documented rare, endangered and threatened species. The Assessment Report for the 2001 Doan Brook Watershed Study outlined the following findings:

A report from the DNAP database identified Richardson’s pondweed (*Potamogeton richardsonii*) (state potentially threatened) present in Lake Erie just outside the watershed boundary. Two locations were identified for Canada hawkweed (*Hieracium canadense*) (state threatened) both just outside of the watershed boundary, one near the Lake Erie shoreline and the second in Forest Hills Park. Emmons’ sedge (*Carex albicans var. emmonsii*) (state threatened) is present in the Doan Brook gorge and is the only listing within the confines of the study area. Additionally a field survey discovered butternuts (*Jugulans cinerea*) (state potentially threatened) along Doan Brook between the Nature Center and Horseshoe Lake. Found within the watershed, the Butternut Tree is imperiled in Ohio due to a rapidly spreading fungal disease. In addition, the report within DNAP’s database indicates that a cave or cavern is located in the Doan Brook gorge, probably a reference to the deep nature of the gorge and its cascading waterfalls.

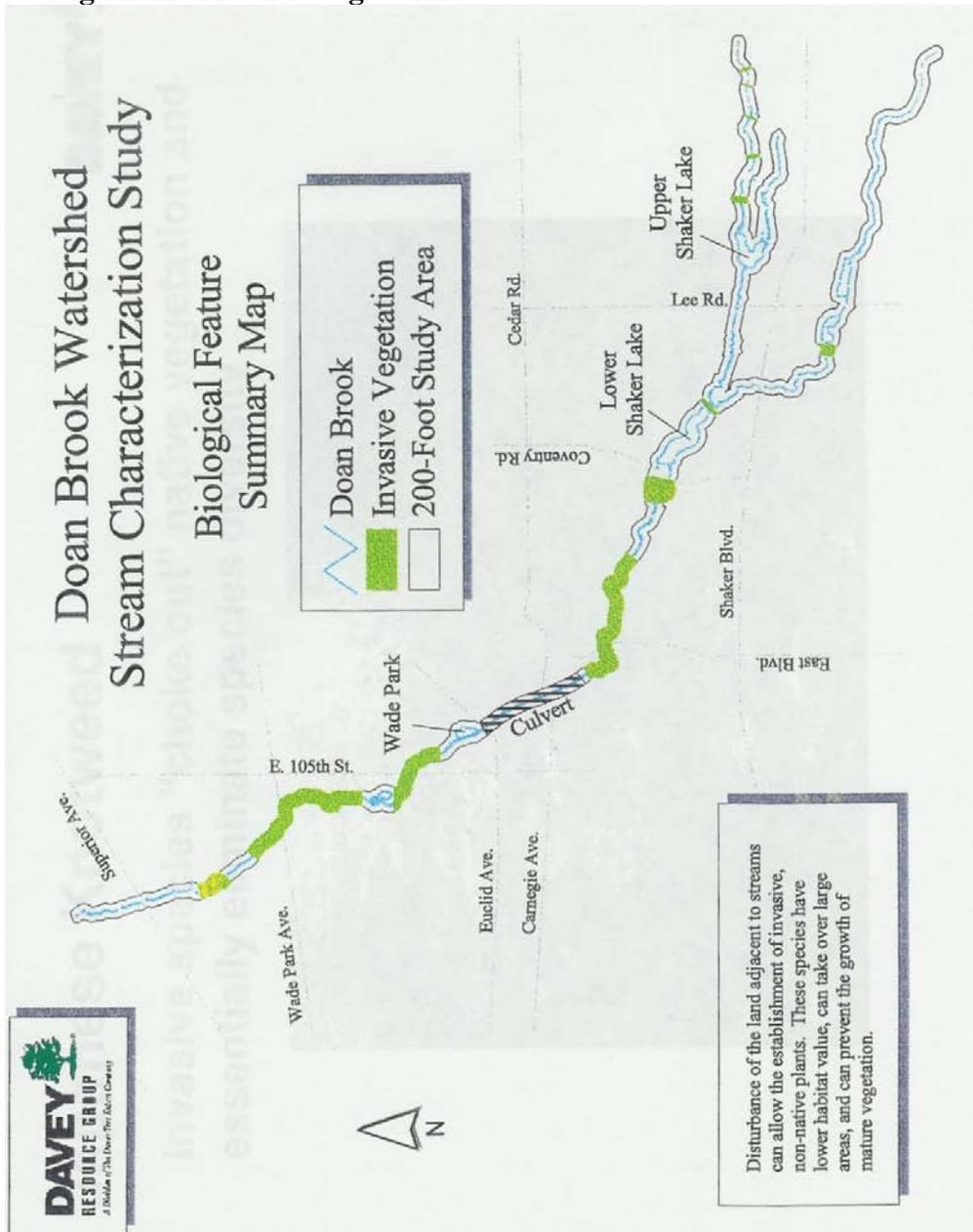
The US Fish and Wildlife Service identified three federally listed species whose range covers all or portions of the Doan Brook watershed: the peregrine falcon (*Falcon peregrinus*), the piping plover (*Charadrius melodus*) and the Indiana Bat (*Myotis sodalis*). There are no known records of these species breeding in the watershed, although they are seasonally present as migrants. (Doan Brook Watershed Study, October 1999, p.4.33)

f. Invasive Non-native Species

The flora of Doan Brook contains non-native plants which are considered invasive or aggressive species that can eliminate native plants and biodiverse plant communities. The Shaker Lakes are dominated by exotic macrophytes (submerged aquatic plants) and in some areas non-native herbaceous species such as garlic mustard, purple loosestrife and bishop's weed have colonized. Japanese knotweed is the most problematic species, primarily along the stream banks downstream of Martin Luther King Boulevard. This limits the succession of these areas to upland woods. In addition to aforementioned invasive species, the following species have been identified within the watershed: European alder (*Alnus glutinosa*), Japanese barberry (*Berberis thunbergii*), bindweed (*Convolvulus sepium*), European buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Rhamnus frangula*), narrow leaf cattail (*Typha angustifolia*), lesser celandine (*Ranunculus ficaria*), crown-vetch (*Coronilla varia*), ox eye daisy (*Chrysanthemum leucanthemum*), dame's rocket (*Hesperis matronalis*), day-lily (*Hemerocallis fulva*), Siberian elm (*Ulmus pumila*), poison hemlock (*Conium maculatum*), highbush cranberry (*Viburnum opulus*), amur honeysuckle (*Lonicera maackii*), Japanese honeysuckle (*Lonicera japonica*), morrow honeysuckle (*Lonicera morrowi*), Bell's honeysuckle (*Lonicera x bella*), tatarian honeysuckle (*Lonicera taratica*), yellow-flag iris (*Iris pseudacorus*), English ivy (*Hedera helix*), black locust (*Robinia pseudoacacia*), Norway maple (*Acer platanoides*), mugwort (*Artemisia vulgaris*), wild mustard (*Brassica kaber*), moneywort (*Lysimachia mummularia*), white mulberry (*Morus alba*), myrtle (*Vinca minor*), deadly nightshade (*Soanum dulcamara*), porcelain-berry (*Ampleopsis brevipedunculata*), privet (*Ligustrum vulgare*), Queen Anne's lace (*Daucus carota*), reed canary grass (*Phalaris arundinacea*), multi-flora rose (*Rosa multiflora*), star-of-Bethlehem (*Orinthogalum umbellatum*), sweet white clover (*Melilous alba*), sweet yellow clover (*Melilotus officinalis*), sweet woodruff (*Galium odorata*), common teasel (*Dipsacu fullonum*), Canada thistle (*Cirsium arvense*), tree-of-heaven (*Ailanthus altissima*), crack willow (*Salix fragilis*), willow-herb (*Epilobium parviflorum*). In 2010 a project was begun to remove narrow leaf cattail and lesser celandine from the marsh area near the Nature Center and restore native plant species.

An aquatic resource can be impacted by both plant and animal invaders. Inventories of invasive species have not been conducted for the Doan Brook watershed in its entirety. The most common invasive fish species in collections from both the Ohio EPA and Northeast Ohio Regional Sewer District is the goldfish (*Carassius auratus*). Other potentially harmful invasive aquatic animal species most likely in the watershed include zebra mussels and the rusty crayfish (*Orconectes rusticus*). Negative impacts associated with the rusty crayfish are not known at this time. (DB Watershed Study, 1999)

Figure 11. Invasive Vegetation



Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

3. Water Resources

a. Climate and Precipitation

The climate of Cuyahoga County is characterized by warm summers and cold winters, with average summer temperatures of 70 degrees Fahrenheit and average winter snowfall of 40 inches per year. According to the NOAA Climate Diagnostics Center, precipitation for Cleveland, Ohio, averages 36.6 inches per year. Precipitation is generally well distributed throughout the year, with most occurring between April and September. Within the watershed, precipitation is

subject to some variance due to the climatic influence of Lake Erie, particularly as it impacts snowfall in the winter months due to “lake effect snow.” Areas closer to the lake and at the higher elevations receive more snow. These differences in snowfall amounts have the greatest impact during the spring when snowmelt contributes to runoff entering the stream system. This also affects the management of Lake Erie in terms of water level and other coastal issues. The amount of precipitation through rain or snowfall has a profound effect on water resource management and the Lake Erie levels along the watershed’s coastal waters.

b. Surface Water

Doan Brook is a direct Lake Erie tributary and drains portions of Shaker Heights, Cleveland Heights, University Circle, and Cleveland in Cuyahoga County. Doan Brook has a drainage area of approximately 11.9 square miles and a total stream length of about 11.3 miles.

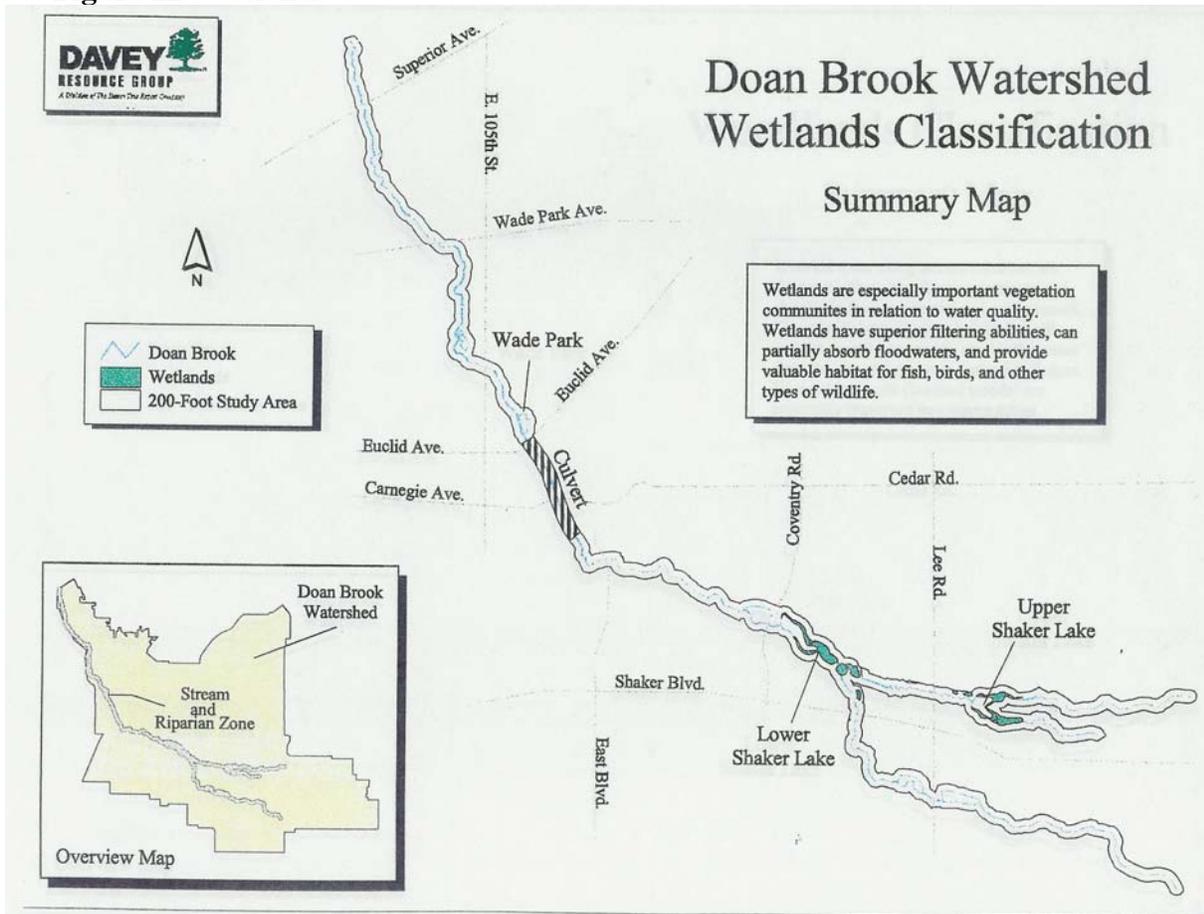
There are no permanent rain or flow gauges in the Doan Brook watershed to fully measure the watershed’s flow regime. In 1998, Montgomery Watson installed six flow gauges throughout the watershed for a four-month period for the Doan Brook Watershed Study. This limited monitoring demonstrated a wide range of peak flows during the study period characteristic of developed urban watersheds and contributing to erosion and flooding problems. (NEORS, WQ Monitoring and Sampling Report, October, 2000, p. 7.24)

The Brook shows poor fish communities consisting of pollution tolerant species. Changes to the watershed include increased stretches of channelized habitat, culverted stream, and both manmade and natural barriers to fish migration (i.e., dams at the Shaker Lakes).

Wetlands

Due to the developed nature of the Doan Brook watershed, few wetlands remain. However, because of the preservation of the riparian corridors along Doan Brook and the existence of four man-made lakes, wetland vegetation communities exist throughout the Brook’s riparian corridor. A study was conducted by Davey Resource Group to evaluate the wetland communities in the watershed. Figure 12 shows the location of wetlands along the Doan Brook riparian corridor. Dense macrophyte communities dominate most of the impounded lakes. The fringes of the lakes are ringed with marsh wetlands. In addition, there are a few areas of scrub/shrub and lowland woods. Despite their current scarcity within the watershed, wetlands were probably once a common and ecologically significant part of the Doan Brook ecosystem. (NEORS, Existing Conditions Inventory and Assessment Volume I, p 4.27)

Figure 12. Wetlands



Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

Stream Use Designations

Use designations for the Doan Brook basin are contained in Ohio Administrative Code Chapter 3745-1-26. Table 8 below contains the use designations for Doan Brook.

Table 8. Use Designations

Use Designations							
Water Body Segment	State Resource Water	Aquatic Life Habitat		Limited Resource Water	Water Supply		Recreation Primary Contact Recreation
		Warm Water Habitat	MWH		Agricultural	Industrial	
Doan Brook		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Shaker Lakes national environmental education landmark	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Source: Ohio EPA

In general, the State of Ohio has classified all public lakes over 5 acres as follows:
Aquatic Life Uses: Exceptional Warmwater Habitat
Water Supply: Public Water Supply
Recreational Use: Primary Contact Recreation

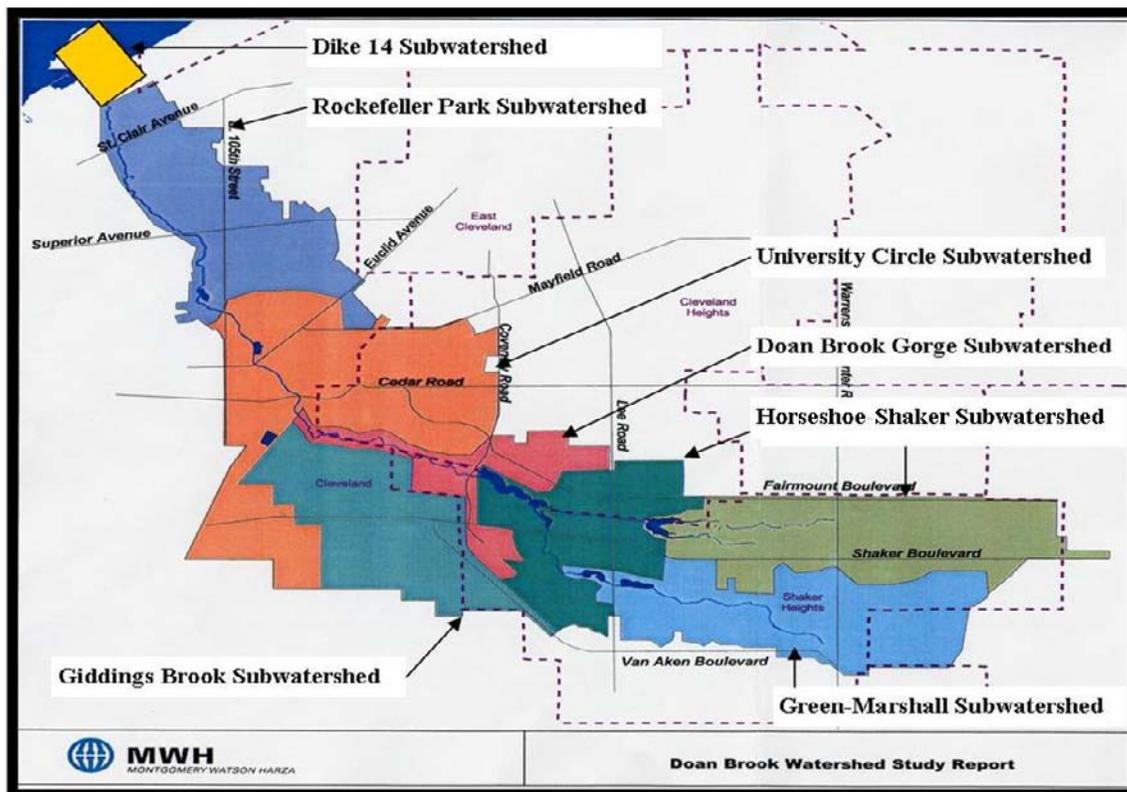
These lake designations pertain to the Upper and Lower Shaker Lakes but not to Green or Marshall Lakes, which are unclassified.

Descriptions of Sub-watersheds

Although the Doan Brook watershed is entirely urban, it travels through different environments. Examining these areas of distinctive conditions provides a framework to identify relevant opportunities and recommendations for the implementation of restoration and education projects. For the purpose of this report, the watershed has been divided in seven sub-watersheds established by previous reports and studies.

The description of the sub-watersheds is in a general form and does not include information regarding sinuosity, entrenchment indices or 10-year low flows. This information is not available in any of the ODNR publications such as Bulletin 47, since Doan Brook is such a small stream and has never had any permanent flow gages.

Figure 13. Doan Brook Sub-watersheds.



Source: NEORS, Doan Brook Watershed Study Report, August, 2001

Sub-watershed 1 – Dike 14/Cleveland Lakefront Park

Acres: 88

Approximate stream length: 750 feet (culverted)

Historically, Doan Brook emptied directly into Lake Erie. Typical of Lake Erie tributaries of its size, the Doan had an open floodplain and marshlands with sweeping bends entering its confluence with the Lake. Gordon Park was created at the mouth of the Brook to take advantage of this beautiful transition from stream to open lake. The park facilities impacted the natural confluence with a boat launch and lake pier. Later a confined disposal facility (Dike 14) for Cuyahoga dredge spoils was built in Lake Erie directly over the mouth of the stream. With increased urbanization, the I-90 freeway interchange, and Dike 14 which completely covered the culverted mouth of the Doan, the subwatershed was severely altered.

Today, the Brook is culverted for approximately 3,300 linear feet starting at the I-90 interchange and ending at the northern border of Dike 14, now the Cleveland Lakefront Nature Preserve. The main impairments in this sub-watershed are the culverts and channels that impede fish migration, in addition to the degraded coastal habitat. Dumping patterns on Dike 14 have created a unique habitat for migrating and nesting birds. Today, the undulating landscape serves as a significant bird migration stopover area and a large greenspace for locals and visitors alike. The Dike 14 Education Collaborative, through the Cuyahoga Soil & Water Conservation District, conducted an environmental assessment of the site in 2007. Results of the assessment concluded that much of the area could be used for passive recreation with no cleanup required. A 5-acre area was identified with pollutant levels of Polynuclear aromatic hydrocarbons (PAH), Polychlorinated Biphenals (PCB) and lead above the standards established by the Ohio Environmental Protection Agency for residential land use areas. The assessment recommended remediation for this area by placing a cap of four feet of soil on top of the area to reduce the exposure to humans and wildlife. The recommendations were accepted and resulted in the creation of the Cleveland Lakefront Nature Preserve, now open to the public.

An analysis conducted in 2007 suggested that daylighting the Doan Brook's mouth would allow for the establishment of a lotic (flowing) fish community that could re-establish upstream populations, thus creating healthier fish populations in Doan Brook and Lake Erie.

Figure 14. Cleveland Lakefront Nature Preserve Restoration & Site Improvement Concept Plan



Existing Conditions

- Fish migration migration is severely limited by culverted section under Cleveland Lakefront Nature Preserve
- This section of stream is subject to high flow velocities from upstream drainage, as well as fluctuations in lake levels.

Opportunities:

- Public access to lakefront.
- Increased use by wildlife, for example as a significant migration stopover location.
- Increased native shoreline vegetation for increased habitat benefits.
- Daylighting the mouth of Doan Brook directly to Lake Erie to increase migration and diversity of fish species.
- Coastal wetland re-creation.



Sub-watershed 2 - Rockefeller Park

Acres: 1,120

Approximate Stream Length: 12,280 feet

The Rockefeller Park sub-watershed encompasses a two-mile long area of Rockefeller Park south of I-90 to East 105th Street. This section of the Brook is largely an open channel that crisscrosses Martin Luther King Boulevard the entire length of the park. While mostly open, this reach has three major structural challenges: 1) roadways and culverts inhibit habitat and floodplain function; 2) walls inhibit habitat and floodplain function; and 3) check dams limit fish migration and riffle, run, pool sequences.

Figure 15. Rockefeller Park Sub-watershed

Restoration of the Doan Brook through Rockefeller Park will require working closely with the Cleveland Cultural Gardens Federation, University Circle Inc., the Community Development Corporations, Cleveland City Council, neighborhood residents and the Holden Parks Trust. Conceived as a means of fostering peace among nations, and more specifically nationalities, after World War I, the Cultural Gardens dot the banks of the Doan Brook through most of Rockefeller Park. Dialogue and a balanced approach will be needed to reach water quality goals while accounting for the aesthetics and mission of the Cultural Gardens. Such an approach is needed for all community projects, as is evidenced in the Rockefeller Park Master Plan.

The Rockefeller corridor has been targeted for stream restoration for the past ten years. Led by the Northeast Ohio Regional Sewer District and funded by the City of Cleveland, a stream enhancement project is underway. The goals for the project include: improve aquatic habitat in restored areas, provide for better control of stream flows, provide for some floodplain relief where possible, improve and enhance riparian vegetative cover, provide limited removal of invasive plant species, provide for some limited access to the Brook, and satisfy Ohio EPA Findings and Orders. Design will be completed in 2013, with construction taking place later that year.

Existing Conditions

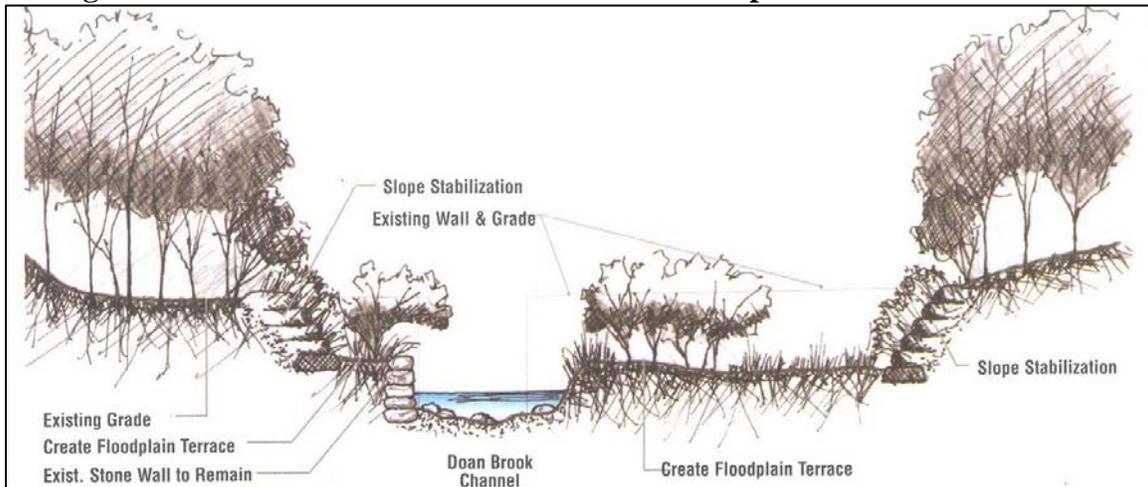
- Amphibian and common stream side species diversity is poor.
- In a year with typical rainfall, there are overflows from one combined sewer outfall (CSO) in this reach approximately 65 times.

- Fish migration is restricted by the presence of velocity check dams throughout the reach and the culverted section under Gordon Park.
- High flow velocities occur due to rapid storm response rates and the presence of narrow channels and vertical walls along the majority of the reach. These velocities contribute to erosion and lack of habitat for aquatic life.
- Japanese knotweed is prolific along this reach.

Opportunities

- Stream restoration throughout Rockefeller Park to restore floodplain functions and improve flow regime.
- Removal of check dams to improve fish migration opportunities.
- Stabilization of banks to reduce erosion and sedimentation along Doan Brook.
- Improved use of Rockefeller Park through the recommendations of the Rockefeller Park Master Plan to increase access and use of Doan Brook corridor by the general public.
- Invasive plant removal.

Figure 16. Stream Restoration Cross-section Concept Rockefeller Park



Source: Northeast Ohio Regional Sewer District

Sub-watershed 3 - University Circle

Acres: 1,720

Approximate Stream length: 5,700 feet (portions culverted)

The Brook is completely culverted under University Circle, traveling 5,160 linear feet underground. This is a primary inhibitor of watershed health and daylighting the stream would provide one of the most significant opportunities for improvement, should funding become available. Due to the high cost of daylighting urban streams, it is highly unlikely that the University Circle culvert will ever be unearthed in one project. A stronger possibility



is for the culvert to be slowly removed, small project by small project. University Circle, with its large number of community institutions and underlying sandy soils, is an optimal place to mitigate for impervious cover with stormwater control measures.

Existing Conditions

- In a year with typical rainfall, there are overflows from four permitted CSO's approximately 44 times in this subwatershed.
- The culvert is a fish migration barrier and devoid of in-stream habitat.
- Impervious surface of this sub-watershed prevents infiltration or rainfall and creates high stormwater runoff rates and volumes.

Opportunities

- Retrofitting University Circle using various best management practices to reduce non-point source pollutant loads entering the stream.
- Reconfiguration of the East 105th intersection in ways that benefit water quality, including daylighting Doan Brook.
- Public participation and stewardship opportunities for many cultural and healthcare institutions, schools, and the large daytime population.
- Daylighting additional segments of Doan Brook.

Sub-watershed 4 – Giddings Brook

Acres: 1,000

Approximate Stream Length: NA

Giddings Brook, once a separate stream system west of the Doan, is now culverted and rerouted into the University Circle culvert at Ambler Park where the Doan Brook transitions from its upper to lower watershed. Prior to urbanization, Giddings Brook flowed directly to Lake Erie. The fact that Giddings is relegated entirely to underground pipes makes public involvement with citizens that live in the former watershed even more important, yet difficult. For this reason the DBWP will include Giddings Brook watershed communities in projects and programs. It is important that the Giddings not be forgotten because any restoration activities in this sub-watershed will improve water quality in downstream stretches of the Doan.

Existing Conditions

- In a year with typical rainfall, there are overflows from one or more of the CSO's in this subwatershed approximately 33 times
- The sub-watershed has a high percentage of impervious cover that prevents infiltration and creates high stormwater runoff.

Opportunities

- Reduction of illicit discharges and outflows.
- Reduction of impervious cover.
- Retrofitting developed areas to increase infiltration in watershed.
- Expanded outreach to Giddings Brook neighborhood.

Subwatershed 5 - Doan Brook Gorge

Acres: 470

Approximate Stream Length: 8,000 feet

The Doan Brook gorge connects the upper and lower sub-watersheds. It is comprised of steep terrain and is dominated by natural forested riparian corridor. The gorge showcases Doan Brook's natural waterfalls and deep ravines. Its waterfall, albeit natural, does restrict fish migration from the upper to the lower part of the watershed. A large detention dam was built by the City of Cleveland immediately downstream of the gorge, where the stream enters Ambler Park. The stream drops into the University Circle culvert in Rudy Rogers Scout Park through Ambler Park in this subwatershed.



Existing Conditions

- Amphibian and fish species diversity is poor and lacks common stream-side species.
- Bank erosion at the downstream end of the gorge exists.
- In a year with typical rainfall, there are overflows from two CSO's, numbering approximately 16 times.
- An abundance of Japanese knotweed is found in this reach.
- Low base flows downstream of the Lower Shaker Lake contribute to poor fish diversity.
- The detention basin downstream of the gorge is improperly located to maximize its flood control function.

Opportunities

- Preservation of existing natural vegetation areas.
- Removal of invasive plants.
- Removal of existing trash rack upstream of MLK Blvd.
- Trail development on the upper rim of the gorge.

Sub-watershed 6 – Lower Shaker Lake and Horseshoe Lake

Acres: 2,050

Approximate Stream Length: 18,500 feet

Lower Shaker Lake: 19.3 acres

Horseshoe Lake: 14.6 acres

Lower Shaker and Horseshoe (also known as Upper Shaker) Lakes, located in the upper watershed, are flanked on all sides by excellent forested buffers, a riparian setting that is rarely found in urban watersheds. Maintaining and enhancing these vegetated conditions

benefits water quality. The largest challenges to healthy water quality in this subwatershed are the lakes themselves. Their man-made dams are fish barriers. They are naturally and continually filling with sediment, becoming shallow, stagnant and chronically eutrophic.



Non-native invasive plants have proliferated around the lakes, but DBWP and its partner, the Nature Center at Shaker Lakes, remove invasive species on an annual basis. Some of the most prominent invasive species in need of removal include: garlic mustard, yellow flag iris, purple loosestrife, celandine, narrow-leaf cattail, buckthorn and Norway maple.

Existing Conditions

- Amphibian and fish diversity is limited and the existence of aggressive green sunfish poses challenges for increased diversity.
- Invasive plant species in the lakes and throughout the riparian corridors limit plant diversity and habitat function.
- Phosphorous has been identified as overabundant, leading to algal blooms in the lakes.
- Hypereutrophic conditions exist within both lakes; this is due, not simply, to phosphorous but shallow water depth and other non-point sources of pollution. Sediment accumulates in both lakes, so they are both average depths of 1-5 feet.
- Impoundments on both lakes create fish migration barriers.
- People do not realize that the lakes are man-made and thus, require maintenance, an awareness that's needed to create a socio-political climate that's supportive of financing the maintenance.

Opportunities

- Short term lake management through dredging of sediment.
- Creation of a long term lakes management plan that examines options in addition to dredging, including stream restoration to reduce sedimentation.
- Restoration of vegetation throughout the Shaker Lakes riparian corridor.
- Implementation of Best Management Practices to reduce imperviousness and store and slow stormwater.
- A Parklands Management Plan for park maintenance exists and should be updated and followed.
- Re-creation of wetlands along Brook floodplains where feasible.
- Green infrastructure & non-point source pollution education should be expanded.

Sub-watershed 7 - Green & Marshall Lakes

Acres: 1,140

Approximate Stream Length: 14,650 feet

Marshall Lake: 5.3 acres

Green Lake: 6.9 acres

Green and Marshall Lakes, located in the upper watershed, face the same conditions as Lower and Horseshoe Lakes, but with worse odor, eutrophication, sediment buildup and depleted oxygen levels. The forest cover in Green/Marshall riparian corridor is much less extensive than in Lower and Horseshoe Lakes. Two golf courses exist along the South Branch through this sub-watershed, posing additional challenges to non-point run-off pollution of nutrients and turbidity.

Existing Conditions

- Amphibian and fish species lack diversity. The presence of Green sunfish provides additional challenges to increased diversity.
- Channel erosion and deterioration along the riparian corridor are significant, especially through portions of Shaker Heights Golf Course.
- Impoundments on Marshall and Green Lakes are fish migration barriers.
- Non-native invasive plants within and surrounding the lakes diminish habitat diversity.
- High levels of phosphorous create algal blooms in the lakes.
- Sediment accumulation is occurring in both lakes, creating shallow lakes that are more susceptible to eutrophication.



Opportunities

- Short term lake management through the dredging of sediment.
- Creation of a long term lakes management plan that examines options in addition to dredging, including stream restoration and dam removal.
- Implementation of best management practices for nutrient reduction on golf courses.
- Stream restoration and riparian vegetation re-establishment along golf course sections.
- Best management practices to reduce impervious cover impacts.
- Outreach to the public regarding non-point source pollution from residential activities.
- Treatment of stormwater and sediment with stormwater control measures.

c. Groundwater Resources

There are shallow aquifers in the upper and lower Doan Brook sub-watersheds and deeper aquifers beneath the upper watershed. The shallow aquifers absorb and slowly release some of the rain that falls in the watershed, reducing flood flows and increasing flows during dry periods. Due to differences in the upper and lower watershed soils, the shallow aquifer in the upper watershed absorbs less rainfall and releases it more slowly than the shallow aquifer in the lower watershed. The deep aquifers also contribute to dry weather flow by carrying some water from both inside and outside of the surface watershed to the Brook. (Gooch, p. 24) The poor groundwater yields, generally less than 10 gallons per minute, in the Doan Brook are obtained from the Cuyahoga and Bedford Group shales and from relatively impermeable glacial deposits.

Source Water Assessment Plan

A Drinking Water Source Assessment for the City of Cleveland was prepared by Ohio EPA in December, 2003. The Doan Brook watershed is within the Baldwin Plant Service Areas which are part of the City of Cleveland Division of Water community public water system. The Baldwin Plant is located within the Doan Brook watershed. The Cleveland water treatment system obtains its water from Lake Erie via four water treatment plants, Baldwin being one of them. As the assessment outlines, “Due to the distance of Cleveland’s supply intakes from the shore (approximately 2.5-4.5 miles), the potential threats identified in the watersheds nearest to the supply intakes are considered low.”

Groundwater Pollution Potential

The Ohio Department of Natural Resources Division of Water has developed the DRASTIC mapping process to identify areas that are vulnerable to groundwater contamination and its pollution potential. The DRASTIC process establishes hydrogeologic settings to represent a composite of various factors that influence groundwater. Thirteen hydrogeologic settings were identified in the Doan Brook watershed with groundwater pollution potential index ratings ranging from a low of 48 (least susceptible to contamination) to a high of 153 (most susceptible to contamination). Areas with highest ratings are found in the northern portion of the watershed near Lake Erie. The lowest pollution potential ratings are found in the southern portion of the study area.

The index ratings for the Doan Brook area generally fall below or within typical ranges for the United States. There is no direct withdrawal of groundwater for water supply within the watershed. (NEORSD, Existing Conditions Inventory and Assessment Volume I, pp. 4.41-4.42)

4. Land Use

a. Land Cover Description

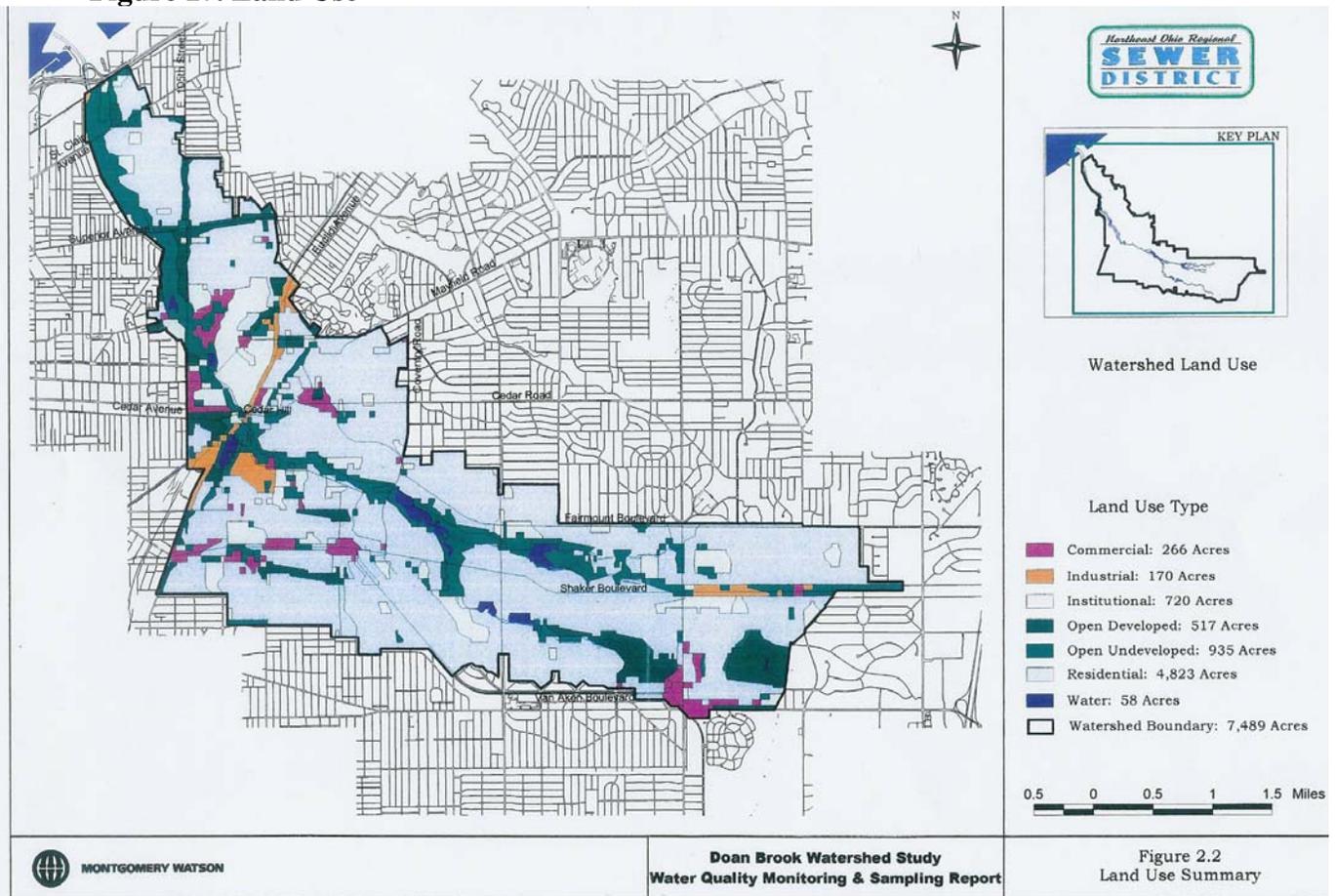
The Northeast Ohio Regional Sewer District conducted a general land use assessment of the watershed in 2000. The watershed’s dominant developed land use identified in the assessment was residential use, at 64% of the total land area. Institutional land use was second highest with 10% of the total land area. (Table 9 and Figure 17.)

Table 9. Land Use Doan Brook Watershed

Land Use	Acres
Commercial	266
Industrial	170
Institutional	720
Open Developed	517
Open Undeveloped	935
Residential	4,823
Open Water	58

Source: NEORSD, Water Quality Monitoring and Sampling Report, September 2000

Figure 17. Land Use

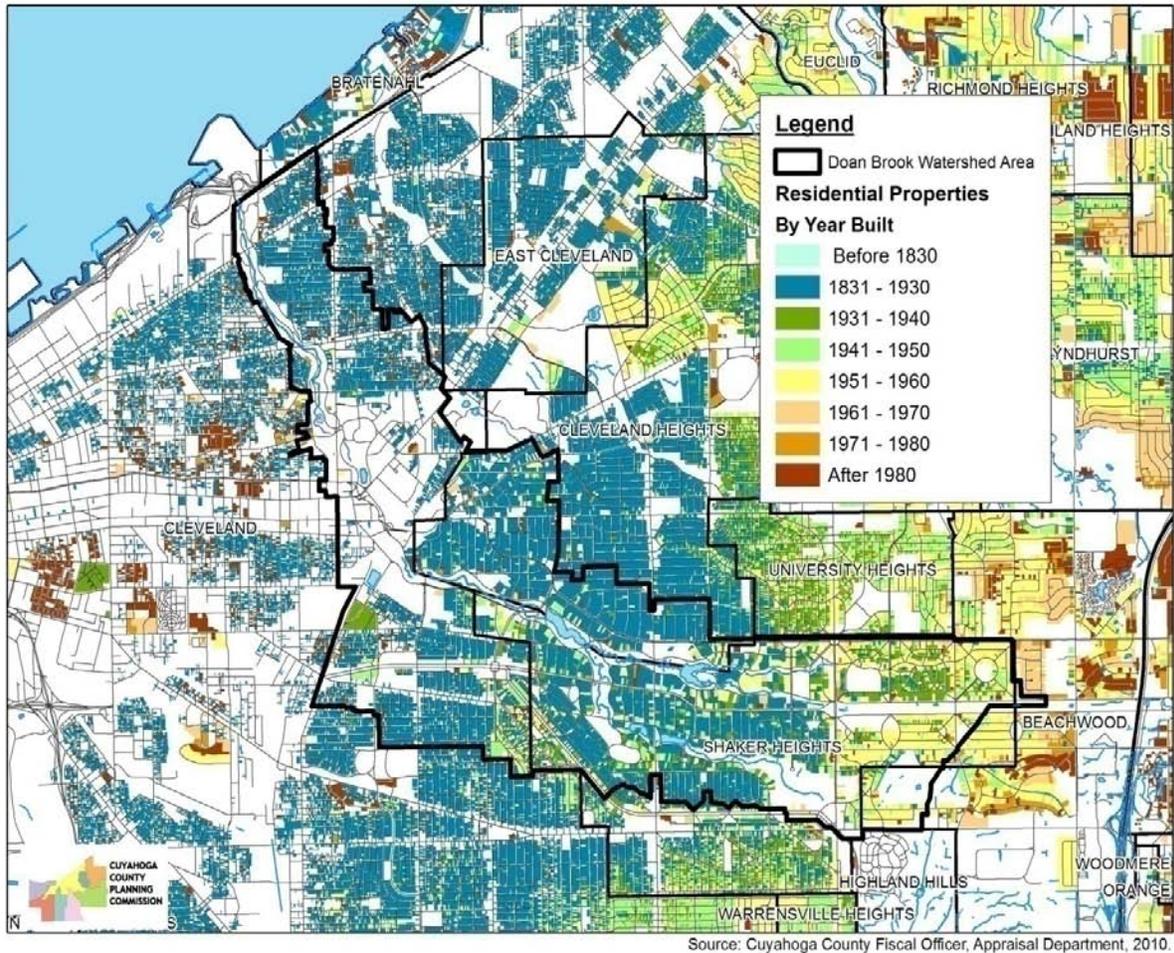


Source: NEORSD, Water Quality Monitoring and Sampling Report, September 2000

Residential

The housing in the Doan Brook watershed is diverse and provides a variety of housing choices for the community. Residential areas consist of single family and multifamily housing in all parts of the watershed. A majority of the housing was built in the early 1900's. As reflected in the population information, residential housing is dense compared to many of the Lake Erie tributary watersheds. Hence the impact of residential units on the watershed is significant.

Figure 18. Residential Housing Age



Source: Cuyahoga County Planning Commission

Institutional

The Doan Brook watershed has one of the highest concentrations of civic, cultural, and educational institutions in Cleveland and is considered a world class destination. Because the “Institutional Use” designation is second only to “Residential Use”, institutions play a significant role in the condition of watershed’s environment. The decisions that institutions make can positively or negatively impact water quality. The watershed is home to University Hospitals, Cleveland Clinic, Case Western Reserve University, John Carroll University, Cleveland Museum of Art, Cleveland Botanical Garden, Cleveland Museum of Natural History, the Cleveland Orchestra, Veterans Administration Hospitals, the Cleveland Institute of Art, the Cleveland Institute of Music, Western Reserve Historical Society and numerous other cultural institutions within the University Circle area. The greatest challenge to these institutions is to mitigate for the impervious cover they impose on the watershed. The Doan Brook Partnership should leverage the significant economic and social contributions of these institutions to include benefits to stormwater management.

Commercial

Along with its institutional establishments, University Circle is also home to many commercial districts, buildings and activities. Outside of University Circle, the watershed is home to Shaker Square, Coventry, Cedar Lee, Taylor Rd., Fairmount Circle, Cedar/Fairmount and Van Aken/Warrensville Center commercial districts. Commercial areas comprise 266 acres of land in the watershed, but their impact is significant due to the high degree of imperviousness typically associated with businesses, roofs and parking lots. As stated many times prior, impervious surface brings non-point source pollution, as well as streambank and in-stream habitat erosion.

Parks & Open Space

Although the Doan Brook Watershed is highly urban, it has an abundance of open space and parks that benefit the watershed. In the lower watershed Cleveland Lakefront State Park Nature Preserve, Gordon Park and Rockefeller Park provide natural green space. Cleveland Lakefront Nature Preserve comprises 88 acres of land that includes Dike 14, which once served as a dredge disposal facility. In the past five years, the land has been converted to passive open space. The Doan Brook is culverted in this section, but could be daylighted if funds and feasibility are identified as priorities.

Gordon Park is 46 acres of active parkland within the City of Cleveland adjacent to the Cleveland Lakefront State Park on the north side of I-90. This park, along with the Cleveland Lakefront State Park Nature Preserve, provides opportunities for restoration and improved land management practices that will benefit the lower watershed and its interface with Lake Erie.

Rockefeller Park is 270 acres of riparian corridor along the main stem of Doan Brook from I-90 south to East 105th Street. Two restoration project concept plans have been developed for this greenspace. One is a stream enhancement plan, managed by the Northeast Ohio Regional Sewer District, to restore aquatic habitat in the lower Doan Brook. The second is the Rockefeller Park Master Plan, completed in 2008 by ParkWorks, calling for greater access to the park and Brook, as well as for the addition of green infrastructure to slow and purify stormwater throughout the park.

In the middle and upper watersheds, Doan Brook finds refuge in Ambler Park and the Shaker Parklands. Ambler Park consists of 52 acres of open space including a natural gorge. The Shaker Parklands consist of nearly 250 acres of forested parkland that flanks the Doan Brook and Shaker Lakes in its upper reaches. It is also home to the Nature Center at Shaker Lakes, a home-base for environmental education and stewardship.

Golf Courses

There are two golf courses in the watershed, both in the upper watershed. Shaker Heights Country Club consists of 128 acres and Canterbury Country Club owns 134 acres of land. In 2005, a stream restoration project was completed on approximately 400 linear feet of the Brook through the Shaker Heights Country Club golf course. Additional sections in both golf courses provide opportunities to restore denuded stream corridors and in-stream habitats throughout the corridor of the South Branch. As neither course currently has an environmental management

plan for their courses, improved golf course maintenance presents another opportunity to filter fertilizer and pesticide runoff.

Utilities/Transportation Corridors

The Doan Brook watershed contains a large network of major roadways that connect the eastern suburbs to downtown Cleveland and University Circle. Interstate 90 crosses the lower watershed between Rockefeller Park and Cleveland Lakefront Nature Preserve. Martin Luther King Jr. Boulevard travels along the Brook north and south, through Rockefeller Park. Other major roadways include the Euclid Corridor, Cedar Road, Lee Road, Shaker Boulevard, Warrensville Center Road, Fairmount, Van Aken, North Park and South Park Boulevards. These are some of the most highly used roadways in Cuyahoga County.

Table 10. Traffic Counts Major Roadways

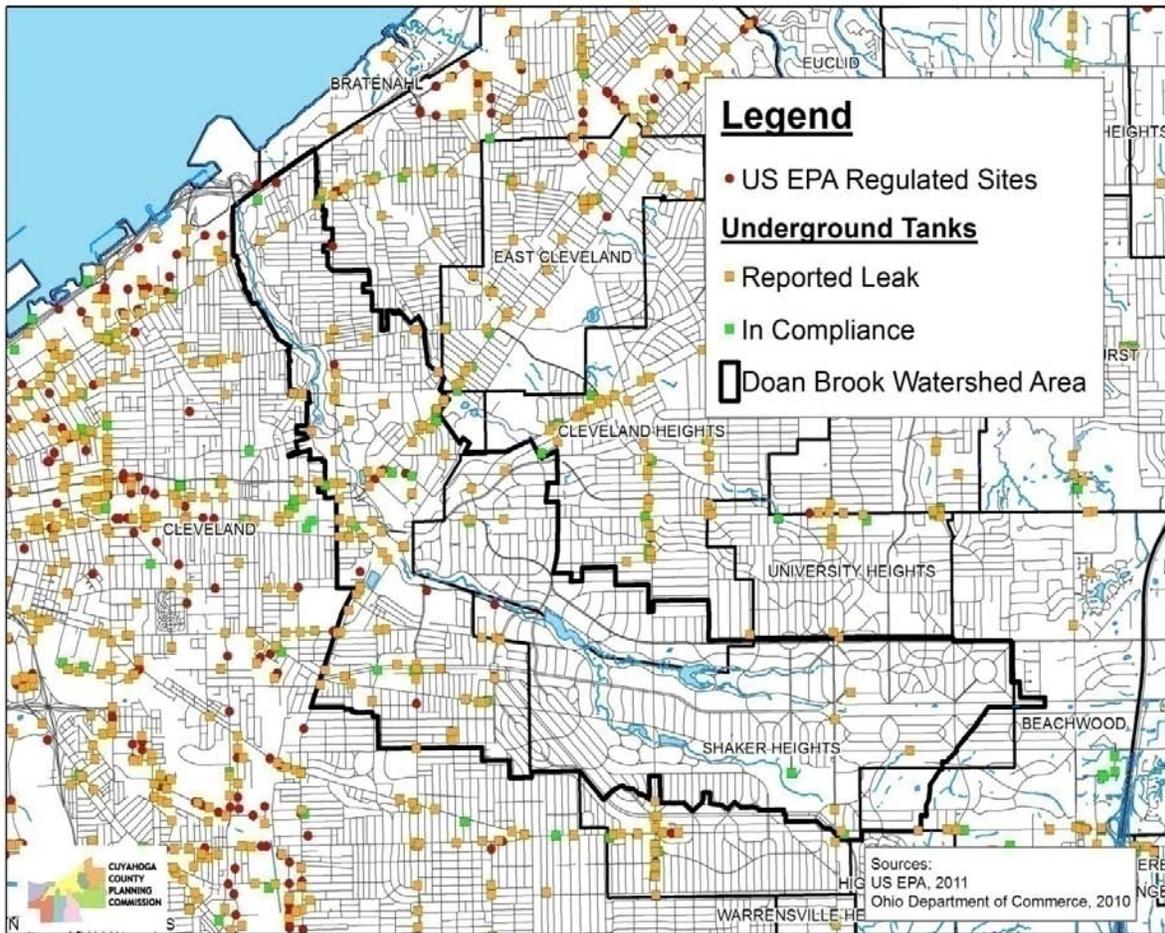
Intersection	24-hour estimate Average Daily Traffic
I-90 off Ramp	25,300
Ford Drive and Euclid	35,221
Carnegie and MLK Boulevard	55,973
Warrensville and Falmouth	36,508
Warrensville and Chesterton	35,098

Source: Cuyahoga County Engineer and Ohio Department of Transportation

Brownfield/Regulated Sites

Due to its urban surroundings, Doan Brook has environmental conditions that reflect land use activities by institutions and commercial businesses. The data reflected in Figure 19 shows regulated sites by Ohio EPA. These include remaining underground storage tanks, sites with air release permits and one site listed on the toxic release inventory. The impact that these sites have on soil and water quality will need to be understood and considered when planning for environmental improvements.

Figure 19. Regulated Sites



Source: Cuyahoga County Planning Commission, and US EPA and Ohio Dept. of Commerce

Wastewater Plants/Pump Stations

The Baldwin Water Treatment plant, just west of Stokes Boulevard, is one of the oldest and largest plants in the United States. Built originally in 1925 to assist with the growing population during Cleveland’s early expansion, the plant provides water treatment for a large population in Cleveland. Due to its size, the site provides an opportunity to educate the public and serve as a demonstration site for best practices in water resource protection, provided a proper site security plan is created.

Impervious Cover

Since Doan Brook is one of the most densely populated and developed watersheds along the Ohio Lake Erie coastline, impervious surfaces are a dominant landscape feature. In the Doan Brook watershed, impervious surfaces include roadways, rooftops and parking lots.

According to the Center for Watershed Protection, the direct correlation between percentage of impervious cover and water quality is presented as follows:

Sensitive Streams 0-10%: These streams are of high quality and are typified by stable channels, excellent habitat structure and diverse communities of both fish and aquatic insects. These streams do not experience frequent flooding and other hydrologic changes that accompany urbanization.

Impacted Streams 11-25%: Streams in this category show clear signs of degradation due to watershed urbanization. The elevated storm flows begin to alter stream geometry, erosion and channel widening. Stream biodiversity declines to fair levels with most sensitive fish and aquatic insects disappearing from the stream.

Non-Supporting Streams Over 25%: Streams in this category can no longer support a diverse stream community and serve as conduits to convey stormwater flows. The stream channel becomes highly unstable and is subject to severe down-cutting and erosion. The biological quality is generally poor and is dominated by pollution tolerant insects and fish.

As part of the Watershed Assessment Study in 2000, the NEORSD examined impervious surface types at a sub-watershed level. Table 11 from the NEORSD Study indicates that rooftops dominate impervious surfaces in all sub-watersheds except Horseshoe Lake. Rooftops and roads comprise 90% of the impervious surfaces in the sub-watersheds. Exceptions are the University Circle and Green–Marshall sub-watersheds where parking lots comprise 20% and 18% respectively of the impervious cover.

Table 11. Impervious Cover Types in Acres

Surface Type	Horseshoe Branch	Lower Shaker Lake	Green-Marshall	Doan Brook Gorge	Giddings Brook	University Circle	Rockefeller Park
Rooftops	85.7	61.6	100	36	149.3	227.2	167.6
Roads	91.6	44.4	50.5	25	98.9	140.4	104.5
Parking Lots	12.7	4	18.5	1.8	25.8	91.4	38.9
Total*	190 (17.3%)	110 (13%)	169 (14.8%)	62.8 (13.3%)	274 (27.4%)	459 (26.8%)	311 (27.7%)

*(x%) is percent of total sub-watershed area

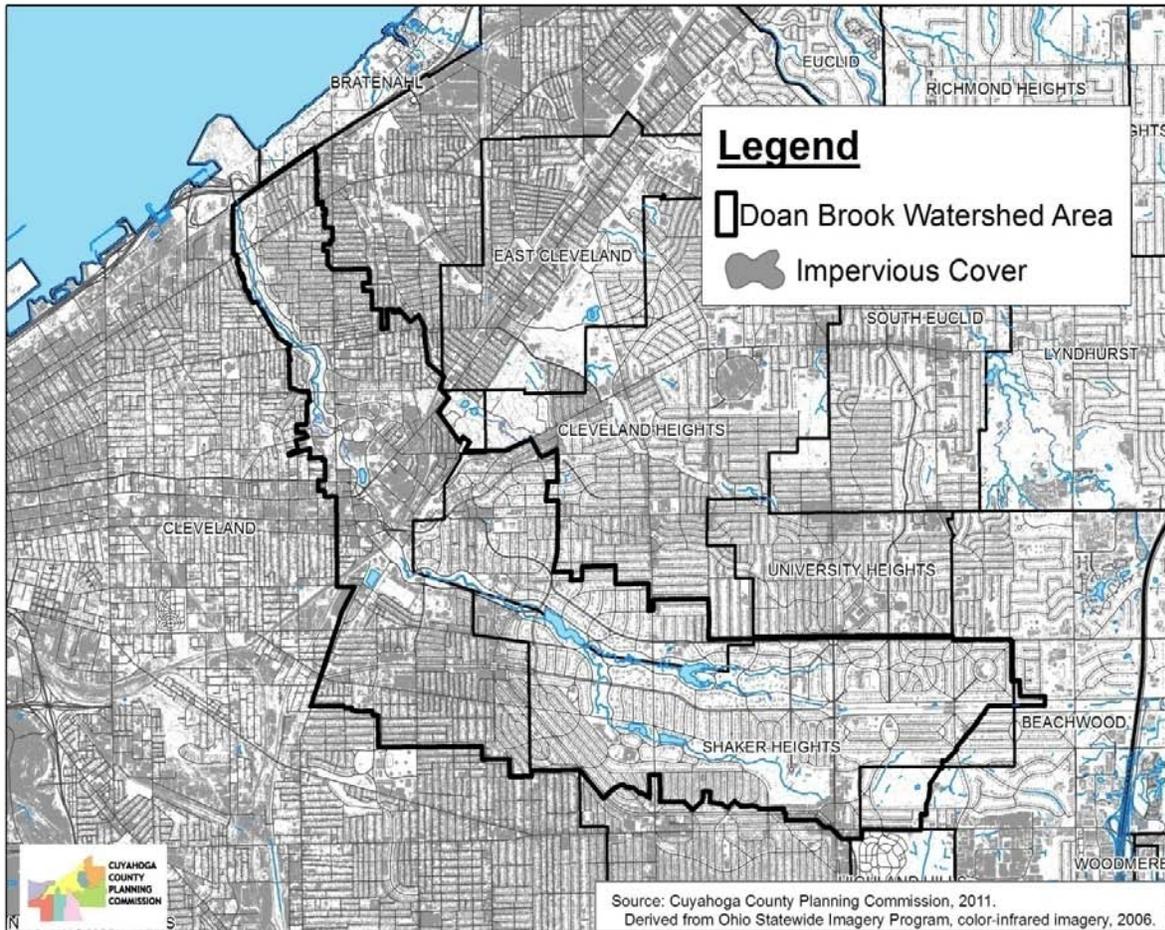
Source: Doan Brook Watershed Study, Montgomery Watson, 2001

Table 12. Impervious Cover by Municipality

City	Acres of Impervious Cover	Percent of Total Land in Watershed
Beachwood	17	9.9%
Cleveland	861	49%
Cleveland Heights	521	33.5%
Shaker Heights	868	31.2%
Total	2270	36.2%

Sources: Cuyahoga County Planning Commission; NEORSD, 2009

Figure 20. Impervious Cover Doan Brook Watershed



Source: Cuyahoga County Planning Commission

The second impediment to rainwater infiltration is compacted soils. Urban areas are notorious for compacted soils, which lose their ability to absorb precipitation and hence can contribute significantly to storm water runoff and high flashy flows in the streams. The NEORS D report conducted a visual assessment of compacted soil conditions and vegetative cover in parkland areas within the watershed. Of these parkland areas, Horseshoe Branch, Lower Shaker Lake and Doan Brook Gorge sub-watersheds were forested. In the other Sub-watersheds, parkland areas consist of more compacted soils and grassy areas, which do not provide optimum absorption.

Home Sewage Septic Systems

Cuyahoga Board of Health records verified that no registered home septic systems exist in the Doan Brook watershed.

Forest

Due to its highly urbanized nature, the Doan Brook watershed does not include any large forest areas. Forested areas are limited to the riparian corridors of the watershed. See Section III.D.5 Forested Riparian Corridor Assessment (p. 70) for a more detailed discussion of forested areas.

Agriculture

The Doan Brook watershed does not contain any large agricultural lands. It does contain small community gardens which could potentially be expanded into urban farms. Currently no farms exceed 10 acres.

Water

There are four man-made lakes on Doan Brook and two man-made lagoons. The lagoons do not receive flow from the stream but do discharge directly into it. The four lakes are Green, Marshall, Horseshoe, and Lower Shaker Lake. Lower Shaker Lake has the largest surface area of 17.6 acres and is located downstream from the confluence of the North and South branches. Horseshoe Lake is located at the confluence of the North and Middle branches of the Brook covering 12.5 acres of surface area and averaging a depth of 2.8 feet. The Green and the Marshall Lakes, located on the South Branch, are smallest in size at 6 to 7 acres of surface area. The Green and Marshall Lakes also are fairly shallow with maximum water depth of up to 5 feet with an average water depth of approximately 3 feet. (NEORSD WQ Monitoring and Sampling Report, p. 10.13-10.17)

Table 13. Lake Physical Characteristics

Lake	Surface Area (Acres)	Average Water Depth (ft)	Water Volume (cubic ft)	Average Sediment Depth (ft)	Sediment Volume (cubic ft)
Green	7.4	2.9	940,000	0.2	70,000
Marshall	6.3	3.4	924,000	1.5	415,000
Upper Shaker	12.5	2.8	1,546,000	0.8	453,000
Lower Shaker	17.6	3.2	2,454,000	1.8	1,380,000

Source: NEORSD, Water Quality and Monitoring Sampling Report, 2000

Other Ponds

Rockefeller and the Fine Arts Lagoon at Wade Oval are filled with municipal water but discharge into the Doan Brook. They are both located in the lower watershed and attract large geese populations which increase bacteria counts in Doan water quality analyses. A full inventory of detention basins and ponds will be completed when the NEORSD's stormwater management program is implemented.

Barren Lands

There are no barren lands in the Doan Brook watershed.

b. Protected Lands

The Doan Brook watershed is completely built out, with the exception of dedicated parklands which generally lie along the stream corridor. Fortunately, most of the stream riparian area falls within several parks within the watershed.

The confluence of Doan Brook and Lake Erie is contained within the Cleveland Lakefront Nature Preserve. This 88-acre man-made peninsula on the Lake Erie shoreline is adjacent to Cleveland Lakefront State Park and located at the northern end of Martin Luther King Jr. Boulevard. The Preserve is a land mass created over time as sediment dredged from the Cuyahoga River and Cleveland Harbor was placed within dike walls along the lakeshore. From 1979 to 1999 the U.S. Army Corps of Engineers managed the site – then known as Dike 14 – as a sediment disposal facility. After the site was closed to dredge material in 1999, nature took hold. The Preserve has 1.2 miles of shoreline, and is a haven for a variety of migratory birds, butterflies and animals. The Cleveland-Cuyahoga County Port Authority manages this community asset, formerly known as Dike 14, and opened it to the public in February 2012. The diverse mix of habitats includes grasslands, a forest area, meadows, mudflats, shrub lands, and wetlands. Audubon Ohio has designated the site as an Important Bird Area.

Moving upstream (south) along the Doan Brook is a series of parks on approximately 570 acres of land originally donated to the City of Cleveland by Jephtha Wade, William Gordon, Mr. and Mrs. John D. Rockefeller, Nathan Ambler and others. The parks include Rockefeller Park, Wade Park and Ambler Park in the City of Cleveland, and the Shaker Lakes Parks in Shaker Heights and Cleveland Heights. In Rockefeller Park the stream has been channelized and the stream banks are primarily artificial stone walls, but moving upstream through the parks the stream has generally been left more in a natural state, and has retained good riparian habitat and vegetative cover, and in most places is well forested.

Outside of existing parklands, there are no significant acres of forested undeveloped land.

c. New Development Trends

University Circle continues to be the epicenter of commercial, housing and institutional development in the watershed. The DBWP will need to seize opportunities to partner with developers to include green infrastructure design and/or retrofitting with stormwater BMPs.

A large development project currently being examined is the Opportunity Corridor. The Corridor would connect University Circle with I-490. The corridor study area covers 1,000 acres of land from I-490 to University Circle, with a small portion within or adjacent to the Doan Brook watershed in the University Circle Sub-watershed. While there are no direct impacts to Doan Brook associated with this project, it has the potential to impact the area in terms of development, redevelopment and traffic patterns. This can provide an opportunity for retrofitting the area with Green Streets and other BMPs.

The City of Shaker Heights has obtained the \$11.5 million required to design and construct improvements to the intersection at Van Aken, Chagrin and Warrensville Rds., in the Van Aken Business District. The six-leg intersection will be reconfigured to create a standard four-way intersection.

Project engineers will analyze potential impacts of each road reconfiguration option and the public comments to determine a preferred alternative, including green infrastructure

additions to the new street configurations. Detailed design is expected to be completed in 2012 and construction is scheduled to begin in 2013.

RTA is seeking funding for the rapid transit track extension from federal, state and government sources. As part of the funding application process, RTA is analyzing the alternatives and impacts for extending the Blue Line rapid transit tracks through the Warrensville/Van Aken intersection and to various endpoints including I-480 and I-271. If funding is acquired for this phase, design is anticipated to be complete in 2012-2013 and construction to begin in 2014.

RTA and the City of Shaker Heights have received funding for the intermodal transit station from federal, state and government sources. A consultant team is working with RTA and the City to study alternatives for the intermodal transit station building(s) and passenger waiting environment, bus/rail passenger transfers, bus access routes, pedestrian/bike connections, LEED certification and parking.

The Doan Brook watershed's primary development trend will be redevelopment and retrofitting of existing developed areas. This will provide opportunity to develop a strong program for green infrastructure practices in a developed urban watershed.

B. Cultural Resources

The cultural resources in Doan Brook are abundant and pose opportunities and challenges to its water quality improvements.

1. History of Doan Brook Watershed

Early Settlement

The surveyors of Moses Cleaveland's 1796 Connecticut Land Company were the first known Europeans to explore the Doan Brook watershed. The territory belonging to the Connecticut Land Company consisted of a sixty-mile wide strip of land extending along the Lake Erie shore from the eastern boundaries of what are now Sandusky and Seneca Counties to the Pennsylvania border. Nathaniel Doan, one of the surveyors from the Connecticut Land Company, was the first to settle in the Doan Brook watershed with his family in 1798. His settlement became known as "Doan's Corners" at today's intersection of Euclid Avenue and East 105th St. and became the gathering place for the other local settlers and travelers venturing east and west. (Gooch, p. 13)

Doan Brook began its transition into a public resource in 1872 when Jephtha H. Wade began the development of 63.5 acres (25.7 ha.) of land north of Euclid Avenue as a public park which he presented to the City of Cleveland in 1882 on the condition that walks, drives and a pond be created. During this same period William J. Gordon developed a 122 acre (49.4 ha.) estate at the mouth of the Doan Brook which was donated to the City in 1893 after his death.

Because the Wade and Gordon donations were on the north and south ends of a very distinctive reach of the Doan Brook, by 1890 the Cleveland Park Commissioners were being urged to acquire the lands in between and preserve the "wild romantic valley. . . as nature has formed and adorned it". Thus, in 1893 when the State of Ohio passed a law allowing park commissioners to raise funds and acquire park lands, the commissioners pursued this goal. Between 1894 and 1985 they acquired over 200 parcels (200 acres) of land in the valley.

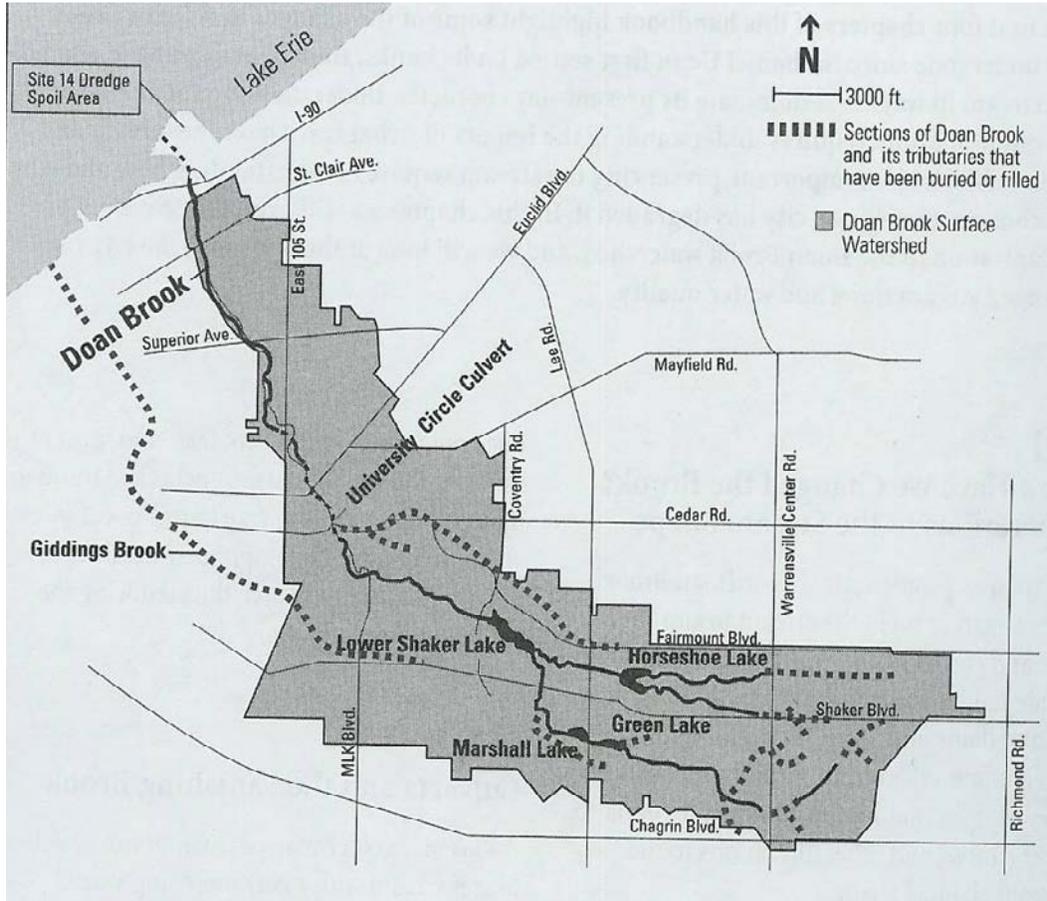
It appears that the park commissioners hoped to acquire the whole Doan Brook stream valley. They acquired substantial portions of the gorge area (Ambler Park) from the Ambler Family in 1894 and a large parcel of land (the Shaker Parklands) containing both Horseshoe Lake and Lower Shaker Lake from the Shaker Heights Land Company owned by John D. Rockefeller in 1896. Although these areas were not in the lower reaches of the Brook, engaging Rockefeller in the concept of a continuous park led to its completion. On July 22, 1896, Cleveland's Centennial Day Celebration, John D. Rockefeller presented the park board with lands to connect Ambler Park to Shaker Lakes Park and 254 acres (102.8 ha.) of land to be designated Rockefeller Park connecting Wade and Gordon Parks. Therefore, as of 1896, the whole lower reach of the Doan Brook became one continuous park. By 1900 the entire area was connected by drives overlooking the park (High Level Drive now known as East Blvd.), paralleling the Brook (Low Level Drive now known as Martin Luther King Blvd.) and numerous bridges crossing the Brook and valley. It has been reported that on a single Sunday in 1896 more than 43,000 people used High Level Drive in carriages, on bicycles and on foot.

In the upper watershed, settlement emerged with the first settlement by Daniel and Margaret Warren in 1819. In 1822, the Shakers established settlement in the upper watershed. The Shakers, a utopian Christian sect, lived and farmed along the Brook between today's Warrensville Center Road and Martin Luther King Boulevard. They were the primary occupants of the area for almost seventy years until they sold their tract. This sale eventually led to the design and development of one of the first planned communities in the country, Shaker Heights. (Gooch, pp. 4-13)

Urban Expansion

Over the next century, the expansion of the human population in Cleveland would emerge as the greatest impact to the Doan Brook watershed and its current condition. The development of Shaker Square and its surrounding residential areas expanded in the early 1900s. During this same period, University Circle's institutions were being expanded in the lower watershed. As urban development proceeded, tributaries of Doan Brook were buried in underground pipes, and nearby Giddings Brook was partially diverted into Doan Brook just upstream of University Circle. These changes had major detrimental impacts on the hydrology and hydraulics of the stream, particularly in the lower watershed. Larger infrastructure projects would further impact the watershed in the 1960's with the I-90 interstate cutting off Gordon Park and the Lakeshore from Doan Brook. In 1970, the Army Corps initiated the filling of the Lower Brook for its dredged disposal, which today is the Cleveland Lakefront Nature Preserve.

Figure 21. Buried Streams of Doan Brook



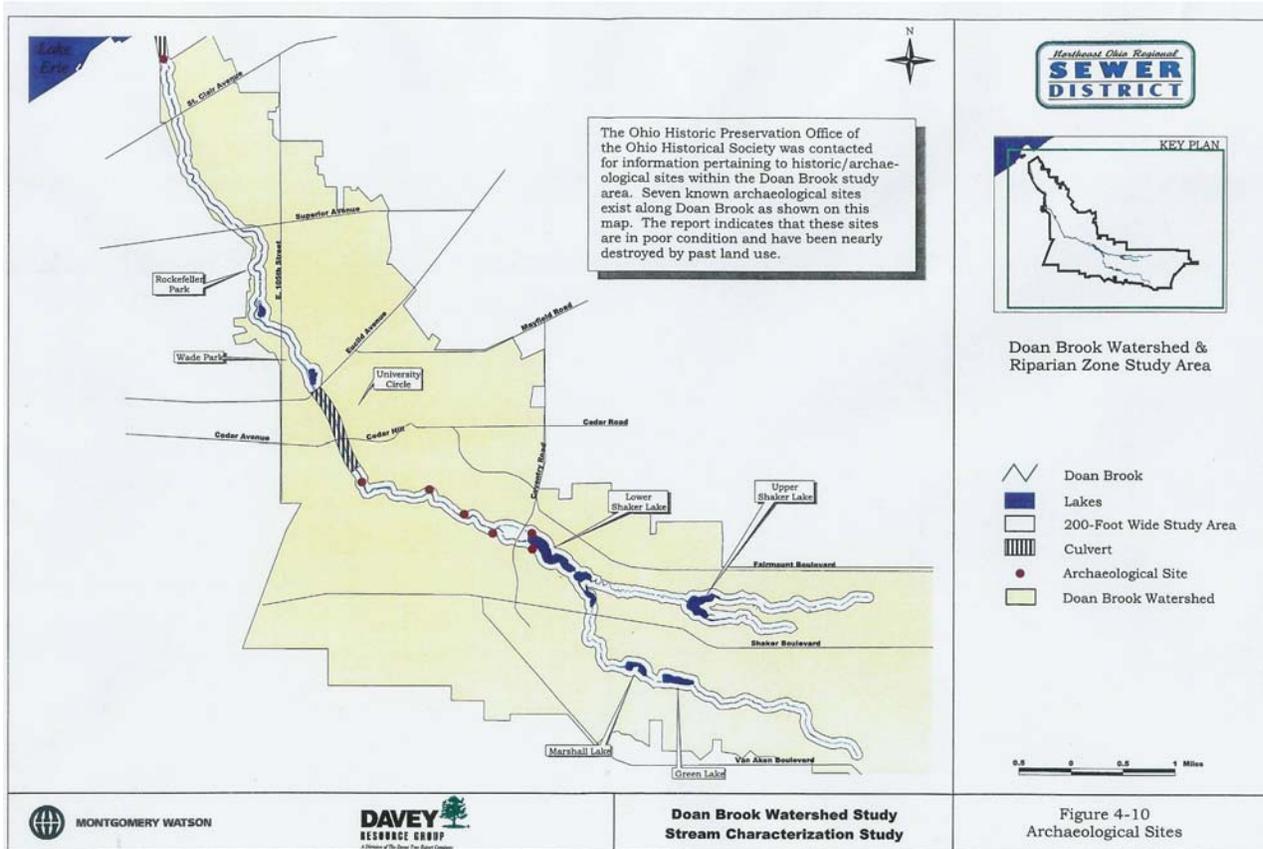
Source: Gooch, Doan Brook Handbook

The biggest accomplishment in land protection came in the 1960s, when a plan to create a freeway between Cleveland’s innerbelt and I-271 was prevented from going to construction. The local women’s garden committee initiated a grass-roots campaign to stop the freeway from destroying the Doan Brook riparian corridor, Lower Lake and Horseshoe Lake. The proposed freeway plan was aborted and the Nature Center at Shaker Lakes was launched.

2. Archeological Sites

In the NEORS 2000 report, the Ohio Historic Preservation Office provided a report of cultural resources within the riparian area of Doan Brook. There are at least seven known archaeological sites and two historic districts within the area. The historic districts are University Circle and Shaker Village. The archaeological sites are of Woodland, Late Archaic and Historic classification periods. The locations of these sites are shown on Figure 22. The Ohio Historic Preservation Office indicates that these archeological sites were in poor condition and most had been destroyed by various land use activities.

Figure 22. Archeological Sites

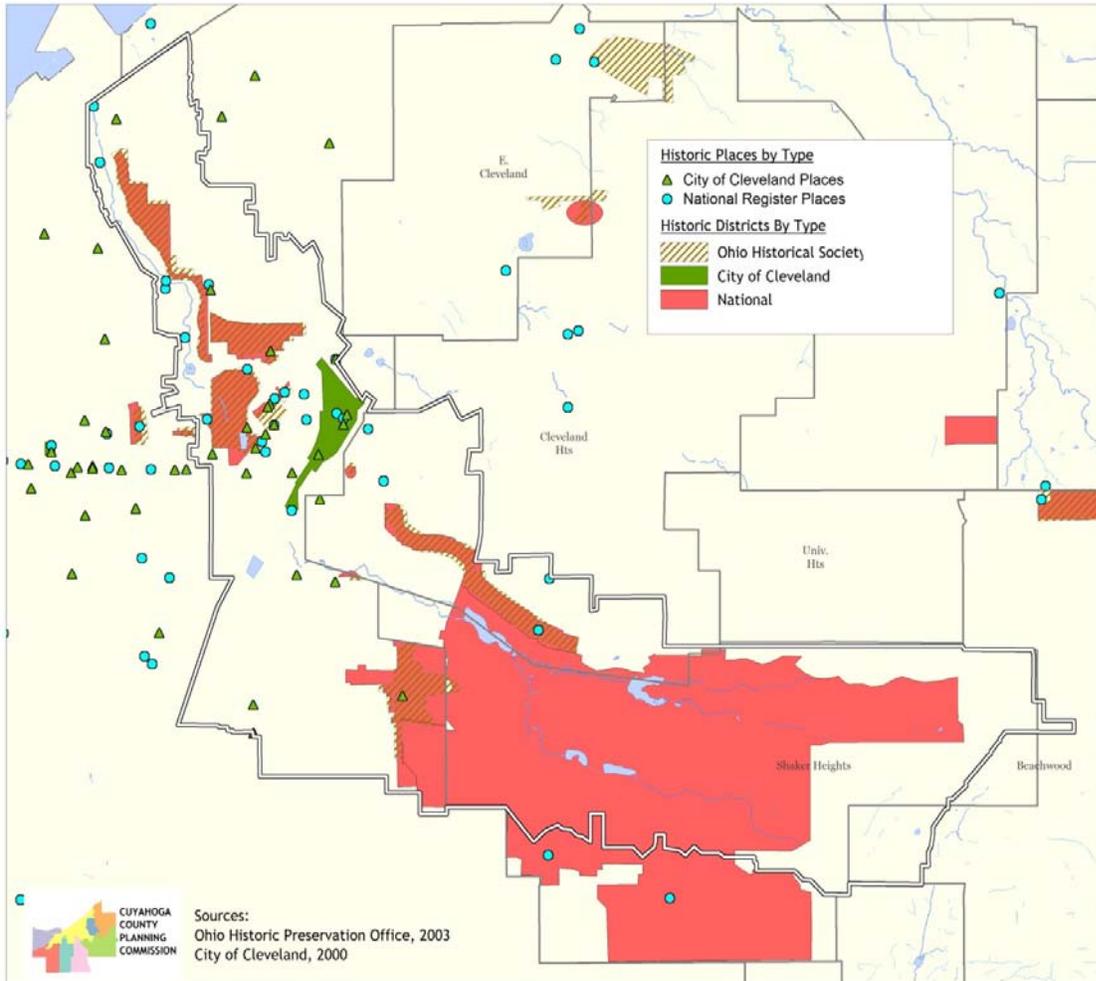


Source: NEORS, Existing Conditions Inventory and Assessment Volume 1, October 1999

3. Historic Landmarks and Districts

A cultural resource assessment was conducted in 2003 for Rockefeller Park. The assessment identified four early twentieth century brick and stone bridges inside the park listed on the National Register and a portion of the East Boulevard Historic District. The four bridges include the Wade Avenue Bridge, the Superior Avenue Bridge, the St. Clair Avenue Bridge and the Lakeshore Railroad Bridge. The Notre Dame Academy building located on the western edge of the park on Ansel Road south of Superior is also individually listed on the National Register. The City of Cleveland’s Landmark Commission also designated the Cleveland Cultural Gardens, East Boulevard, Martin Luther King Drive and the City Greenhouse within Rockefeller Park as Cleveland Landmarks. These Cleveland Landmark sites are not on the National Register except for the Shakespeare and American Legion Peace Gardens, which are within the East Boulevard National Register District. In Shaker Heights, the Shaker Historical Museum provides the relevant history of the Shaker colony settlement.

Figure 23. Historic Places & Districts.



Source: Cuyahoga County Planning Commission

C. Previous and Complementary Efforts

The Doan Brook watershed has benefited from forty years of community support. After the freeway fight, the Committee on the Doan Brook was formed to shepherd an understanding of the Brook and initiate new studies and remedial efforts. The Northeast Ohio Regional Sewer District's Doan Brook Study formed a community committee to guide its process of data collection and analysis. At the close of that study, the two committees decided timing was right to formalize civic engagement and create a new non-profit, the Doan Brook watershed Partnership.

The DBWP works to restore the watershed through projects, policy and education. It has completed two stream bioengineering projects, a stream bank revegetation project, a signage project, a bioswale, and on-going policy change efforts. The DBWP collaborates with many

community partners, but primarily the Nature Center at Shaker Lakes, to host events, classes and volunteer opportunities. The most popular of these community engagement actions have been the “Music By the Brook” concert series, storm drain stenciling, rain barrel workshops, rain gardens and sustainable landscaping. The NCSL, the three watershed cities and the DBWP have created a Parklands Management Plan for the Shaker Parklands of the upper watershed.

The DBWP continues to facilitate dialogue between the City of Cleveland, NEORSD and stakeholders of the Rockefeller Park Sub-watershed regarding mitigation funding that the City received via Ohio EPA, due to environmental impacts from construction at Cleveland Hopkins Airport. The mitigation funding, now being managed by NEORSD, will go to enhancement of the Doan Brook between E. 105th and Superior Avenue in the Rockefeller Park Sub-watershed.

In addition to these projects, water quality monitoring is ongoing in the watershed. The Northeast Ohio Regional Sewer District monitors consistently and additional monitoring has occurred related to focused studies on the Shaker Lakes.

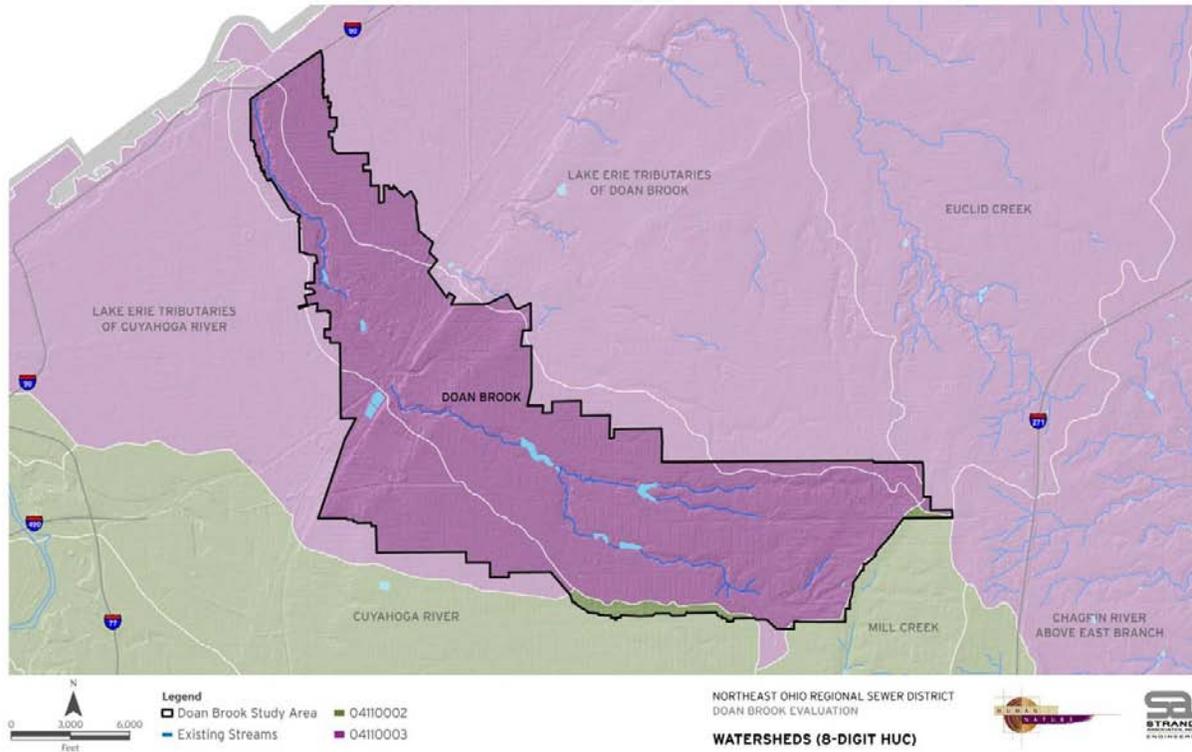
Numerous plans and studies have been conducted of the watershed and listed in the Reference section of this report.

D. Physical Attributes

1. Early Settlement Conditions

The Doan Brook watershed has undergone two changes that have significantly affected its function and quality: size and nature. The expansion of sewer systems and rerouting have increased the size of the Doan Brook watershed by almost 23 percent from an original area of 9.7 square miles in the 1920s to its current 11.9 square miles. This expansion includes the drainage area of Giddings Brook. (Gooch, p. 42) The current drainage area is determined by the storm sewer drainage network, not necessarily topography. Figure 24 illustrates the difference between the historical, topographically-based watershed boundary, shown in the faint white outlines, and the actual current drainage boundary or sewershed, shown in darker shading.

Figure 24. Historic and Current Watershed Boundaries



Source: NEORSD, 2011

The dense forest that once covered the watershed in the early settlement days has been replaced by impervious cover surfaces such as parking lots, roads and buildings. The loss of forest cover and the increase of non-porous surfaces has greatly impacted the groundwater recharge, flow regime and quality of the Doan Brook from its pre-settlement days.

2. Channel and Floodplain Conditions

As part of the assessment conducted by NEORSD in 2000, the geomorphology of Doan Brook was analyzed. For the purpose of the study, the Brook was divided into five sections: the headwaters (the watershed east of Coventry Rd.), the gorge, University Circle closed culvert, engineered open channel along Martin Luther King Boulevard in Wade and Rockefeller Parks, and the closed culvert at the mouth of Doan Brook near Lake Erie. A summary of this assessment is provided in Table 14.

Table 14. Doan Brook Stream Characterizations and Classifications

Segment	Headwaters	Gorge	Closed Culverts	Engineered Open Channel
Rosgen Stream Type	C-3/C-4	B-2	n/a	C-2
Stream Gradient (average %)	0.9% to 1.3%	2.7%	1.8% ^a 0.23% ^b	0.42%
QHEI (average range)	64 to 70	60 to 86	n/a	44 to 67
Valley Width	Wide	Narrow	n/a	Wide
Entrenchment	Minor (except locally where retaining walls are present)	Deeply incised	n/a	Incised and locally undermining structures
Confinement	Minor (except locally by short retaining walls)	Strongly confined by valley walls	Culverted	Moderate overall; strong where retaining walls are present
Channel Width-to-Depth Ratio	>12	>12	Culverted	>12
Stability	Stable	Stable	Artificially stable	Unstable and prone to erosion locally
Sensitivity to Disturbance	Moderate to very high	Very low	n/a	Low
Flooding Potential	Minor	Minor	Minor	Large
Sediment Supply	Moderate to high	Very low	n/a	Low
Streambank Erosion Potential	Moderate to very high	Very low	n/a	Low
Vegetation Controlling Influence	Very high	Moderate	n/a	Moderate
^a University Circle closed culvert				
^b Closed culvert at the mouth				

Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

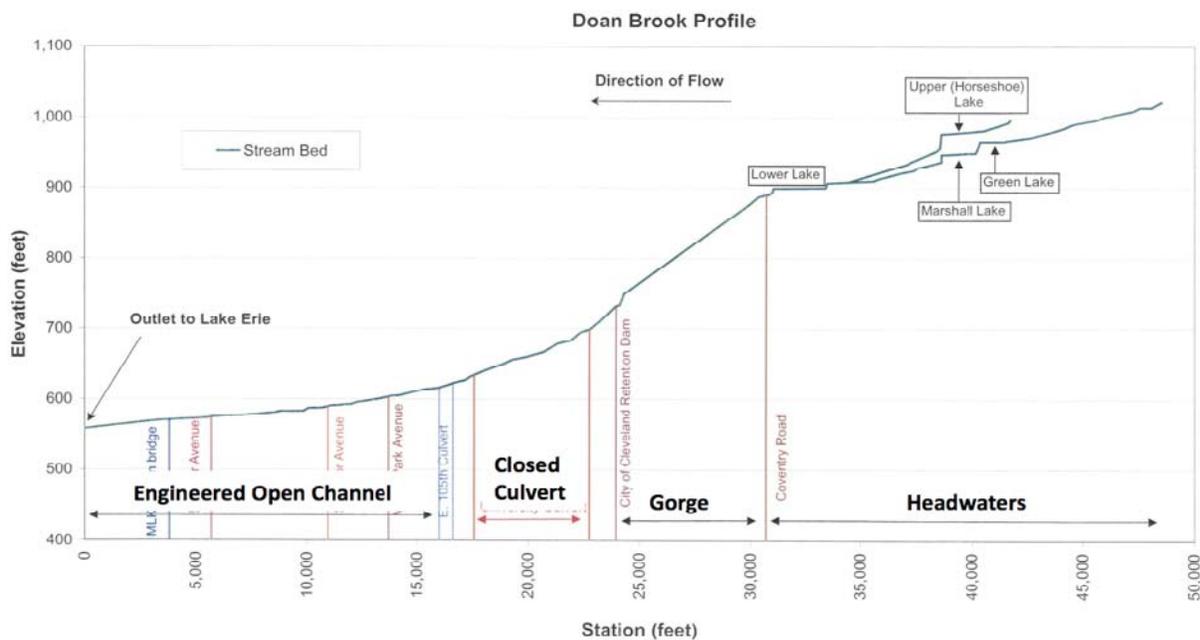
The headwaters of a stream typically include the upper portions that drain less than 20 square miles. Technically, all of Doan Brook is considered headwaters for Lake Erie; however, the headwaters for Doan Brook itself include the upper portions and tributaries above Lower Shaker Lake. For most of this reach the stream riparian corridor is in park lands, and therefore is largely vegetated.

Gorges are deep, narrow passages confined within steep rocky sides. A gorge exists within the segment of Doan Brook that extends from below Lower Shaker Lake south to Ambler Park. This segment is also included in the park lands, and most of the riparian corridor is vegetated with forest.

Closed culverts are engineered concrete pipes which convey water beneath the ground. There are two segments of Doan Brook that are culverted. The upstream culverted segment extends beneath University Circle from Ambler Park north to several hundred feet beyond Wade Lagoon. The second culverted segment of the Brook discharges into Lake Erie.

Engineered open channels are manmade or altered watercourses, and the channel banks may consist of natural or constructed materials. The segment of Doan Brook that is shown to be an engineered open channel extends along Martin Luther King, Jr. Boulevard through Wade and Rockefeller Parks, between the two closed culverted segments. Most of this open channel segment consists of rock and metal sheet pile walls.

Figure 25. Stream Profile

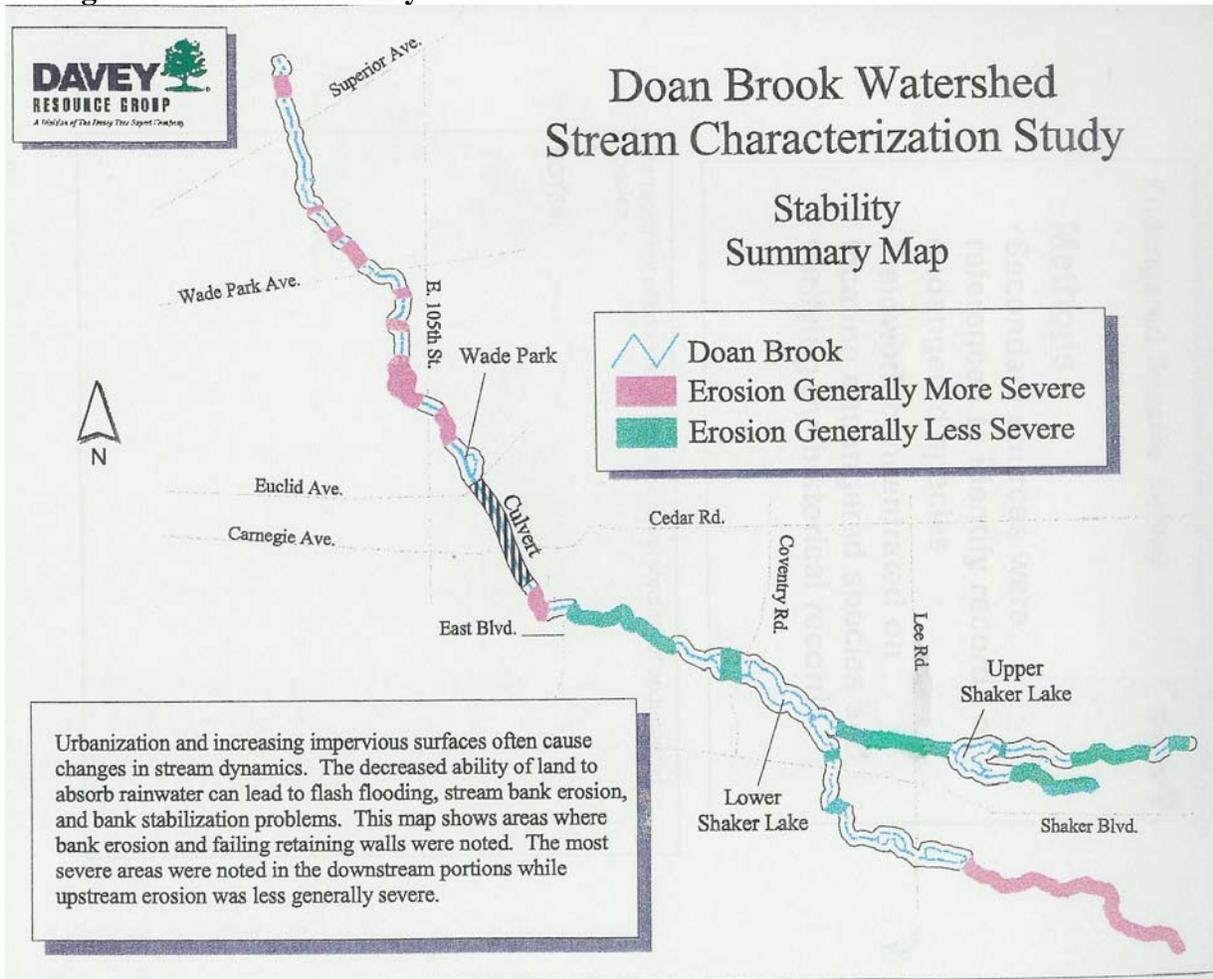


Source: NEORSD, Doan Brook Model Development and Calibration Report, June 2001

3. Streambank Stability and Erosion

Erosion and streambank stability are constant challenges along streams. In rural forested watersheds the movement of the stream and its erosive behavior can occur naturally with minimal impact to its surroundings. In urban watersheds, erosion and bank stability can have a profound effect on structures, in-stream flows and debris management. The NEORSD 2001 report identified that generally the upper reaches of Doan Brook do not suffer from severe streambank erosion because there is natural vegetation to stabilize the banks. Thus, erosion occurs but the presence of a wider floodplain allows the process to continue without impact to the surrounding areas. The exceptions in the upper watershed are the golf courses where removal of the natural riparian vegetation has greatly destabilized the streambanks. The downstream portions of the watershed suffer more extensive streambank erosion due to the absence of natural riparian vegetation.

Figure 26. Stream Stability

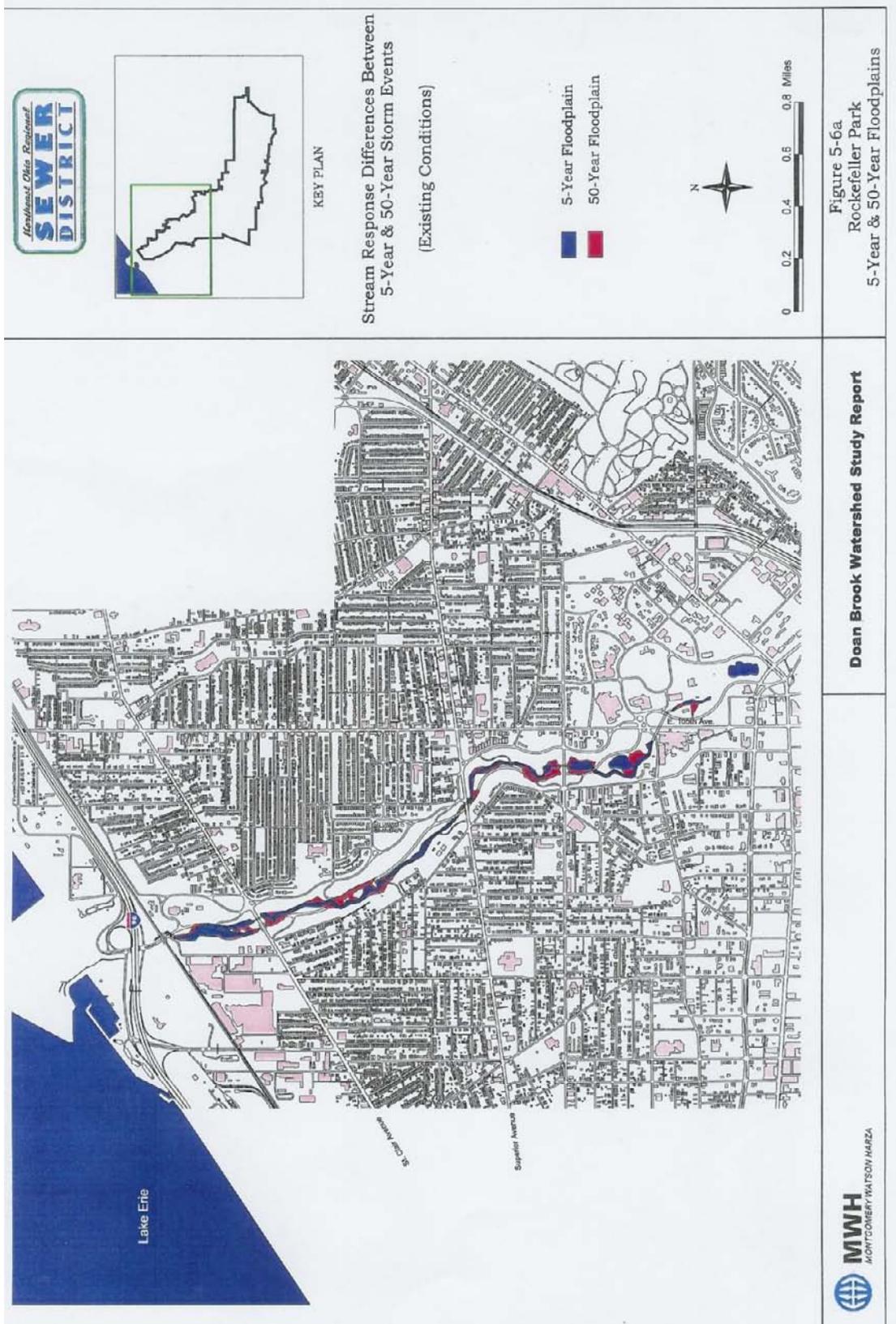


Source: Davey Resource Group, Doan Brook Watershed Stream Characterization Study, Sept. 1998

4. Hydrology and Flooding

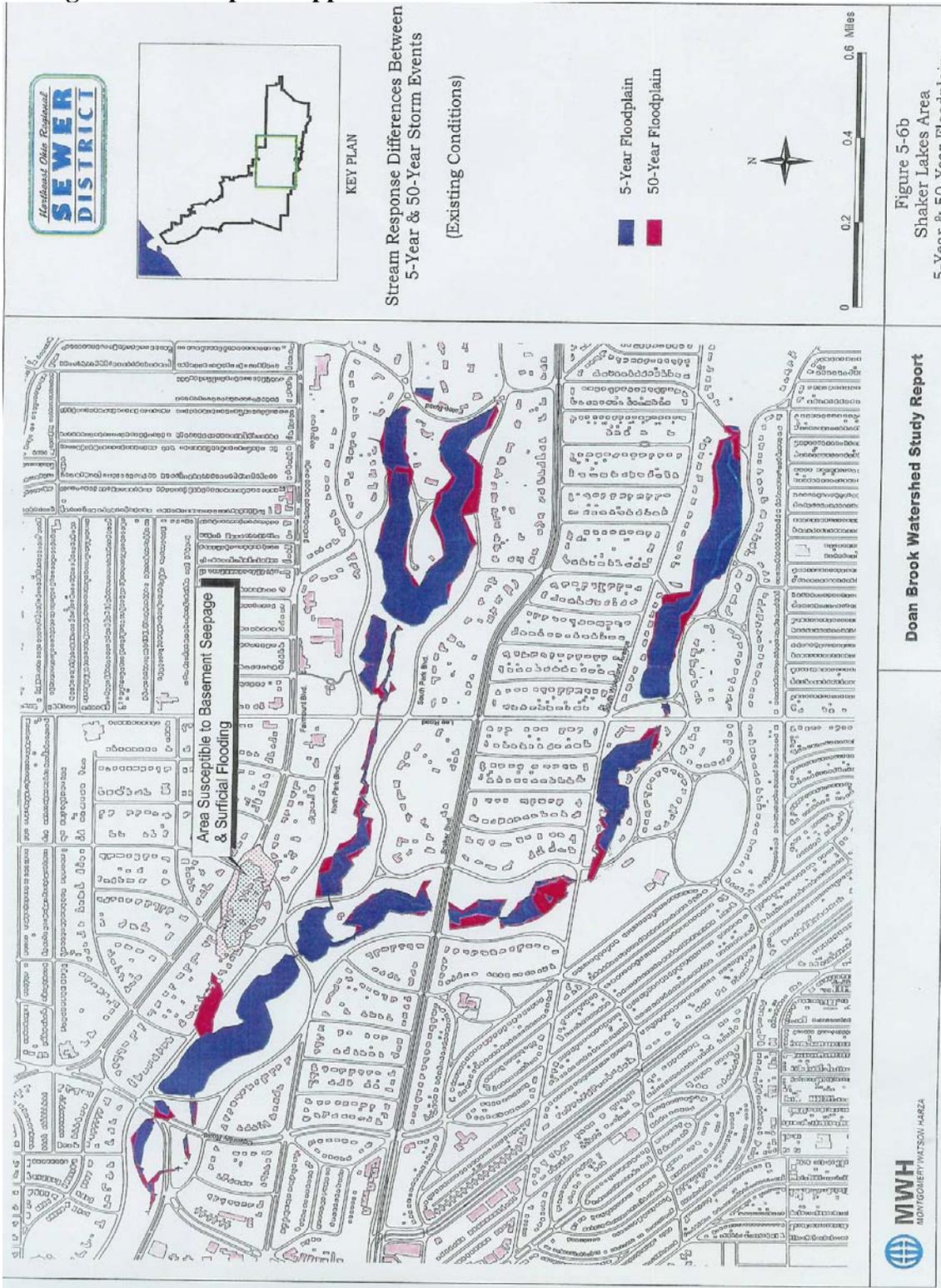
The surface hydrology of the Doan Brook watershed is a result of various factors and conditions. First, its urban conditions have resulted in increased flows. Pavements, storm sewers and buildings provide little room for natural floodplains to occur. In addition they create increased flow velocities and volumes that hit the Brook from all the storm sewers, causing erosion and instability in the channel. In addition to the urban conditions, Giddings Brook, originally not part of the watershed, now drains a large percentage of its flow into Doan Brook through a sewer diversion. Flooding has occurred in the Doan Brook watershed frequently over the years. Culverts that were designed for less flow cannot withstand the high velocity flows that short intense storms produce. Increased debris in Doan Brook and near its culverts limits the capacity of the culverts and the streambed to dissipate the energy of the flows. Lastly, the lack of floodplain access in the lower watershed, hampered by stone and bulkhead channel walls, prohibits the flow from slowing and spreading sediment across the valley (Gooch, pp. 64). In sum, outdated infrastructure, increased imperviousness, and loss of floodplain in the lower watershed all contribute to the flooding issues in the watershed.

Figure 27. Floodplain Lower Watershed



Source: NEORS, Doan Brook Watershed Study Report, August 2001

Figure 28. Floodplain Upper Watershed



Source: NEORS, Doan Brook Watershed Study Report, August 2001

5. Forested Riparian Corridor Assessment

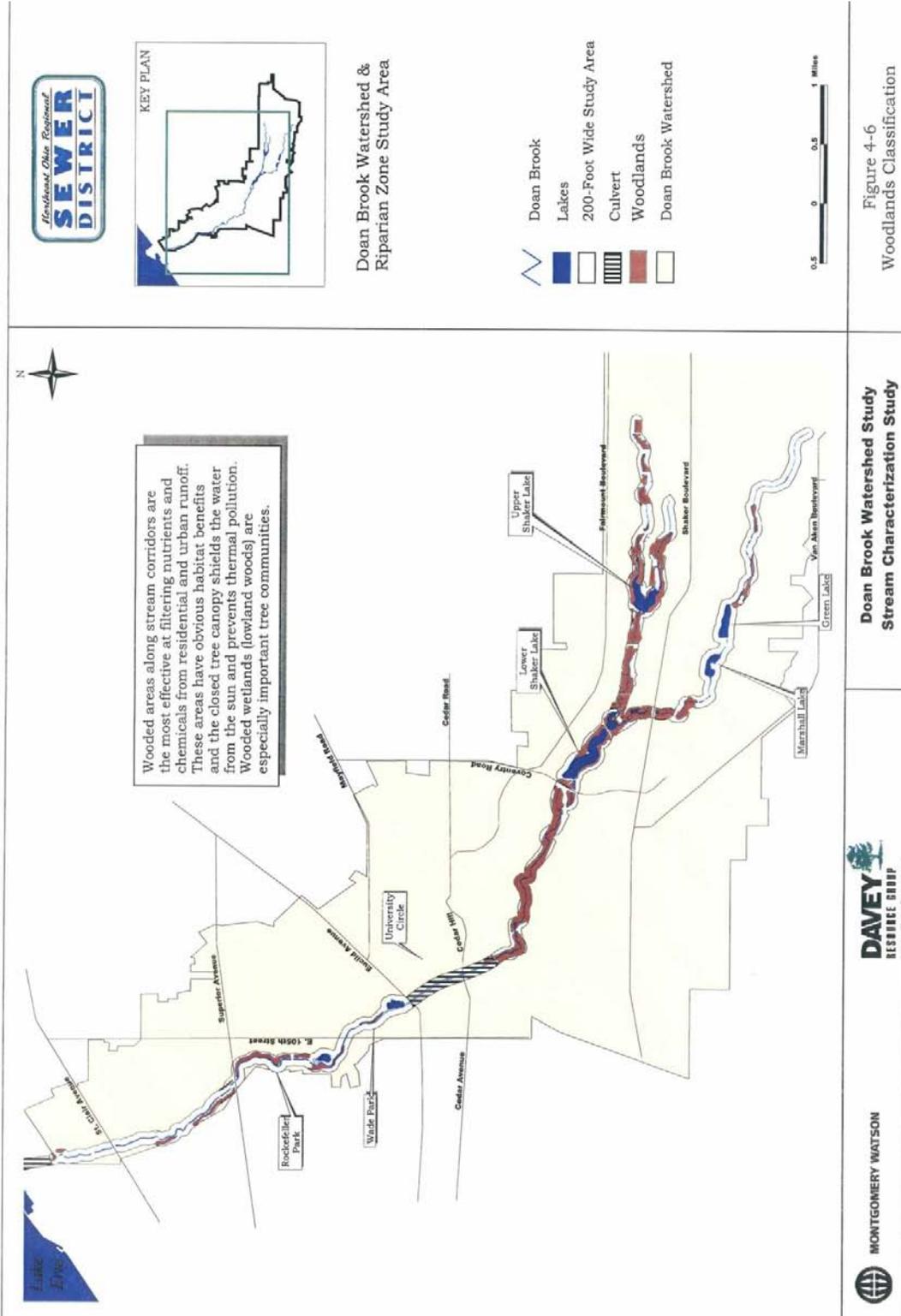
Although Doan Brook is surrounded by dense urbanization, its riparian corridor has largely been preserved, much of it a healthy deciduous forest. In the upper watershed, the riparian corridor is home to a dense, tall-treed forest and a few marshes, associated with the Shaker Lakes. In this forested riparian corridor, two general vegetative associations dominate: forests of drier upland areas and forests of wetter lowland areas. The largest area of relatively undisturbed upland forest in the upper watershed lies along the Brook between Horseshoe Lake and Lower Shaker Lake. Northern red oak, beech and sugar maple are dominant with a significant number of tulip poplars. If left to themselves the trees of this area will someday resemble those found by Moses Cleveland, at least until climate change has altered the vegetation zone of the region.

A representative stand of wet lowland forest lies along the Brook, immediately south of the Nature Center at Shaker Lakes. The bottomland along the stream is dominated by silver maple, cottonwood and pin oak, while the drier slopes of the valley provide habitat for northern red oak, hemlock, white oak and hickory.

The Escarpment and Doan Brook gorge are home to increasing slopes and a deep ravine which are habitat for a vegetative community that differs from that of the upper watershed. The forest along the dry Escarpment edge and upper slopes is dominated by red, white and chestnut oaks, with some cucumber trees and shagbark hickory. This is very similar to the pre-settlement forests that had existed. Within the ravine itself, red and sugar maple dominate along with red oak, tulip poplar, wild black cherry and yellow birch. In wetter parts of the ravine, cottonwood, sycamore and green ash are also present. Hemlocks, which once dominated the ravine, have thinned with less forest surrounding the area. Many under-story species exist, including viburnum and honeysuckle in the Escarpment, and dogwood, cranberry and hornbeam in the ravine.

The lower watershed provides remnants of the native forest, particularly in Rockefeller Park. American elm, black ash, silver maple, pin oak and tupelo are found in some areas on the sloping valley sides. The tops of the valley sides and sand ridges are home to oaks and tulip poplar. A variety of under-story vegetation also exists, consisting of dogwood, hornbeam and honeysuckle. (Gooch, p. 31)

Figure 29. Woodlands in Doan Brook Riparian Corridor



Source: NEORSD, Existing Conditions Inventory and Assessment Volume 1, October 1999

6. Dams

There are five dams in the watershed. Four of the dams form the lakes in the upper watershed; Horseshoe, Lower Shaker, Marshall and Green. The fifth is the Ambler Park detention dam located downstream from Martin Luther King Boulevard. This dam was installed in 1997 to create a flood detention basin and does not form a permanent lake.



Table 15. Dams

Dam Location	Subwatershed	Height
Horseshoe	Horseshoe Lake	30 feet
Shaker	Shaker Lake	17.3
Marshall	Green-Marshall Lake	N/A
Green	Green-Marshall Lake	N/A
Ambler	Doan Brook Gorge	28 ft

Source: Gooch, Doan Brook Handbook, Appendix H

7. Channelization

Some reaches of Doan Brook have been extensively channelized. The most significant is the nearly two miles along Rockefeller Park where rectangular channels lined by vertical stone walls were installed to protect Martin Luther King Blvd and prevent flooding. The walls, 1930's WPA projects, fit the aesthetic of the Frederick Law Olmsted style park design. Reinforced channels have also been built in Ambler Park and other isolated sections of the upper watershed.

8. Floodplain Connectivity

A general assessment of the specific floodplain connectivity in the watershed was conducted as part of the Doan Brook Watershed Study in 1999. Five locations in the watershed were assessed to determine stream type and conditions. In four of the five locations, Doan Brook was classified as a Type C stream, according to Rosgen classifications. The Rosgen classification that was conducted defined these locations in Doan Brook as low gradient meandering channels with well-defined floodplains. The fifth location, the gorge, was identified as a type B stream and described by Rosgen as moderately entrenched with moderate relief. Additionally, the lower watershed in Rockefeller Park is largely channelized and thus limits its floodplain connectivity. Table 14 (p. 65) in this report outlines the locations and findings of this assessment.

9. Entrenchment

Streambed entrenchment is very common in urban streams due to short intense storms, increased erosion and decreased stability of the stream banks. As part of the Doan Brook Inventory and Assessment Study in 1999, a general assessment of entrenchment was conducted in the watershed. The entrenchment ranged from minor in the headwaters and upper watershed, to deeply incised in the gorge. Table 14 (p. 65) of this report outlines these findings.

10. Status of New Impacts

New development trends in the watershed, as discussed in the land use section, will be focused on redevelopment of existing disturbed lands and retrofitting of structures and facilities.

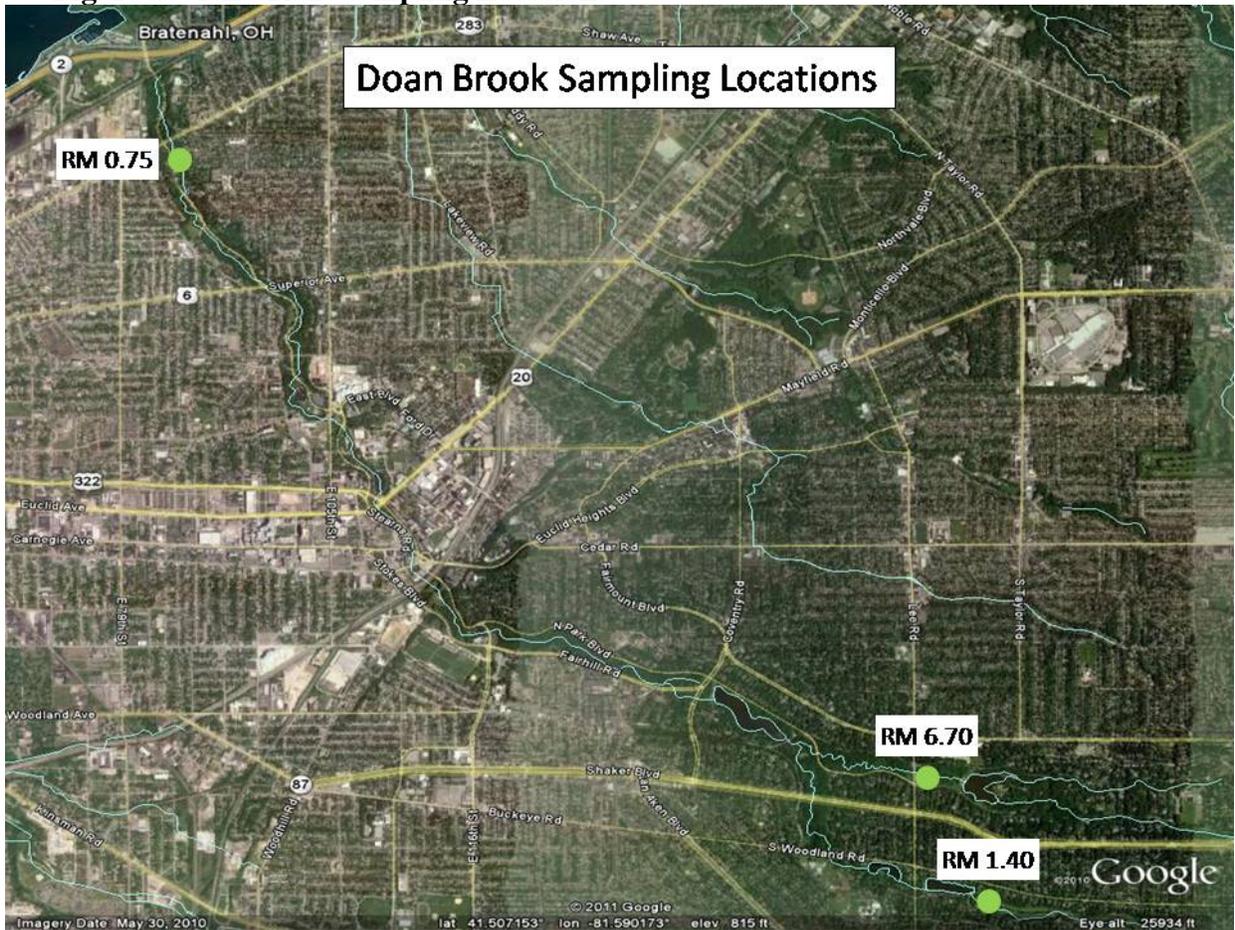
The expected road, highway and bridge construction will include study of the Opportunity Corridor, any realignment at the Van Aken Business District, and reconfiguration of Martin Luther King Boulevard at East 105th Street. Additional road improvements will likely be for replacement of older infrastructure or resurfacing of existing roads through the cities' capital improvement programs.

E. Water Resource Quality

The key parameters to measure water resource quality have been established by the Ohio Environmental Protection Agency (Ohio EPA). These standards include "beneficial use designation criteria and aquatic habitat use designation criteria." With these parameters, the condition of a water body can be determined and its restoration, management, and protection needs can be identified for the future.

Water quality sampling has been performed on an annual basis by the NEORSD for a number of years in order to evaluate how well the Brook is meeting the applicable water quality standards. The sampling locations are shown below in Figure 30.

Figure 30. NEORSD Sampling Locations



Source: NEORSD 2011

1. Attainment Status

The Ohio EPA has developed criteria to assess the biological use attainment of a water body segment. The general criteria include full attainment, partial attainment and non-attainment. Table 16 represents the most recent attainment status for the Doan Brook watershed, which, as stated throughout, is severely impacted by urbanization. The fish communities are in non-attainment status throughout the surveyed segments. The benthic macroinvertebrate communities are in attainment or non-significant departure of attainment at two of the segments sampled in 2010. The attainment status table presented compiles two of Ohio EPA's three biological indices for assessing the ecological quality of streams. The Index of Biotic Integrity (IBI) utilizes fish communities and the Invertebrate Community Index (ICI) uses benthic macroinvertebrates. The Modified Index of Well-being (MIwb), another fish community assessment, is not applicable to headwater sites (<20 sq. mi.).

Table 16. Use Attainment

Attainment Table				
Doan Brook (19-039) - WWH Use Designation				
Fish/Invert. River Mile ¹	IBI	ICI ²	QHEI	Attainment Status
NEORSD – 2010				
1.40 / 1.40	23 (ave. of 2)	34	67.50	PARTIAL
6.70 / 6.70	19 (ave. of 2)	6	67.00	NON
0.75 / 0.75	26 (ave. of 2)	32	62.50	PARTIAL
NEORSD – 2009				
1.40 / 1.40	24	20	66.00	NON
6.70 / 6.70	24	12	56.50	NON
1.30	-	-	68.25	-
0.75 / 0.75	30	28	62.00	NON
NEORSD – 2008				
1.40 / 1.40	22	8/8	59.00	NON
6.70 / 6.70	20	4	65.00	NON
0.75 / 0.75	22	(FAIR) ³	51.00	NON
NEORSD – 2007				
1.40 / 1.40	12	10/8	50.75	NON
6.70 / 6.70	12	0/8	57.50	NON
0.75 / 0.75	26	28	57.00	NON

Ecoregion Biocriteria: Erie/Ontario Lake Plain (EOLP)

¹River Mile 1.40 is located on the South Branch of Doan Brook; all other sites are located on the Main Branch.

²In 2007 and 2008 two Hester-Dendy's were installed, all associated scores have been listed. However, an average was used to determine attainment.

³The narrative rating was based upon a qualitative sampling, since no quantitative sampling was collected.

INDEX - Site Type	WWH	EWH	MWH
		IBI - Headwaters	40
		ICI	34
			50
			46
			24
			22

Source: NEORSD 2011

Chemistry

The extremely urbanized nature of the watershed results in elevated levels of some nutrients (resulting from CSOs, fertilizers, and animal wastes) and dissolved solids (possible long-term consequence of winter deicing). Table 17 displays chemistry data for several points in the stream.

Table 17. Selected Chemistry Results

Percentile	<u>Total Dissolved Solids (mg/l)</u>			Statewide Data
	RM	RM	RM	
	0.75	1.40	6.70	
95%	517	461	426	1250
75%	473	401	391	529
50%	410	365	384	413
25%	369	337	381	298
Ohio Water Quality Standard			1500	

Percentile	<u>Phosphorus (mg/l)</u>			Statewide Data
	RM	RM	RM	
	0.75	1.40	6.70	
95%	0.23	0.22	0.22	0.7
75%	0.19	0.17	0.21	0.16
50%	0.14	0.14	0.19	0.06
25%	0.13	0.13	0.16	0.025
Ohio EPA Target			0.1	

Percentile	<u>Nitrate (mg/l)</u>			Statewide Data
	RM	RM	RM	
	0.75	1.40	6.70	
95%	0.70	1.12	0.53	3.1
75%	0.57	0.93	0.50	0.9
50%	0.46	0.70	0.41	uj0.47
25%	0.35	0.24	0.09	0.19
Ohio EPA Target			1	

Red shaded results are above the statewide data

Bolded and underlined results are above the standard or target

Source: Northeast Ohio Regional Sewer District, 2010; Ohio EPA

Water Quality of Lakes

All of the lakes' water quality was monitored and reported by the NEORSD in 2000. As a result of this monitoring, the following general information was summarized.

All of the lakes indicate low levels of heavy metals, but Fe (iron) is well within metal concentrations of Ohio Water Quality Standards (WQS). Fecal coliform and *E. coli* densities are within Ohio WQS during dry weather monitoring of the lakes. Phosphorous, chlorophyll-a and water clarity showed distinct seasonal variation reflecting the patterns of algal growth and nutrient uptake in the lakes. Dissolved oxygen is generally above the Ohio WQS under the water's surface. However, depleted DO conditions were observed at the sediment-water interface during the summer period. This is likely the result of high sediment oxygen demand (SOD) from the organic lake sediment. Average sediment depth for the lakes ranged from 0.2 feet in Green Lake to 1.8 feet in Lower Shaker Lake. Based upon the Ohio EPA classification method, all of the lakes have eutrophic states in the range from 70 to 78, which indicates hypereutrophic conditions. (NEORSD Water Quality Monitoring and Sampling Report, September 2000, Section 10)

Groundwater Quality

There are currently no monitoring wells for groundwater quality and no studies found, to date, on any sites.

Wetlands Quality

There have been no studies or assessments performed to determine the quality of the wetlands in the Doan Brook watershed. Further investigation on the quality of the wetlands will need to be conducted to classify their condition and quality in accordance with Ohio EPA standards for wetlands.

Amphibian Diversity

Data was collected on amphibians and reptiles in 1998 by a variety of academic institutions. Project findings showed a high density of red-backed salamanders, but common streamside species were completely lacking. According to the 2001 NEORS D Watershed report, potential contributing factors for these conditions include:

- Water quality – slightly elevated concentrations of copper, sediment deposition, low dissolved oxygen concentrations in the lakes and hypereutrophic conditions in the lakes.
- Lack of recruitment – The Brook is cut off from Lake Erie and significant distances exist between the Brook and other sources for recruiting new species, such as vernal pools.
- High velocity flows – Multiple lines of evidence point to high flows and the resulting habitat abrasion as significant stressors to aquatic communities in the Brook.
- Lack of in-stream habitat – A lack of in-stream habitat particularly refuge and rearing areas to escape high velocity flows was identified in some sub-watersheds in the studies.
- Lack of habitat in riparian and upland areas – Lack of riparian wetlands and small vernal pools were identified in some areas.

Fish Diversity

Doan Brook possesses physical characteristics that could support a variety of fish communities. These characteristics include well-developed riffles, runs and pools, a tree canopy in most areas, and the presence of deadfall accumulation and undercut banks for refuge and habitat. The two major challenges for the fish communities in Doan Brook are water chemistry and physical barriers. The dominance of pollution-tolerant species in Doan Brook indicates that water chemistry is a factor limiting healthy fish communities. Fish migration barriers are numerous in Doan Brook, both natural in the gorge area with its waterfalls, and artificial with the culverts and dams, particularly the culvert at Lake Erie.

The NEORS D Watershed report identified the following factors limiting fish diversity in Doan Brook:

- Water quality
- Lack of recruitment ability
- High velocity flows
- Lack of in-stream habitat
- Aggressive/invasive species competition
- Fish migration barriers
- Low base flows

The Assessment Study of 1999 assembled a list of headwater and pioneering fish that were likely historical fish in the lower reaches of Doan Brook.

Table 18. Probable Historic Fish in Doan Brook

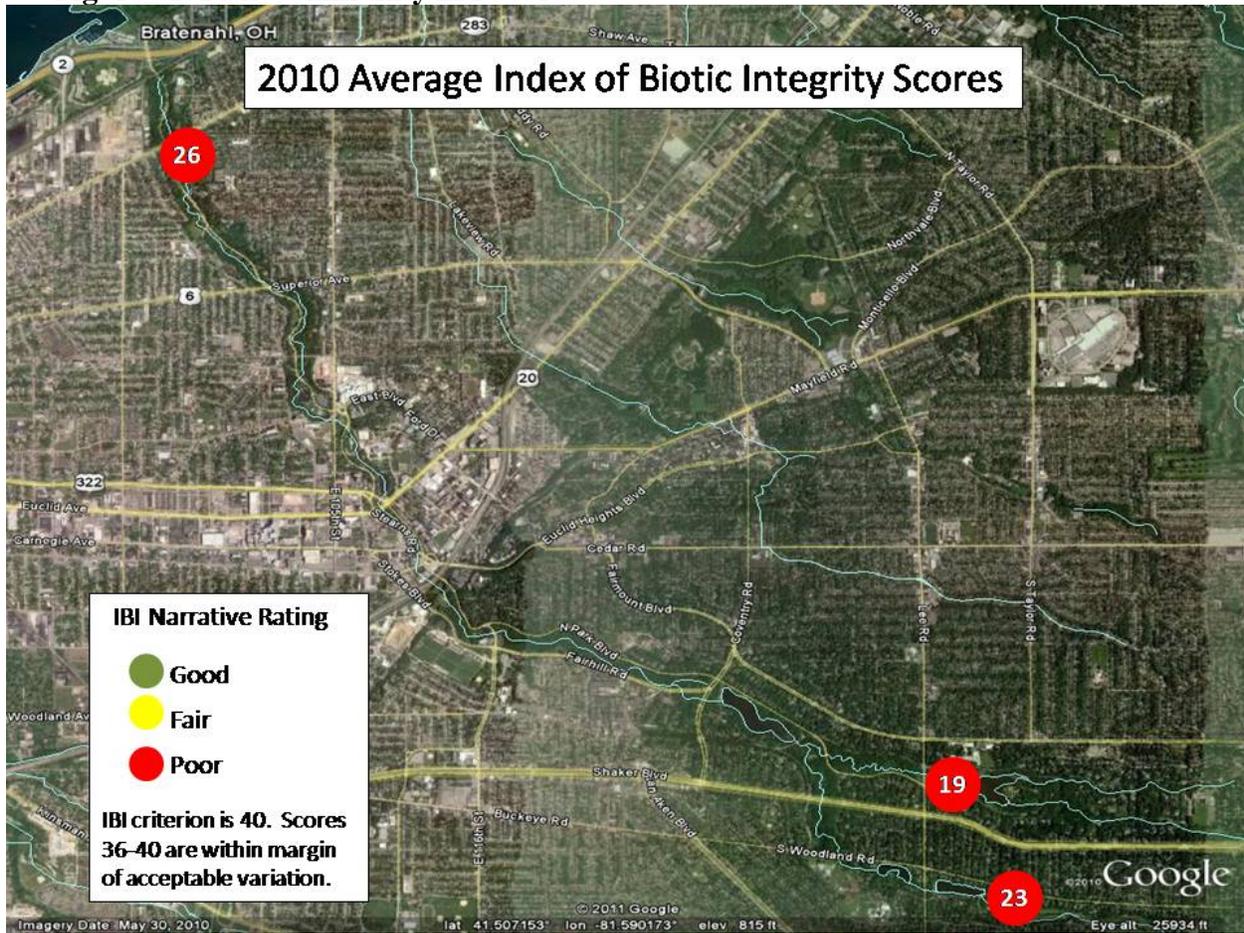
Scientific Name	Common Name
Clinostomus elongates	Redside dace
Cottus bairdi	Mottled sculpin
Culaea inconstans	Brook stickleback
Etheostoma flabellare	Fantail darter
Etheostoma nigrum	Johnny darter
Lampetra appendix	American Brook lamprey
Lepomis cyanellus	Green sunfish
Notropis buccata	Silverjaw minnow
Phoxinus erythrogaster	Southern redbelly dace
Pimephales notatus	Bluntnose minnow
Pimephales promephales	Fathead minnow
Rhinichthys atratulus	Blacknose dace

Source: NEORSD, Existing Conditions Inventory and Assessment Volume I, October 1999

Index of Biotic Integrity (IBI). The IBI is a measure of fish species diversity and populations. The index identifies the types and number of species within a water body. The index ascribes a number or score to its findings to determine the health of the aquatic community.

The most recent sampling conducted by NEORSD in 2010 showed that the fish community at all locations sampled was poor (Figure 31). The communities at these locations had low diversity and were dominated by pollution-tolerant fish. The factors listed under “Fish Diversity” (p. 77) continue to be the main reasons why the fish community in Doan Brook is not healthier.

Figure 31. Fish Community IBI Scores



Source: NEORSD annual stream sampling

Macroinvertebrate Diversity

The NEORSD completed the Doan Brook Watershed Study in 1999 which analyzed the benthic macroinvertebrate community structure to assess water quality in Doan Brook. The study utilized the application of the Invertebrate Community Index (ICI) to assess the macroinvertebrate community and broke the watershed into eight stream segments as part of the study. The study identified water quality across the watershed as a potential contributing factor of poor benthic macroinvertebrate communities. However, in addition to water quality the report also identified specific segments as lacking in-stream habitat and both high and low flow fluctuations as being potential contributing factors to poor benthic macroinvertebrate communities.

Since the 1999 study, NEORSD has surveyed at least one site within the Doan Brook watershed every year. From 2002 to 2008 a total of three sites were sampled and all sites had two sampling events completed each year. The three sites were also sampled 2009-2010, however only one sampling event took place per year.

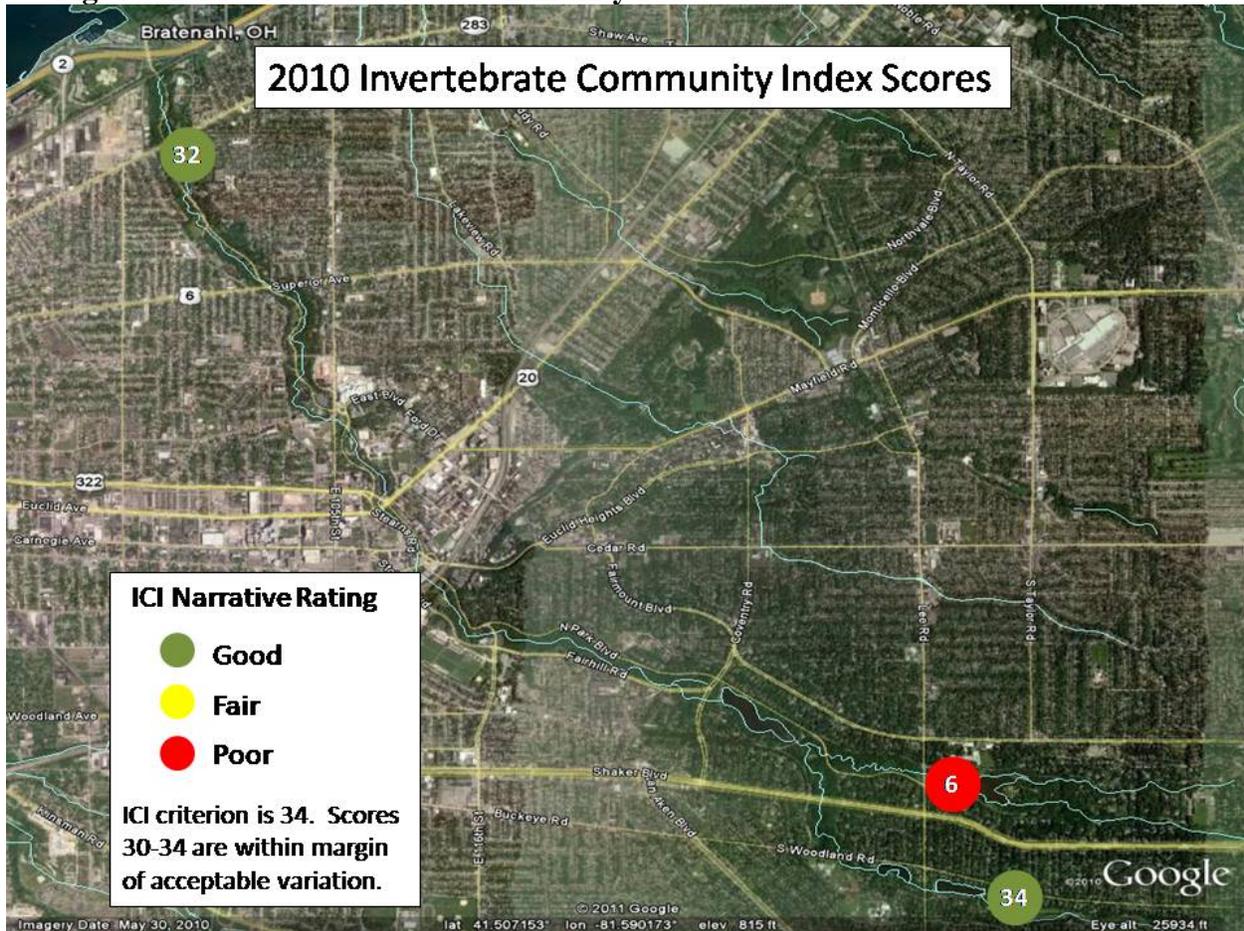
Invertebrate Community Index (ICI)

The ICI measures the community structure of the benthic macroinvertebrate community within a water body segment and compares its structure with reference sites within its eco-region. A

maximum score for this index is 60. The Warmwater Habitat (WWH) ICI criterion for the Doan Brook watershed is 34, with a score of 30 being considered in non-significant departure of attainment. The “poor” score at River Mile 6.70 is likely due to the fact that the sampling site is located just downstream of the Horseshoe Lake impoundment. The other two sampling sites are in more free-flowing stream locations and are more representative of typical conditions throughout the Brook. Since the Watershed Study of 1999 the benthic macroinvertebrate scores have improved at the other two sampling locations.

Figure 32 presents results of the most recent macroinvertebrate community assessments (ICI score) for sites in the watershed.

Figure 32. Macroinvertebrate Community ICI Scores



Source: NEORS annual stream sampling

Habitat Evaluation

Habitat impacts associated with urbanization, such as increased sediment load and substrate embeddedness, are evident within the watershed. Floodplain access is often limited resulting in streambed down-cutting and bank destabilization. However, Doan Brook is channelized and culverted in many segments, which can also cause extreme flow fluctuations and have a negative impact on biological communities.

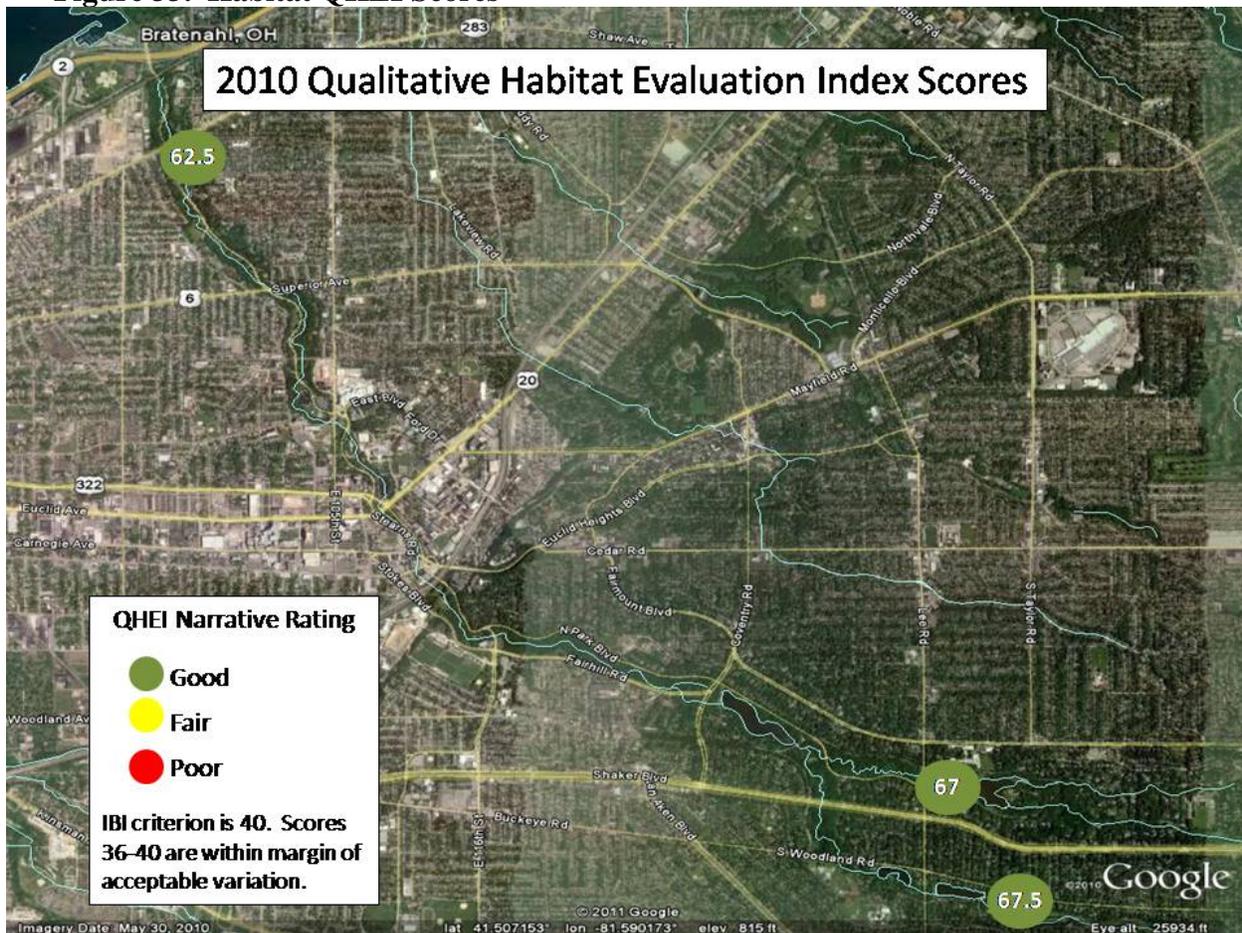
Detailed assessments of headwater streams within the watershed are limited. Within the upper watershed, especially east of Warrensville Rd., the number of primary headwater streams (>1 square mile in drainage) has decreased since pre-settlement to almost none. These small streams were enclosed in culverts due to residential and commercial development.

Qualitative Habitat Evaluation Index (QHEI)

The QHEI examines the physical characteristics of a stream or water body to determine its ability to support a fish community. It examines a stream’s vegetative cover, substrate profile, bank stability and morphology to determine its condition. Figure 33 indicates the most recent QHEI scoring by NEORS in 2010. Table 19 outlines the most recent QHEI evaluations conducted by the NEORS from 2007-2010. Table 19 also lists specific attributes which were recorded at each site. The WWH Attributes are considered as positive attributes, while the MWH attributes are considered negative attributes. These attributes can help determine if healthy fish populations can survive at a site.

The state has set a target score of 60, based on a correlation of IBI scores across the State of Ohio. However it is important to note that the target score is just the potential ability for a stream segment to support a fish community and may not reflect the actual community at a site.

Figure 33. Habitat QHEI Scores



Source: NEORS annual stream sampling

2. Causes & Sources of Impairment

Ohio EPA listed organic enrichment, flow alteration, urban runoff and combined sewer overflows as sources in its 2012 Integrated Water Quality Report. Below is the information from that report.

Assessment Unit Name: Doan Brook-Frontal Lake Erie
 Hydrologic Unit Code: 04110003 05 04
 Assessment Unit Size: 45.3 square miles
 Priority Points: 1
 Monitoring Scheduled: 2015
 TMDL Scheduled: 2018

Land Use Statistics:

Developed	Forest	Grass/Pasture	Row Crops	Other
98.6%	1%	0.2%	0%	0.1%

Aquatic Life Use Assessment

Reporting Category: 5
 Aquatic Life Uses: WWH
 Sampling Years: 2010
 Watershed Score: 0

Assessment Details:

Headwater Sites <20 sq. mi.	Wading Sites >20 & <50 sq. mi.	Principal Sites >50 & <500 sq. mi.
Sites Assessed: 8 Sites Attaining: 0	Sites Assessed: 0 Sites Attaining: 0	Sites Assessed: 0 Sites Attaining: 0

Most Recent Data:

Year Assessed	Station Name	River Mile	Drainage Area	Aquatic Life Use	Attainment Status
2010	DOAN BROOK AT SHAKER HEIGHTS, DST. LEE RD.	6.6	1.3	WWH	Non
2010	DOAN BROOK AT CLEVELAND @ ST. CLAIR AVE.	0.8	9.1	WWH	Non
2010	S. BR. DOAN BROOK AT SHAKER HEIGHTS @ ATTLEBORO RD.	1.3	3.4	WWH	Non

2010	NINEMILE CREEK ADJ. BELVOIR BLVD, UPST. NELA PARK TRIB.	3.3	0.7	WWH	Non
2010	NINEMILE CREEK AT CLEVELAND @ LAKE SHORE BLVD.	0.3	11.8	WWH	Non
2010	NINEMILE CREEK (NELA PARK BRANCH) UPST BELVOIR BLVD. CULVERT	0.0	3.1	WWH	Non
2010	DUGWAY BROOK (W. BR.) AT EAST CLEVELAND @ LAKEVIEW CEMETERY	2.4	2.6	WWH	Non
2010	DUGWAY BROOK AT BRATENAHL @ LAKE SHORE BLVD.	0.4	6.2	WWH	Non

Causes of Impairment:

- flow alteration
- impairment unknown
- organic enrichment/DO

Sources of Impairment:

- combined sewer overflows
- municipal (urbanized high density area)
- urban runoff/storm sewers (NPS)

Comments: Assessment includes data from Doan Brook, Ninemile Creek, and Dugway Brook collected by NEORS D staff in support of projects in the NEORS D service area. Causes and sources are those assigned during prior surveys and listed in an earlier Integrated Report.

Recreation Use Assessment

Reporting Category: 3

Assessment Unit Score: Not calculated

Public Drinking Water Supply Assessment

Reporting Category: No active intakes

Cause of Impairment: None

Nitrate Watch List: No

Pesticide Watch List: No

Fish Tissue Assessment

Reporting Category: 3

Causes of Impairment: None

The highly urban environment that exists in the Doan Brook watershed can be linked to all of the sources of impairment in the Ohio EPA Integrated Water Quality Report. Organic enrichment is

caused by fertilizer runoff from urban lawns, as well as sanitary sewage from cross-connected or leaking sanitary sewers and combined sewer overflows. Flow alteration is a result of the high percentage of impervious surfaces throughout the watershed, and leads to greater variation of high and low flow regimes, as well as increased erosion and therefore siltation and sediment deposition. Habitat is degraded due to channelization, and the presence of many structures that block fish passage. Further discussion of the point and non-point sources of pollution and watershed impairments follows in the sections below.

3. Point Sources

Combined Sewer Overflows

There are fourteen combined sewer outfalls (CSOs) located in the Doan Brook watershed primarily in the lower watershed in the City of Cleveland. These outfalls are managed by the Northeast Ohio Regional Sewer District (NEORS). According to the assessment performed in 2001, ten of the CSOs overflow an average of 35 times each year due to a lack of capacity during rainfall events. A summary of the CSOs is provided in Table 20.

Figure 34. Combined Sewer Outfalls

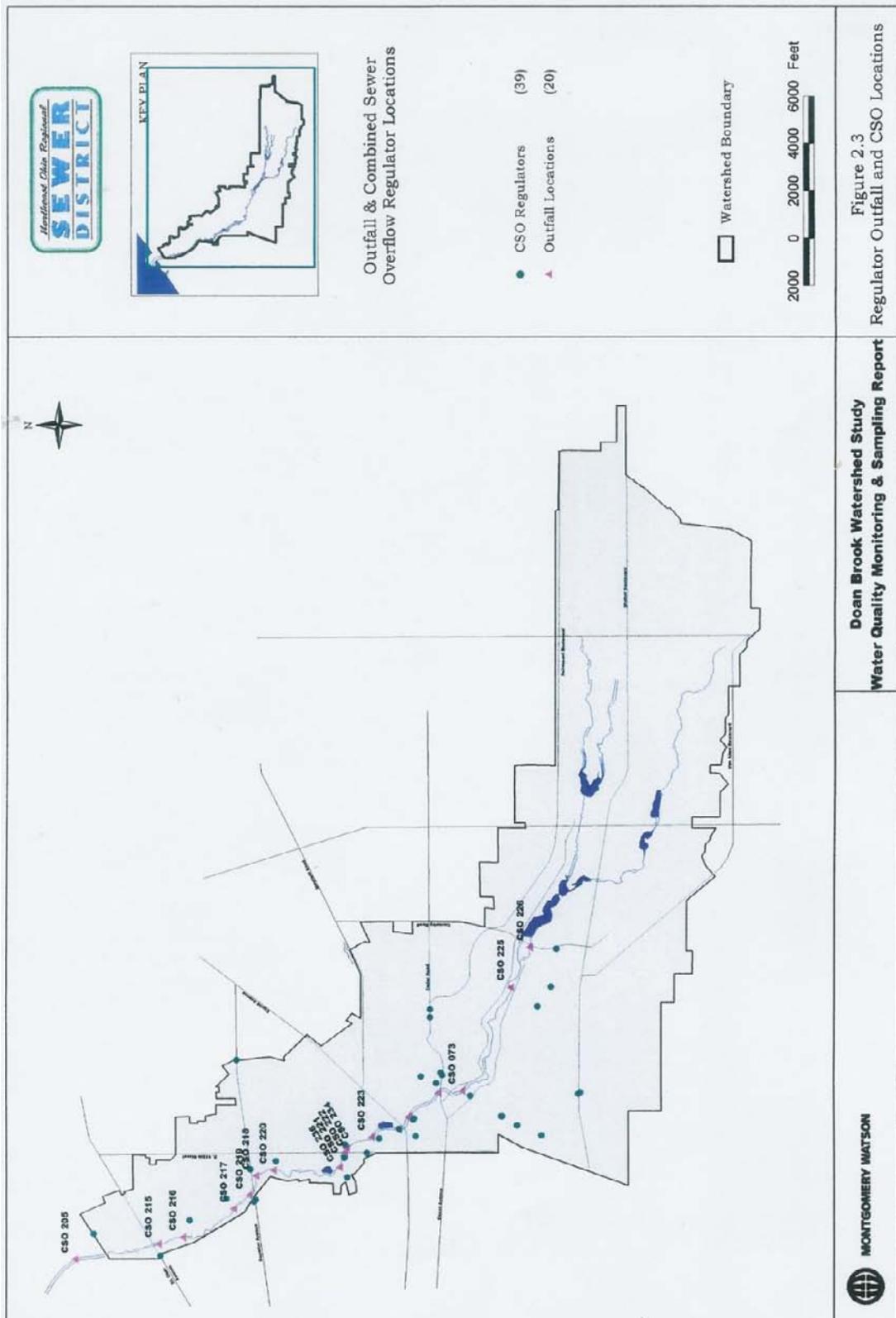


Figure 2.3
Regulator Outfall and CSO Locations

Doan Brook Watershed Study
Water Quality Monitoring & Sampling Report



Source: NEORSD, Water Quality Monitoring and Sampling Report, September 2000

The NEORSRD has developed a Long-Term CSO Control Plan that recommends a significant reduction in the number of overflows and outlines the strategy to reduce or remove CSO contribution to pollution sources through the installation of relief sewers, incorporation of storage tunnels, and other infrastructure improvements. However, through modeling performed for the assessment, it was identified that removal or reduction of CSO overflow will not eliminate Doan Brook’s fecal coliform pollution due to non-point source pollution, including geese and pets.

The NEORSRD recently came to an agreement with US EPA and the Department of Justice on a Long Term Control Plan for CSOs. A 17 ft. diameter storage tunnel and consolidation/relief sewers will capture and store combined sewer flows from the Doan Brook area, and convey them to the Easterly WWTP. When completed, the improvements will reduce overflow events to 3 or less per year. The Doan Brook tunnel is scheduled to begin construction in 2017, with full operation scheduled for 2021.

Table 20. CSOs in Doan Brook

NEORSRD CSO Reference No.	Total Vol of Overflow (MG) per year	# Overflows per year	Total Vol (MG) per year after control	# Overflows per year after control
073	59.05	33	7.56	2
215	0	0	0	0
216	0	0	0	0
217	6.37	53	0.06	2
218	102.29	39	0.14	1
219	4.1	35	0.01	3
220	31.01	31	0.37	2
221	8.87	30	0.1	2
222	150.12	29	36.28	2
223/224	16.81	44	0.42	1
225	0	0	0	0
226	0.86	16	0	0
234	13.48	40	0.11	1
236	0	0	0	0
TOTAL	392.96		45.05	

Source: NEORSRD, 2010

Permitted Discharges (NPDES)

Point source discharges to the Doan Brook watershed are regulated by the Clean Water Act. A regulated discharge requires a permit issued under the National Pollutant Discharge Elimination System (NPDES). There are two general permitted discharges in the Doan Brook watershed administered and regulated by the Ohio EPA. The first is a general permit to the Northeast Ohio Regional Sewer District for its combined sewer outfalls in the watershed. The second permit on record is to the City of Cleveland for the Baldwin Water Treatment Facility. These sites are permitted an allotted amount of point source discharge to Doan Brook. Table 21 contains a list of all individual NPDES permitted facilities in the basin.

Table 21. Individual NPDES Permitted Dischargers in Doan Brook Watershed

ENTITY	RECEIVING STREAM	DISCHARGE VOLUME	PERMIT NO.
City of Cleveland Baldwin Water Treatment Plant	Doan Brook	1,000,000 GPD	3IN00354
NEORSD CSO Permit	Doan Brook (13 outfalls) East Branch Doan Brook (1 outfall)	Varies (CSOs)	3PA00002 (effective April 1, 1997)

Spills and Illicit Discharges

According to Ohio EPA records, there have been no known spills within the watershed that have impacted the stream.

4. Non-Point Sources

As an urban watershed, urban runoff and non-point pollution sources are prevalent as demonstrated by the water quality sampling conducted over the years for Doan Brook by the various agency resources.

Phase II Stormwater Activities.

All of the Doan Brook watershed communities are directed under the MS4 permit and Phase II requirements established by the US EPA in 2003. Each watershed community submitted a Stormwater Management Plan and subsequent annual reports, outlining how it was going to meet the six minimum measure requirements each year. The DBWP and other watershed partners will assist with the implementation of Phase II activities. In a reciprocal fashion, Phase II activities will work to fulfill many Watershed Action Plan goals.

Stormwater Management Program

The Northeast Ohio Regional Sewer District is in the process of implementing a stormwater management program. The program will encourage the construction and proper maintenance of stormwater control measures that reduce non-point source pollution, by offering credits on the stormwater fee to individual property owners. Credits will be offered for measures that reduce stormwater quantity and improve stormwater quality through practices such as infiltration. Through this stormwater management program NEORSD will also assist communities with their Phase II Stormwater requirements, such as Illicit Discharge Detection and Elimination.

Green Infrastructure

The NEORSD is currently undertaking a study of green infrastructure possibilities in the Doan Brook area as part of the requirements of their CSO Control Plan consent decree. In this study, they are looking for specific locations within the Doan Brook watershed that stormwater can be removed from the combined system in order to further reduce overflows during rain events. Many of the recommendations from this study will involve direct infiltration of stormwater, particularly in areas of sandy soils. Any direct infiltration of stormwater will result in a reduction of both stormwater volume and pollutants.

Acres of Highly Erodible Land

The areas of highly erodible land are defined by the soils within the watershed identified in Table 7 (p. 27). A watershed-wide assessment of potential soil loss and high erosion areas has not been conducted.

Culverts

The Doan Brook of the past hosted a longer stream with many more fingers and branches than the Doan Brook of today. The headwaters of the Brook in 1900 extended about a mile farther east than where the stream currently surfaces. During the development of Shaker Heights and Cleveland Heights, the upstream reaches of the Brook's three branches, together with a number of smaller tributaries, were diverted into underground storm sewers. The most significant of the vanished tributaries included a stream that fed into the South Branch just south of Shaker Boulevard, a tributary that ran down the escarpment where Cedar Road now lies, and a tributary that cut northwest across Cleveland Heights to join the Cedar Road stream at Euclid Heights Boulevard. Large storm sewers now feed into the Brook in these locations carrying water that once flowed in natural open channels.

The most significant alteration to Doan Brook has been the culverting of large stretches of the stream. The University Circle culvert is the largest and longest culvert on Doan Brook. It stretches almost a mile (5,160 feet) between the base of the escarpment near Martin Luther King Boulevard and Ambleside Drive to the west side of the Cleveland Museum of Art. There are two other significant culverts on the main channel in the lower watershed. The first is a 650 foot culvert about 1000 feet downstream from the outlet of the University Circle culvert under the Cancer Survivors Monument to Hough Avenue. The second culvert is a 3,300 foot culvert near the Brook's mouth that carries the stream beneath Interstate 90 and the Dike 14 area. (Gooch, Appendix H.)

Table 22. Major Culverts in Doan Brook

Culvert Location	Length
Gordon Park/Dike 14	3,300 feet
Rockefeller Park (at MLK Blvd and East 105 th Street)	650 feet (approximate)
University Circle	5,160 feet
Under MLK at North Park	340 feet
Middle Branch- South Park to Courtland	950 feet
South Branch (Canterbury Golf Course to Shaker Country Club Golf Course)	2000 feet (approximate)

Source: Doan Brook Handbook, Gooch

5. Status and Trends

Since the Doan Brook watershed is a completely built-out watershed and has been so for a number of years, there is no information that indicates that the current situation, if left unchanged, will likely result in further water quality degradation.

IV. Watershed Impairments

A. Pollutant Load Allocations

Pollutant load allocations were generated utilizing Spreadsheet Tool for Estimating Pollutant Load (STEPL) which employs simple algorithms to calculate nutrient and sediment loads from different land uses. STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio.

The STEPL model was chosen based on several criteria. A key factor influencing model selection was compatibility with work currently done for the Watershed Action Plan. STEPL has been utilized for watershed plans and is an accepted model for EPA 319 grant projects. In the future, this model will allow for easy demonstration of loading reductions utilizing different BMPs.

The STEPL model utilizes land use data, precipitation data, and runoff concentrations to generate annual loading for phosphorus, (total) nitrogen, biochemical oxygen demand, and suspended solids. Output of the model includes tables and graphs depicting loadings with and without BMP implementation.

Land use data (Table 23) from the Doan Brook watershed was input into the model and results are included in Table 24. The results reflect a watershed dominated by residential development.

Table 23. Pollutant Load Land use data

	<u>Acres</u>	<u>%</u>
Commercial	266	3.6%
Industrial	170	2.3%
Institutional	720	9.6%
Residential single family	4500	60.1%
Residential multi-family	323	4.3%
Open Developed	517	6.9%
Open Undeveloped	<u>993</u>	13.2%
TOTAL	7,489	

Source: NEORSD, Water Quality Monitoring and Sampling Report, September 2000

Table 24. STEPL Model Results

1. Total load by subwatershed(s)				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	t/year
W1	20838.2	3341.2	87709.6	457.4
Total	20838.2	3341.2	87709.6	457.4

B. Habitat Conditions

In 1999, Montgomery Watson and Davey Resource Group conducted a comprehensive assessment of the riparian conditions of the Doan Brook watershed. The assessment involved evaluating the in-stream corridor and a 400 foot zone of the riparian corridor. Based on this assessment, the following conclusions were provided. Despite the numerous impacts associated with the urbanized surroundings of Doan Brook, it maintains a diversity of instream habitats. In most instances, the stream met or exceeded the Warm Water Habitat criterion for the designated ecoregion. Riffles, runs and pools are well-developed in most segments. The nearly intact riparian vegetation helps to shield the stream and provide shade to keep water temperatures cool. The substrate is a mixture of gravel, cobble and sand with areas of abundant boulders. Habitat for fish is also present in the form of undercut banks, rootwads and debris accumulations. The most impacted portions of the Brook are in the golf course areas, where natural riparian vegetation has been removed, and in the downstream section through Rockefeller Park. These areas fail to meet Warm Water Habitat criteria.

C. Cuyahoga RAP AOC Beneficial Use Impairments

As part of the Great Lakes Water Quality Agreement (GLWQA) established in 1985, the International Joint Commission designated Areas of Concern (AOC) throughout the Great Lakes to river basins with the most severely impaired conditions. Doan Brook is part of the Cuyahoga River AOC which was established in 1988. Under the GLWQA, fourteen delisting targets were commissioned to measure improvements to these AOCs and determine the progress of the RAP’s activities, in which are called beneficial use impairments (BUI). In 2008, Ohio EPA reviewed these original targets and refined them further for each Ohio Area of Concern. The following status list was developed for the Cuyahoga Area of Concern, of which the Doan Brook is a part:

Table 25. Beneficial use Impairments Cuyahoga AOC

Beneficial Use Impairment	Cuyahoga AOC
BUI 1	
Restrictions on Fish Consumption	Impaired
Restrictions on Wildlife Consumption	Not Impaired

BUI 2	Tainting of Fish and Wildlife Flavor	Not Impaired
BUI 3	Degradation of Fish Populations	Impaired
	Degradation of Wildlife Populations	Not Impaired
BUI 4	Fish Tumors or Other Deformities	Impaired
BUI 5	Bird and Animal Deformities or Reproductive Problems	Not Impaired
BUI 6	Degradation of Benthos	Impaired
BUI 7	Restrictions on Dredging Activities	Impaired
BUI 8	Eutrophication or Undesirable Algae	Impaired
BUI 9	Restrictions on Drinking Water Consumption or Taste & Odor Problems	Not Impaired
BUI 10	Beach Closings	Impaired
BUI 11	Degradation of Aesthetics	Impaired
BUI 12	Added Costs to Agriculture or Industry	Not Impaired
BUI 13	Degradation of Phytoplankton and Zooplankton Populations	NA
BUI 14	Loss of Fish Habitat	Impaired
	Loss of Wildlife Habitat	Not Impaired

Source: Delisting Targets for Ohio Areas of Concern, Ohio EPA, December 2008

To further refine the delisting targets for Doan Brook’s contribution to the Area of Concern, Beneficial Use Impairments 7 and 10 do not apply to Doan Brook due to the absence of both of these activities in the watershed. Beneficial Use Impairment 1 does not apply to Doan Brook because there are no fish consumption advisories in Doan Brook itself, and the Brook has no impact on the Cuyahoga River. Doan Brook’s goals and actions will address the remaining impaired beneficial use impairments and will work with the Cuyahoga Area of Concern and the Cuyahoga River Community Planning Organization on meeting the targets for these impairments. Ohio EPA’s criteria for delisting targets will be utilized in Doan Brook as part of its performance indicators and measured progress toward delisting the remaining impairments.

Table 26. Doan Brook BUI Performance Criteria

Beneficial Use Impairment-Doan Brook	Performance Criteria – OEPA Target	Doan Brook Problems/Goals (from Section V) that will address BUI
BUI 3 – Degradation of fish	IBI: meet state water	3.1, 3.2, 4.1, 4.2

populations	quality standards	
BUI 4 – Fish tumors or other deformities	DELT levels do not exceed 0.5%	
BUI 6 – Degradation of benthos	ICI: meet state water quality standards	3.1, 3.2, 4.1, 4.2
BUI 8 – Eutrophication or undesirable algae	Dissolved Oxygen criteria for Ohio Water Quality standards are met	1.1, 1.2, 2.1, 2.2
BUI 11 – Degradation of aesthetics	Meet Ohio EPA ‘free froms’ criteria and demonstrate source reductions	
BUI 14 – Loss of fish habitat	QHEI meet a score a of 60	3.1, 3.2, 4.1, 4.2

V. Watershed Restoration and Protection Goals

The Doan Brook is in non-attainment of its Warmwater Habitat (WWH) use designation. The following problem statements regarding non-attainment have been developed based on linkages between causes and sources of impairments identified in the Doan Brook watershed, and as discussed in the 303(d) report (see page 83). The problem statements and accompanying restoration/protection goals were used to develop the objectives and actions for implementation throughout various reaches of the brook. The long-term goals are to address the stated problems and bring all reaches of the brook into full attainment of designated aquatic life uses. Since no TMDL has been developed for Doan Brook, pollutant loading reductions stated within the problem statements represent reasonable goals that will move the stream towards attainment of Ohio EPA instream targets for the pollutants of concern.

Problem statements, goals, objectives, and actions for Doan Brook are described below. In addition to these goals, the de-listing of Beneficial Use Impairments (BUIs) applicable to the Area of Concern (AOC) designation is also a long-term objective of this plan. Table 26 above links the de-listing of BUIs to the problems/goals below.

Problem Statement 1:

Excessive nutrients from stream bank erosion and urban runoff contribute to non-attainment of Warmwater Habitat (WWH) use designation. In-stream nitrogen loads should be reduced by 252.3 lb/year to move the brook towards attainment of the Ohio EPA instream target of 1.0 mg/l.

Goal 1:

Reduce nutrient loads (98 lb/year of in-stream nitrogen) resulting from stream bank erosion.

Objective 1:

Complete 2,000 feet of stream enhancement through Rockefeller Park between E. 105th St. and Wade Park Ave, including bank stabilization of 1,000 feet, resulting in an N load reduction of 40 lb/yr.

Action Items:

1. Pursue Great Lakes Restoration Initiative (GLRI), Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 2:

Reconstruct a stable stream channel in Rockefeller Park with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible, resulting in an N load reduction 30 lb/yr.

Action Items:

1. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants.

Objective 3:

Reconstruct a stable stream channel through the Upper Watershed (North, Middle, South Branches) with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible, resulting in an N load reduction of 20 lb/yr.

Action Items:

1. Inventory potential stream restoration projects and prioritize.
2. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 4:

Perform streambank stabilization/restoration in area of severe erosion near trash rack on Doan Brook at MLK Blvd., resulting in an N load reduction of 8 lb/yr.

Action Items:

1. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Goal 2:

Reduce nutrient loads (154.3 lb/yr of in-stream nitrogen) resulting from urban runoff.

Objective 1:

Direct 0.37 acres of impervious surface to stormwater control measures that provide water quality benefit as part of the E 105th St./MLK intersection redesign, resulting in an N load reduction of 3.0 lb/yr.

Action Items:

1. Coordinate with Cuyahoga County Dept. of Public Works and University Circle, Inc. on the design of this intersection.

Objective 2:

Direct 0.28 acres of impervious surface to stormwater control measures that provide water quality benefit as part of the Ashbury Avenue Greenway, resulting in an N load reduction of 2.3 lb/yr.

Action Items:

1. Pursue Ohio EPA Surface Water Improvement Fund (SWIF) grants, stormwater district funds, and other funding sources for potential stormwater projects.
2. Work with community groups to develop maintenance plans for rain gardens already established.
3. Develop list of opportunities add other greenway projects.

Objective 3:

Implement projects that will direct 20 acres of impervious surface to stormwater control measures that provide water quality benefit, resulting in an N load reduction of 149 lb/yr.

Action Items:

1. Work with the NEORS, cities and commercial property owners to prioritize and select redevelopment or new development areas that provide possible projects for implementation.
2. Pursue Ohio EPA Surface Water Improvement Fund (SWIF) grants, stormwater district funds, and other funding sources to complete the projects.

Problem Statement 2:

Excessive nutrients from stream bank erosion and urban runoff contribute to non-attainment of Warmwater Habitat (WWH) use designation. In-stream phosphorous loads should be reduced by 48.5 lb/year to move the brook towards attainment of the Ohio EPA instream target of 0.1 mg/l.

Goal 1:

Reduce nutrient loads (22.4 lb/year of in-stream phosphorous) resulting from stream bank erosion.

Objective 1:

Complete 2,000 feet of stream enhancement through Rockefeller Park between E. 105th St. and Wade Park Ave, including bank stabilization of 1,000 feet, resulting in a P load reduction of 7 lb/yr.

Action Items:

1. Pursue Great Lakes Restoration Initiative (GLRI), Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 2:

Reconstruct a stable stream channel in Rockefeller Park with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible, resulting in a P load reduction 10.5 lb/yr.

Action Items:

1. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants.

Objective 3:

Reconstruct a stable stream channel through the Upper Watershed (North, Middle, South Branches) with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible, resulting in a P load reduction of 3.5 lb/yr.

Action Items:

1. Inventory potential stream restoration projects and prioritize.
2. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 4:

Perform streambank stabilization/restoration in area of severe erosion near trash rack on Doan Brook at MLK Blvd., resulting in a P load reduction of 1.4 lb/yr.

Action Items:

1. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Goal 2:

Reduce nutrient loads (26.1 lb/yr of in-stream phosphorous) resulting from urban runoff.

Objective 1:

Direct 0.37 acres of impervious surface to stormwater control measures that provide water quality benefit as part of the E 105th St./MLK intersection redesign, resulting in a P load reduction of 0.6 lb/yr.

Action Items:

1. Coordinate with Cuyahoga County Dept. of Public Works and University Circle, Inc. on the design of this intersection.

Objective 2:

Direct 0.28 acres of impervious surface to stormwater control measures that provide water quality benefit as part of the Ashbury Avenue Greenway, resulting in a P load reduction of 0.5 lb/yr.

Action Items:

1. Pursue Ohio EPA Surface Water Improvement Fund (SWIF) grants, stormwater district funds, and other funding sources for potential stormwater projects.
2. Work with community groups to develop maintenance plans for rain gardens already established.
3. Develop list of opportunities add other greenway projects.

Objective 3:

Implement projects that will direct 20 acres of impervious surface to stormwater control measures that provide water quality benefit, resulting in a P load reduction of 25 lb/yr.

Action Items:

1. Work with the NEORS, cities and commercial property owners to prioritize and select redevelopment or new development areas that provide possible projects for implementation.
2. Pursue Ohio EPA Surface Water Improvement Fund (SWIF) grants, stormwater district funds, and other funding sources to complete the projects.

Problem Statement 3:

In-stream and/or riparian habitat loss, and manmade alterations to the Doan Brook channel are causing non-attainment of aquatic life use designations throughout the entire length of the stream.

Goal 1:

Restore in-stream and riparian habitat along 5300 lineal feet of the brook to achieve QHEI, ICI, and IBI scores indicative of attainment of aquatic life use designations.

Objective 1:

Plant native plants, shrubs and trees along 2000 feet of stream bank through the Rockefeller Park Subwatershed.

Action Items:

1. Inventory potential planting areas and prioritize.
2. Develop maintenance plan and partner support for ongoing maintenance.
3. Pursue Great Lakes Restoration Initiative (GLRI), Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 2:

Plant native plants, shrubs and trees along 800 feet of stream bank along the South Branch at Woodbury School in the Lower Lake and Horseshoe Lake Subwatershed.

Action Items:

1. Develop maintenance plan and partner support for ongoing maintenance.
2. Pursue Great Lakes Restoration Initiative (GLRI), Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 3:

Remove check dams along 600 lineal feet of the stream in Rockefeller Park

Action Items:

1. Pursue grant programs and other potential funding sources for completion of the project.

Objective 4:

Evaluate the feasibility of various day-lighting alternatives at Cleveland Lakefront Nature Preserve. Include design and construction parameters and a habitat benefit analysis for the existing culvert (the portion of the culvert through the Preserve is 1900 feet, about half of the entire 3,300 foot culvert).

Action Items:

1. Pursue grant programs and other potential funding sources for evaluating feasibility of the project.

Goal 2:

Restore in-stream and riparian habitat in 16 acres of the watershed to achieve QHEI, ICI, and IBI scores indicative of attainment of aquatic life use designations.

Objective 1:

Plant and maintain native plants, shrubs and trees in 10 acres of the Marsh at the Nature Center at Shaker Lakes in the Lower Lake and Horseshoe Lake Subwatershed.

Action Items:

1. Develop maintenance plan and partner support for ongoing maintenance.
2. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 2:

Remove invasive species along stream bank throughout Rockefeller Park Subwatershed (approximately 4 acres).

Action Items:

1. Pursue grant programs and other potential funding sources for invasive species removal and subsequent restoration.
2. Partner with the City of Cleveland and volunteer organizations on invasive species removal programs.

Objective 3:

Continued Control of invasive species in 2 acres of wetland at the Nature Center at Shaker Lakes. Targeted species include Crack Willows, Celandine and Narrow Leaf Cattail. Replant with native wetland species. Lower Lake and Horseshoe Lake Subwatershed.

Action Items:

1. Pursue grant programs and other potential funding sources for invasive species removal and subsequent restoration.
2. Partner with the City of Shaker Heights, the Nature Center at Shaker Lakes and volunteer organizations on invasive species removal programs.

Problem Statement 4:

Siltation from stream bank erosion and urban runoff is contributing to poor in-stream habitat and low QHEI scores. In-stream Total Suspended Solids (TSS) loads should be reduced by 13.6 tons/year to move the brook towards attainment of the Ohio EPA instream water quality standard of 1500 mg/l.

Goal 1:

Reduce sediment loads (8.2 tons/year of TSS) resulting from stream bank erosion.

Objective 1:

Complete 2,000 feet of stream enhancement through Rockefeller Park between E. 105th St. and Wade Park Ave, including bank stabilization of 1,000 feet, resulting in a TSS load reduction of 5100 lb/yr.

Action Items:

1. Pursue Great Lakes Restoration Initiative (GLRI), Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 2:

Reconstruct a stable stream channel in Rockefeller Park with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible, resulting in a TSS load reduction of 7650 lb/yr.

Action Items:

1. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants.

Objective 3:

Reconstruct a stable stream channel through the Upper Watershed (North, Middle, South Branches) with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible, resulting in a TSS load reduction of 2550 lb/yr.

Action Items:

1. Inventory potential stream restoration projects and prioritize.
2. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Objective 4:

Perform streambank stabilization/restoration in area of severe erosion near trash rack on Doan Brook at MLK Blvd., resulting in a TSS load reduction of 1020 lb/yr.

Action Items:

1. Pursue Ohio EPA Section 319(h) Non-point Source Program Grants, Ohio EPA Surface Water Improvement Fund (SWIF) grants, and other grants for potential restoration projects.

Goal 2:

Reduce sediment loads (5.4 tons/yr of TSS) resulting from urban runoff.

Objective 1:

Direct 0.37 acres of impervious surface to stormwater control measures that provide water quality benefit as part of the E 105th St./MLK intersection redesign, resulting in a TSS load reduction of 209 lb/yr.

Action Items:

1. Coordinate with Cuyahoga County Dept. of Public Works and University Circle, Inc. on the design of this intersection.

Objective 2:

Direct 0.28 acres of impervious surface to stormwater control measures that provide water quality benefit as part of the Ashbury Avenue Greenway, resulting in a TSS load reduction of 158 lb/yr.

Action Items:

1. Pursue Ohio EPA Surface Water Improvement Fund (SWIF) grants, stormwater district funds, and other funding sources for potential stormwater projects.
2. Work with community groups to develop maintenance plans for rain gardens already established.
3. Develop list of opportunities add other greenway projects.

Objective 3:

Implement projects that will direct 20 acres of impervious surface to stormwater control measures that provide water quality benefit, resulting in a TSS load reduction of 10,626 lb/yr.

Action Items:

1. Work with the NEORSD, cities and commercial property owners to prioritize and select redevelopment or new development areas that provide possible projects for implementation.
2. Pursue Ohio EPA Surface Water Improvement Fund (SWIF) grants, stormwater district funds, and other funding sources to complete the projects.

VI. Implementation

The Doan Brook Watershed Partnership and its community partners have begun to implement watershed restoration with a number of projects and programs including Doan Brook stream restoration, parklands management, and the East 105th and MLK Boulevard daylighting project. In addition to providing measurable improvements, these projects will assist in establishing momentum, to which other entities can contribute.

Secondly, the DBWP will develop an annual Work Plan, based upon funding opportunities and community needs, to further implement goals. Funding, such as Clean Ohio, OEPA 319, OEPA Surface Water Improvement Fund, Great Lakes Commission Sediment & Erosion Funds, Lake Erie Commission, Coastal Management Assistance Grants and the Great Lakes Restoration Initiative, will be important to pursue. Implementation will require DBWP's vision and management, community partnerships and municipal leadership to pursue funding and accomplish successful projects.

VII. Ohio Coastal Non-Point Pollution Control Plan

As part of meeting the state and federal requirements, as established by the Coastal Zone Management Act (1972) and its Reauthorization Amendment (1990), watershed plans within the Ohio Lake Erie Basin must describe how the Management Measures of the Ohio Coastal Nonpoint Pollution Control Program will be implemented within the specific watershed, if watershed inventory or sources and causes of impairment indicate applicability. Management measures are defined as economically achievable measures to control the addition of pollutants to our coastal waters, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives.

Doan Brook is a direct tributary to Lake Erie; hence, it impacts the health of Lake Erie and its coastal resources cumulatively with the other watersheds in Lake Erie. A review of the applicability of Management Measures as a result of the Doan Brook watershed's land uses has been evaluated to determine which areas of the Coastal Non-Point Pollution Control Program are applicable. This section outlines how Doan Brook efforts will then address and implement the applicable Management Measures to meet the conditions of the Ohio Coastal Nonpoint Pollution Control Program. For each coastal management measure that is applicable to Doan Brook, the appropriate goals from Section V of this Watershed Action Plan are identified. For specific actions, partners and measurable outcomes, refer to the details in Section V.

Due to the urban nature of the Doan Brook watershed, the emphasis in addressing the coastal non-point pollution control measures will be on the urban impacts and modification elements of the Coastal Non- Point Control Plan.

Coastal Management Measures and Applicability in the Doan Brook Watershed

- Urban
 - *New development*
 - Watershed protection
 - Site development
 - *Existing development*
 - *New on-site disposal systems*
 - *Operating on-site disposal systems*
 - Planning, siting, & developing roads & highways (local only)
 - Bridges (local only)
 - *Operation & maintenance of roads, highways, & bridges*
 - *Runoff systems for roads, highways & bridges*
- Hydromodification
 - Channelization & channel modification (physical & chemical characteristics of surface waters)
 - Channelization & channel modification (instream & riparian habitat restoration)
 - Dams
 - Eroding streambanks and shorelines

Exempt and Non-Applicable Management Measures in the Doan Brook Watershed

The Doan Brook watershed communities are regulated under the Phase II Storm Water permit requirements. As such, the watershed is exempt from the following management measures:

- New development
- Existing development
- Operation and maintenance of roads, highways and bridges
- Runoff systems for roads, highways and bridges

In addition, the Doan Brook watershed is exempt from the following management measures due to the lack of on-site disposal systems in the watershed:

- New on-site disposal systems
- Operating on-site disposal systems

Watershed Protection: The purpose of this measure is to reduce non-point source pollutants and mitigate the impacts of urban runoff from new development or redevelopment. The measure is aimed to 1) avoid conversion of areas susceptible to erosion and sediment loss; 2) preserve areas that provide important water quality benefits and are necessary to maintain riparian habitat; and 3) protect the natural integrity of water bodies and natural drainage systems during sites development.

Primary Goals:

- A.1 Plant native plants in riparian areas
- A.2 Implement the Parklands Management Plan
- A.3 Remove/treat Invasive Species in riparian areas and floodplains
- B.1 Remove barriers to fish migration
- B.2 Maintain hydrology of the stream
- B.3 Daylight culverted sections of the stream
- C.2 Create Lakes Management Plans for Green, Marshall, Horseshoe and Lower Lakes
- D.1 Reduce Impervious Cover and Implement Green Infrastructure Stormwater Controls to slow stormwater flows.

Site Development: The purpose of this measure is to provide guidance to plan, design and develop sites in order to 1) protect areas that provide water quality benefits and are susceptible to erosion and sediment loss; 2) limit increases in impervious areas; 3) limit land disturbance activities such as clearing, grading, cutting and filling to reduce erosion and sediment loss; and 4) limit disturbance of natural drainage features and vegetation.

Primary Goals:

- A.1 Plant native plants in riparian areas
- A.2 Implement the Parklands Management Plan
- A.3 Remove/treat Invasive Species in riparian areas and floodplains
- B.2 Maintain hydrology of the stream
- B.3 Daylight culverted sections of the stream
- C.2 Create Lakes Management Plans for Green, Marshall, Horseshoe and Lower Lakes
- D.1 Reduce Impervious Cover and Implement Green Infrastructure Stormwater Controls to slow stormwater flows.

Planning, Siting and Developing Roads &Highways : The purpose of this measure is to ensure that the planning processes for new roads, highways and bridges include environmental considerations relative to the Doan Brook watershed and its water quality. The Doan Brook watershed may have three major roadway re-configurations or expansions; Opportunity Corridor, Van Aken Business District, and reconfiguration of Martin Luther King Boulevard at East 105th Street.

Primary Goals:

- B.2 Maintain hydrology of the stream
- B.3 Daylight culverted sections of the stream
- C.2 Create Lakes Management Plans for Green, Marshall, Horseshoe and Lower Lakes

- D.1 Reduce Impervious Cover and Implement Green Infrastructure Stormwater Controls to slow stormwater flows.

Bridges (local): The purpose of this management measure is to site, design and maintain bridge structures so that sensitive aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

There are no new bridges planned for the Doan Brook watershed in the next five years.

Primary Goals:

- B.2 Maintain hydrology of the stream
- B.3 Daylight culverted sections of the stream
- E.3 Organize and participate in Educational Events

Channelization & channel modification (physical & chemical characteristics of surface waters): For existing channelization projects, the purpose of this management measure is to ensure that the operation and maintenance program uses any opportunities available to improve the physical and chemical characteristics of the surface waters. The physical and chemical characteristics of surface waters that may be influenced by channelization and channel modification include sediment, turbidity, salinity, temperature, nutrients, dissolved oxygen, oxygen demand, and contaminants.

Primary Goals:

- A.2 Implement the Parklands Management Plan
- B.1 Remove barriers to fish migration
- B.2 Maintain hydrology of the stream
- B.3 Daylight culverted sections of the stream

Channelization & channel modification (instream & riparian habitat restoration): The purpose of this management measure is to correct or prevent detrimental changes to instream and riparian habitat from the impacts of channelization and channel modification projects.

Primary Goals:

- A.1 Plant native plants in riparian areas
- A.2 Implement the Parklands Management Plan
- A.3 Remove/treat Invasive Species in riparian areas and floodplains
- B.1 Remove barriers to fish migration
- B.2 Maintain hydrology of the stream
- B.3 Daylight culverted sections of the stream

Dams: This management measure's purpose is to protect the quality of surface waters downstream from an impoundment. The dams in the Doan Brook watershed encompass a wide variety of purposes and conditions.

Primary Goals:

- C.1 Repair dams at Horseshoe and Green Lakes to comply with ODNR standards
- C.2 Create Lakes Management Plans for Green, Marshall, Horseshoe and Lower Lakes

Eroding Streambanks and Shorelines: This management measure addresses eroding streambanks and shorelines that create non point pollution problems in coastal rivers and streams. Doan Brook has eroding streambanks that must be a priority in its future restoration and improvements.

Primary Goals:

- A.1 Plant native plants in riparian areas
- B.2 Maintain hydrology of the stream

VIII. Evaluation

Evaluation of the Plan's intent and success will need to be conducted through the assessment of watershed-wide work plans and watershed improvements. The Executive Director and the DBWP work plan are given a performance evaluation on an annual basis.

A. Annual Work Plans

The Doan Brook Watershed Partnership will conduct an evaluation of its progress toward plan goals and their implementation on an annual basis. The Partnership will develop an annual work plan of tasks associated with the Watershed Action Plan goals to maintain priorities on an annual basis. As part of this annual work plan, the Doan Brook Watershed Partnership will also evaluate the tasks, their feasibility and priorities. As staffing, funding and stakeholders shift over time, evaluating implementation conditions will be essential to success.

B. Water Quality Monitoring

An aggressive monitoring program will assist in providing baseline conditions throughout the watershed and establishing trends against which to measure improvements or setbacks. This data will be essential in monitoring progress and water quality improvement benchmarks and identifying new project priorities. The Doan Brook Watershed Partnership will work with the Northeast Ohio Regional Sewer District, the Nature Center at Shaker Lakes, Ohio EPA, the three watershed municipalities and the local communities to compile the data from their respective

monitoring programs, organize it in a comprehensive manner and make it available for public analysis.

C. Plan Update/Revision

As with any comprehensive plan, updating and revising to reflect economic, social and environmental conditions of a watershed will be needed. The Doan Brook Watershed Partnership will determine a plan update process in the first year of implementation and identify how best to monitor its progress.

XI. References

- 2004-2007 Doan Brook Water Quality Data*, Northeast Ohio Regional Sewer District.
- Action Plan for the Doan Brook Watershed*, Doan Brook Watershed Partnership, September, 2004.
- CSO Facilities Planning Summary Report*, Northeast Ohio Regional Sewer District, March, 2005.
- Delisting Targets for Ohio Areas of Concerns*, Ohio EPA, December, 2008.
- Dike 14 Study Fact Sheet*, Cuyahoga Soil & Water Conservation District.
- The Doan Brook Handbook*, Laura C. Gooch, 2001.
- Doan Brook Mitigation Report, Basis of Design*, Cleveland Department of Port Control and Water Pollution Control, January, 2005.
- Doan Brook Stream Characterization Study*, Davey Resource Group, September, 1998.
- Doan Brook Stream Restoration Assessment Project*, URS, October, 2007.
- Doan Brook Watershed Study*, Northeast Ohio Regional Sewer District, August, 2001.
- The Evolution of Flood Risk and Erosion Damage in the Shaker Lakes/Doan Brook Watershed*, CWRU Department of Civil Engineering, Researchers, Dr. Jennings, Dr. Gardner, J. Dietrich, J. Maehr, J. Zielinski.
- Existing Conditions Inventory and Assessment, Volume 1, Secondary Source Watershed Data and Summary of Field Surveys*, Northeast Ohio Regional Sewer District, October, 1999.
- Inventory and Evaluation of Historic Resources for the Doan Brook Stream Restoration Project, Volume 1&2*, Hardlines Design Company, May, 2003.
- Non Point Source Pollution Control Plan, South Branch Doan Brook and Green and Marshall Lakes*, Davey Resource Group, March, 2006.
- Ohio EPA 2008 Integrated Report*, Ohio EPA, 2008.
- Retrofit Inventory of the Doan Brook Watershed*, Center for Watershed Protection, 2000.
- Water Quality Monitoring and Sampling Report*, Northeast Ohio Regional Sewer District, September 2000.

XII. Appendices

Appendix A: Water Quality Data

Source: NEORSD

QHEI Scores



IBI Scores

River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Number of				Percent of Individuals				Rel.No. minus tolerant / (0.3km) IBI	
							Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies		
<i>Doan Brook - (19-039)</i>																
Year: 2011																
5.50	E	09/01/2011	4.4	4(1)	3(3)	1(1)	0(1)	0(1)	1(1)	100(1)	2(5)	97(1)	5(1)	5.1(1)	5(1)	18
Year: 2000																
2.70	E	08/29/2000	8.1	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	100(1)	0(1)	100(1)	100(1)	0.0(1)	0(1) * * 12	

◆ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

1

10/13/2011

Appendix B. Historic Sites

Designation	Name
NAT/LOCALS	FAIRHILL VILLAGE
LOCAL	LITTLE ITALY
NATIONAL	WADE PARK
NAT/LOCALS	NEWTON AVE
NAT/LOCALS	HESSLER ROAD
NAT/LOCALS	EAST BLVD
NATIONAL	MAGNOLIA DR / WADE PARK
NATIONAL	MATHER, FLORA STONE COLLEGE
NAT/LOCALS	SHAKER SQUARE

NATIONAL REGISTER OF HISTORIC PLACES - DISTRICTS

Resource Name	Description	City	Listed Date
Fairmount Boulevard District	2485--3121 Fairmount Blvd. Roughly bounded by Fairmount and Lomond Blvds., Green, Warrensville Center, Becket, and Coventry Rds.	Cleveland Heights	19761212
Shaker Village Historic District	1--5 Herrick Mews	Shaker Heights	19840531
Overlook Road Carriage House District		Cleveland Heights	19740506

OHIO HISTORICAL SOCIETY DISTRICTS

District Name	Place	Listed Date	No. Properties
East Boulevard Historic District	Cleveland	19951129	401
Magnolia-Wade Park Historic District	Cleveland	19901025	432
Wade Park District	Cleveland	19821002	7
Hessler Court Wooden Pavement	Cleveland	19750303	0
Mather Flora Stone College District	Cleveland	19740215	5
Newton Avenue Historic District	Cleveland	19880831	23
Overlook Road Carriage House District	Cleveland Heights	19740506	5
Fairmount Boulevard District	Cleveland	19761212	96
Fairhill Road Village Historic District	Cleveland	19900510	12
Shaker Square Historic District (+ Boundary Increase)	Cleveland	19830912	10300

Source: Cuyahoga County Planning Commission

Appendix D. Plant and Animals of Doan Brook Watershed

Source: Existing Conditions Inventory and Assessment, 1999
Northeast Ohio Regional Sewer District

Plants and Animals of the Doan Brook Watershed

VEGETATION OF DOAN BROOK - SUCCESSIONAL WOODS

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acer negundo</i>	Box elder
* <i>Acer platanoides</i>	Norway maple
<i>Acer rubrum</i>	Red maple
<i>Acer saccharum</i>	Sugar maple
* <i>Alliaria petiolata</i>	Garlic mustard
<i>Arctium minus</i>	Burdock
* <i>Berberis thunbergii</i>	Japanese barberry
<i>Carex amphibola</i>	Sedge
<i>Carex debilis</i> var. <i>Rudgei</i>	Sedge
* <i>Celastrus orbiculatus</i>	Asiatic bittersweet
* <i>Conium maculatum</i>	Poison hemlock
* <i>Convallaria majalis</i>	Lily-of-the-valley
<i>Cornus amomum</i>	Silky dogwood
<i>Crataegus</i> spp.	Hawthorns
* <i>Dactylis glomerata</i>	Orchard grass
<i>Fraxinus americana</i>	White ash
<i>Fraxinus pennsylvanica</i>	Green ash
* <i>Glechoma hederacea</i>	Ground ivy
* <i>Hemerocallis fulva</i>	Daylily
<i>Impatiens capensis</i>	Spotted touch-me-not
<i>Juglans nigra</i>	Black walnut
† <i>Juglans cinerea</i>	Butternut
* <i>Ligustrum vulgare</i>	Privet
<i>Lindera benzoin</i>	Northern spicebush
<i>Liriodendron tulipifera</i>	Tulip-tree
* <i>Lonicera japonica</i>	Japanese honeysuckle
* <i>Lonicera tatarica</i>	Tartarian honeysuckle
* <i>Malus pumila</i>	Apple
* <i>Morus alba</i>	White mulberry
<i>Parthenocissus quinquefolia</i>	Virginia creeper
* <i>Picea abies</i>	Norway spruce
* <i>Polygonum cuspidatum</i>	Japanese knotweed
<i>Polygonum virginiana</i>	Virginia knotweed
<i>Populus deltoides</i>	Cottonwood

† Rare, threatened, or endangered species

* Non-native species

VEGETATION OF DOAN BROOK - SUCCESSIONAL WOODS (Cont.)

<u>Scientific Name</u>	<u>Common Name</u>
* <i>Prunus avium</i>	Sweet cherry
<i>Prunus serotina</i>	Black cherry
<i>Quercus palustris</i>	Pin oak
<i>Quercus rubra</i>	Red oak
* <i>Ranunculus acris</i>	Buttercup
* <i>Rhamnus cathartica</i>	Common buckthorn
* <i>Rhamnus frangula</i>	European buckthorn
<i>Robinia pseudoacacia</i>	Black locust
* <i>Rosa multiflora</i>	Multiflora rose
<i>Rubus allegheniensis</i>	Allegheny blackberry
<i>Rubus occidentalis</i>	Black raspberry
<i>Salix nigra</i>	Black willow
<i>Sambucus canadensis</i>	Common elder
<i>Smilax rotundifolia</i>	Common greenbriar
* <i>Solanum dulcamara</i>	Bittersweet nightshade
* <i>Sorbus aucuparia</i>	European mountain ash
* <i>Syringa vulgaris</i>	Lilac
<i>Tilia americana</i>	American basswood
<i>Toxicodendron radicans</i>	Poison ivy
<i>Ulmus americana</i>	American elm
<i>Viburnum acerifolium</i>	Maple-leaved viburnum
* <i>Viburnum opulus</i>	European cranberry bush
<i>Viburnum recognitum</i>	Northern arrow-wood
* <i>Vinca minor</i>	Myrtle
<i>Viola papilionacea</i>	Violet
<i>Vitis aestivalis</i>	Summer grape
<i>Vitis riparia</i>	Riverbank grape

VEGETATION OF DOAN BROOK - UPLAND WOODS

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acer saccharum</i>	<i>Sugar maple</i>
* <i>Alliaria petiolata</i>	Garlic mustard
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit
<i>Asimina triloba</i>	Common pawpaw
<i>Aster</i>	Asters
<i>Carex amphibola</i>	Sedge
<i>Carex complanata</i>	Sedge
<i>Carex debilis</i> var. <i>Rudgei</i>	Sedge
<i>Carex pensylvanica</i>	Sedge

* Non-native species

VEGETATION OF DOAN BROOK - UPLAND WOODS (Cont.)

<u>Scientific Name</u>	<u>Common Name</u>
<i>Carpinus caroliniana</i>	Ironwood
<i>Carya cordiformis</i>	Bitternut hickory
<i>Circaea lutetiana</i>	Southern broad-leaved enchanter's nightshade
<i>Conopholis americana</i>	Squaw root
<i>Cornus florida</i>	Flowering dogwood
<i>Cornus foemina</i>	Gray dogwood
<i>Euonymus obovatus</i>	Running strawberry bush
<i>Fagus grandifolia</i>	American beech
<i>Fraxinus americana</i>	White ash
<i>Geranium maculatum</i>	Wild geranium
<i>Hamamelis virginiana</i>	Witch hazel
<i>Hydrophyllum virginianum</i>	Virginia waterleaf
<i>Impatiens capensis</i>	Spotted touch-me-not
† <i>Juglans cinerea</i>	Butternut
* <i>Ligustrum vulgare</i>	Privet
<i>Lindera benzoin</i>	Northern spicebush
<i>Liriodendron tulipifera</i>	Tulip tree
* <i>Lonicera japonica</i>	Japanese honeysuckle
<i>Maianthemum canadense</i>	Canada mayflower
<i>Ostrya virginiana</i>	Hop hornbeam
<i>Parthenocissus quinquefolia</i>	Virginia creeper
<i>Phytolacca americana</i>	Pokeweed
<i>Platanus occidentalis</i>	American sycamore
<i>Podophyllum peltatum</i>	Mayapple
<i>Polygonum virginianum</i>	Virginia knotweed
<i>Prunus serotina</i>	Black cherry
<i>Quercus alba</i>	White oak
<i>Quercus rubra</i>	Red oak
<i>Quercus velutina</i>	Black oak
* <i>Rhamnus frangula</i>	European buckthorn
<i>Rubus allegheniensis</i>	Allegheny blackberry
<i>Salix nigra</i>	Black willow
<i>Smilacina racemosa</i>	False Solomon's seal
<i>Tilia americana</i>	American basswood
<i>Toxicodendron radicans</i>	Poison ivy
<i>Viburnum acerifolium</i>	Maple-leaved viburnum
* <i>Viburnum opulus</i>	European cranberry bush
<i>Vitis riparia</i>	Riverbank grape

† Rare, threatened, or endangered species

* Non-native species

VEGETATION OF DOAN BROOK - UPLAND OLD FIELD

<u>Scientific Name</u>	<u>Common Name</u>
* <i>Chrysanthemum leucanthemum</i>	Oxeye daisy
* <i>Cichorium intybus</i>	Chicory
* <i>Dactylis glomerata</i>	Orchard grass
* <i>Daucus carota</i>	Queen Anne's lace
* <i>Dipsacus sylvestris</i>	Teasel
* <i>Lotus corniculatus</i>	Birdsfoot trefoil
* <i>Melilotus</i>	Sweet clover
* <i>Phleum pratense</i>	Timothy
* <i>Plantago lanceolata</i>	English plantain
* <i>Rosa multiflora</i>	Multiflora rose
* <i>Trifolium pratense</i>	Red clover

VEGETATION OF DOAN BROOK - MARSH

<u>Scientific Name</u>	<u>Common Name</u>
<i>Alisma plantago-aquatica</i>	Water plantain
<i>Carex stricta</i>	Sedge
<i>Impatiens</i>	Jewelweed
* <i>Iris pseudoacorus</i>	Yellow iris
* <i>Lythrum salicaria</i>	Purple loosestrife
* <i>Myosotis scorpioides</i>	Forget-me-not
<i>Sagittaria latifolia</i>	Duck potato
<i>Scirpus atrovirens</i>	Green bulrush
<i>Typha angustifolia</i>	Narrow-leaved cattail
<i>Typha latifolia</i>	Broad-leaved cattail

VEGETATION OF DOAN BROOK - SCRUB/SHRUB WETLANDS

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acer saccharinum</i>	Silver maple
<i>Carex stricta</i>	Sedge
<i>Cornus amomum</i>	Silky dogwood
<i>Eupatorium perfoliatum</i>	Boneset
<i>Glyceria striata</i>	Fowl manna grass
<i>Impatiens</i>	Jewelweed
* <i>Iris pseudoacorus</i>	Yellow iris
<i>Laportea canadensis</i>	Wood nettle
<i>Leersia oryzoides</i>	Rice cutgrass
<i>Lycopus americanus</i>	Water horehound

* Non-native species

VEGETATION OF DOAN BROOK - SCRUB/SHRUB WETLANDS (Cont.)

<u>Scientific Name</u>	<u>Common Name</u>
* <i>Lysimachia nummularia</i>	Moneywort
* <i>Myosotis scorpioides</i>	Forget-me-not
<i>Phalaris arundinacea</i>	Reed canary grass
* <i>Rhamnus frangula</i>	European buckthorn
<i>Sagittaria latifolia</i>	Duck potato
<i>Salix nigra</i>	Black willow
<i>Typha latifolia</i>	Broad-leaved cattail
<i>Ulmus americana</i>	American elm

VEGETATION OF DOAN BROOK - LOWLAND WOODS

<u>Scientific Name</u>	<u>Common Name</u>
<i>Acer saccharinum</i>	Silver maple
* <i>Alliaria petiolata</i>	Garlic mustard
<i>Alnus serrulata</i>	Common alder
<i>Eupatorium perfoliatum</i>	Boneset
<i>Glyceria striata</i>	Fowl manna grass
<i>Impatiens</i> sp.	Jewelweed
<i>Leersia virginica</i>	White grass
* <i>Lysimachia nummularia</i>	Moneywort
<i>Poa</i> sp.....	Bluegrass
<i>Polygonum virginianum</i>	Virginia knotweed
<i>Ribes americanum</i>	American currant
<i>Salix nigra</i>	Black willow
<i>Saururus cernuus</i>	Lizard's tail
<i>Symplocarpus foetidus</i>	Skunk cabbage
<i>Ulmus americana</i>	American elm
<i>Viburnum recognitum</i>	Northern arrow-wood

VEGETATION OF DOAN BROOK - DENSE MACROPHYTE COMMUNITY

<u>Scientific Name</u>	<u>Common Name</u>
<i>Ceratophyllum demersum</i>	Coontail
<i>Elodea canadensis</i>	Elodea
<i>Potamogeton pectinatus</i>	Sago pondweed
* <i>Potamogeton crispus</i>	Curly pondweed
* <i>Miriophyllum spicatum</i>	Eurasian water milfoil

* Non-native species

AMPHIBIANS AND REPTILES OF DOAN BROOK

<u>Scientific Name</u>	<u>Common Name</u>
<i>Eurycea bislineata bislineata</i>	Two-lined salamander
<i>Plethodon cinereus</i>	Redback salamander
<i>Bufo americanus americanus</i>	American toad
<i>Rana clamitans melanota</i>	Green frog
<i>Rana palustris</i>	Pickerel frog
<i>Rana sylvatica sylvatica</i>	Wood frog
<i>Chelydra serpentina</i>	Snapping turtle
<i>Chrysemys picta marginata</i>	Painted turtle
<i>Storeria dekayi dekayi</i>	Brown snake
<i>Thamnophis sirtalis sirtalis</i>	Garter snake

MAMMALS OF DOAN BROOK

<u>Scientific Name</u>	<u>Common Name</u>
<i>Blarina brevicauda</i>	Short-tailed shrew
<i>Didelphis virginiana</i>	Opossum
<i>Eptesicus fuscus</i>	Big brown bat
<i>Glaucomys volans</i>	Southern flying squirrel
<i>Marmota monax</i>	Woodchuck
<i>Mephitis mephitis</i>	Skunk
<i>Microtus pennsylvanicus</i>	Meadow vole
* <i>Mus musculus</i>	House mouse
<i>Odocoileus virginianus</i>	White-tailed deer
<i>Peromyscus leucopus</i>	White-footed mouse
* <i>Rattus norvegicus</i>	Norway rat
<i>Sciurus niger</i>	Fox squirrel
<i>Sylvilagus floridanus</i>	Eastern cottontail
<i>Tamias striatus</i>	Eastern chipmunk

† Rare, threatened, or endangered species

* Non-native species

BIRDS OF DOAN BROOK (Common Names)

Alder flycatcher	Gray catbird	Ruby-crowned kinglet
†American bittern	Gray-cheeked thrush	Ruby-throated hummingbird
American crow	Great blue heron	Rufous-sided towhee
American goldfinch	Great crested flycatcher	Savannah sparrow
American kestrel	Great egret	Scarlet tanager
American redstart	Greater scaup	†Sharp-shinned hawk
American robin	Green-backed heron	Short-billed marsh wren
American wigeon	Hairy woodpecker	Snow Goose
American woodcock	†Hermit thrush	Snowy owl
Bank swallow	Herring gull	Solitary vireo
Barn swallow	Hooded merganser	Song sparrow
Barred owl	Hooded warbler	†Sora rail
Bay-breasted warbler	Horned lark	Spotted sandpiper
Belted kingfisher	House finch	Summer tanager
†Black duck	*House sparrow	Swainson's thrush
Black tern	House wren	Swamp sparrow
Black-and-white warbler	Indigo bunting	Tennessee warbler
Black-capped chickadee	Kentucky warbler	Tree swallow
Black-throated green warbler	Killdeer	Tufted titmouse
Blue jay	†Least bittern	Turkey vulture
Blue-gray gnatcatcher	Least flycatcher	Veery
Blue-winged teal	Lesser scaup	Vesper sparrow
Blue-winged warbler	Loggerhead shrike	†Virginia rail
Brown creeper	†Long-billed marsh wren	Warbling vireo
Brown thrasher	†Magnolia warbler	Whip-poor-will
Brown-headed cowbird	Mallard	White-breasted nuthatch
Canada goose	Merlin	White-throated sparrow
†Canada warbler	Mourning dove	Willow flycatcher
Cape May warbler	Nashville warbler	Wilson's phalarope
Carolina wren	Northern cardinal	Wilson's warbler
Caspian tern	Northern flicker	†Winter wren
Cedar waxwing	Northern oriole	Wood duck
Cerulean warbler	Northern Parula warbler	Wood duck
Chestnut-sided warbler	Northern rough-winged swallow	Wood thrush
Chimney swift	Northern shrike	Worm-eating warbler
Chipping sparrow	Oldsquaw	Yellow warbler
Clay throated sparrow	Olive-sided flycatcher	Yellow-bellied flycatcher
Cliff swallow	Orange-crowned warbler	†Yellow-crowned night heron
Common flicker	Orchard oriole	Yellow-rumped warbler
Common goldeneye	†Osprey	Yellow-throated vireo
Common grackle	Ovenbird	Yellow-throated warbler
Common loon	Palm warbler	
Common nighthawk	Pine warbler	
Common tern	†Pintail	
Common yellowthroat	Prairie warbler	
Connecticut warbler	Prothonotary warbler	
†Dark-eyed junco	Purple finch	
Downy woodpecker	†Purple martin	
Eastern bluebird	Red-breasted merganser	
Eastern kingbird	Red-breasted nuthatch	
Eastern wood-pewee	Red-eyed vireo	
*European starling	Red-headed woodpecker	
European wigeon	Red-tailed hawk	
Evening grosbeak	Red-winged blackbird	
Field sparrow	Ring-billed gull	
Golden-crowned kinglet	*Ring-necked pheasant	
†Golden-winged warbler	*Rock dove	
Goshawk	Rose-breasted grosbeak	

†Rare, threatened, endangered species
*Non-native species

Source: NEORSD

Doan Brook Downstream of St. Clair Avenue
09/18/07

Collection Distance: 0.15 km
Collection Method: Longline Electroshocking
Drainage Area: 9.1 miles²
River Mile: 0.75

<u>Species</u>	<u>Number</u>	<u>Weight (kg)</u>	<u>Pollution Tolerance</u>	<u>DELTA Anomalies #</u>	<u>Description</u>
Catostomus commersoni Common white sucker	11	0.682	Highly Tolerant	0	--
Carassius auratus Goldfish	7	1.100	Highly Tolerant	2	Body and fin lesion
Ictalurus natalis Yellow bullhead	2	0.135	Highly Tolerant	0	--
Lepomis cyaneilus Green sunfish	9	0.194	Highly Tolerant	0	--
Lepomis macrochirus Northern bluegill sunfish	17	0.135	Moderately Tolerant	0	--
Lepomis gibbosus Pumpkinseed sunfish	47	0.500	Moderately Tolerant	0	--
HYBRID Bluegill X Pumpkinseed	7	0.120	--	3	Deformed spine Eroded fins
HYBRID Green SF X Pumpkinseed	2	0.050	--	0	
Totals	102	2.916		5	

*DELTA anomalies were observed on 4.9 of the fish collected.
Index of Biotic Integrity (IBI) = 26 (Fair)

Doan Brook-North Branch Upstream of Lee Road
09/17/07

Collection Distance: 0.15 km
Collection Method: Longline Electroshocking
Drainage Area: 1.2 miles²
River Mile: 6.70

<u>Species</u>	<u>Number</u>	<u>Weight (kg)</u>	<u>Pollution Tolerance</u>	<u>#</u>	<u>DELTA Anomalies Description</u>
<i>Semotilus atromaculatus</i> Creek chub	77	0.720	Highly Tolerant	0	--
<i>Lepomis cyanellus</i> Green sunfish	98	0.260	Highly Tolerant	0	--
Totals	<u>175</u>	<u>0.980</u>		<u>0</u>	

*DELTA anomalies were observed on 0.0 of the fish collected.
Index of Biotic Integrity (IBI) = 12 (Very Poor)

Doan Brook-South Branch Upstream of Attleboro Road
09/17/07

Collection Distance: 0.15 km
Collection Method: Longline Electroshocking
Drainage Area: 0.9 miles²
River Mile: 1.40

<u>Species</u>	<u>Number</u>	<u>Weight (kg)</u>	<u>Pollution Tolerance</u>	<u>#</u>	<u>DELTA Anomalies Description</u>
<i>Lepomis cyanellus</i> Green sunfish	640	2.055	Highly Tolerant	1	Lesion
Totals	<u>640</u>	<u>2.055</u>		<u>1</u>	

*DELTA anomalies were observed on 0.2 of the fish collected.
Index of Biotic Integrity (IBI) = 12 (Very Poor)

**Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection**

Site: Doan Brook
dst. East Ave.

Collection Date: 08/15/2000 River Code: 19-039 RM: 4.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
00401	<i>Spongillidae</i>	+			
01801	<i>Turbellaria</i>	+			
04666	<i>Helobdella triserialis</i>	+			
04935	<i>Erpobdella punctata punctata</i>	+			
06700	<i>Crangonyx sp</i>	+			
11120	<i>Baetis flavistriga</i>	+			
22001	<i>Coenagrionidae</i>	+			
52200	<i>Cheumatopsyche sp</i>	+			
52530	<i>Hydropsyche depravata group</i>	+			
74100	<i>Simulium sp</i>	+			
77500	<i>Conchapelopia sp</i>	+			
78350	<i>Meropelopia sp</i>	+			
80410	<i>Cricotopus (C.) sp</i>	+			
82070	<i>Synorthocladius semivirens</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	+			
84888	<i>Xenochironomus xenolabis</i>	+			
85625	<i>Rheotanytarsus sp</i>	+			
85800	<i>Tanytarsus sp</i>	+			

No. Quantitative Taxa: 0 Total Taxa: 20
 No. Qualitative Taxa: 20 ICI:
 Number of Organisms: 0 Qual EPT: 3

**Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection**

Site: Doan Brook
dst. E. 105th St.

Collection Date: 08/15/2000 River Code: 19-039 RM: 2.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	+			
03600	<i>Oligochaeta</i>	+			
04664	<i>Helobdella stagnalis</i>	+			
04666	<i>Helobdella triserialis</i>	+			
04935	<i>Erpobdella punctata punctata</i>	+			
04960	<i>Mooreobdella sp</i>	+			
06700	<i>Crangonyx sp</i>	+			
11120	<i>Baetis flavistriga</i>	+			
52530	<i>Hydropsyche depravata group</i>	+			
53800	<i>Hydroptila sp</i>	+			
74100	<i>Simulium sp</i>	+			
77500	<i>Conchapelopia sp</i>	+			
77800	<i>Helopelopia sp</i>	+			
78350	<i>Meropelopia sp</i>	+			
80420	<i>Cricotopus (C.) bicinctus</i>	+			
80510	<i>Cricotopus (Isocladius) sylvestris group</i>	+			
82730	<i>Chironomus (C.) decorus group</i>	+			
82770	<i>Chironomus (C.) riparius group</i>	+			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	+			
84315	<i>Phaenopsectra flavipes</i>	+			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
85625	<i>Rheotanytarsus sp</i>	+			
85800	<i>Tanytarsus sp</i>	+			
95100	<i>Physella sp</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 25
No. Qualitative Taxa: 25	ICI:
Number of Organisms: 0	Qual EPT: 3

Species List

River Code: 19-039	Stream: Doan Brook	Sample Date: 2011
River Mile: 5.50	Location: Coventry Rd.	Date Range: 09/01/2011
Time Fished: 1422 sec	Drainage: 4.4 sq mi	
Dist Fished: 0.11 km	Basin: Cuyahoga River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Goldfish	G	O	M T	9	24.55	1.45			
Western Blacknose Dace	N	G	S T	9	24.55	1.45			
Creek Chub	N	G	N T	569	1,551.82	91.48			
Central Stoneroller	N	H	N	2	5.46	0.32			
Green Sunfish	S	I	C T	33	90.00	5.31			
<i>Mile Total</i>				622	1,696.36				
<i>Number of Species</i>				5					
<i>Number of Hybrids</i>				0					

Species List

River Code: 19-039	Stream: Doan Brook	Sample Date: 2000
River Mile: 2.70	Location: Wade Park	Date Range: 08/29/2000
Time Fished: 1172 sec	Drainage: 8.1 sq mi	
Dist Fished: 0.20 km	Basin: Cuyahoga River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Green Sunfish	S	I	C T	4	6.00	100.00	0.15	100.00	24.50
	<i>Mile Total</i>			4	6.00		0.15		
	<i>Number of Species</i>			1					
	<i>Number of Hybrids</i>			0					

Shaker Lakes Nature Center BioBlitz-8/17/2010

"Marsh Area"

Geauga Park District- Paul Pira, Linda Gilbert, Tami Gingrich, Heidi Mathiott

	Scientific Name	Common Name
Vegetation	<i>Agrimonia gryposepala</i>	Agrimony
	<i>Alisma plantago-aquatica</i>	Water-plantain
	<i>Asclepias incarnata</i>	Swamp Milkweed
	<i>Bidens frondosa</i>	Beggar Ticks
	<i>Boehmeria cylindrica</i>	False Nettle
	<i>Carex tribuloides</i>	Blunt Broom Sedge
	<i>Carex vulpinoidea</i>	Fox Sedge
	<i>Catalpa speciosa</i>	Catalpa
	<i>Cephalanthus occidentalis</i>	Buttonbush
	<i>Ceratophyllum demersum</i>	Common Coontail
	<i>Chara spp.</i>	
	<i>Cirsium vulgare</i>	Bull Thistle
	<i>Cladophera spp.</i>	
	<i>Cyperus strigosus</i>	Strawcolored FlatSedge
	<i>Elodea canadensis</i>	Common Water-weed
	<i>Epilobium hirsutum</i>	Hairy Willow Herb
	<i>Eupatorium maculatum</i>	Spotted Joe-pye-weed
	<i>Glyceria striata</i>	Fowl Mannagrass
	<i>Hibiscus moscheutos</i>	Swamp Rose-mallow
	<i>Impatiens capensis</i>	Jewelweed
	<i>Iris pseudocorus</i>	Yellow Flag Iris
	<i>Juncus tenuis</i>	Poverty Rush
	<i>Leersia oryzoides</i>	Rice-cut Grass
	<i>Lemna major</i>	Duckweed
	<i>Lycopus americanus</i>	Water Horehound
	<i>Lythrum salicaria</i>	Purple Loosestrife
	<i>Myriophyllum spicatum</i>	Eurasian Water-milfoil
	<i>Oenothera biennis</i>	Common Evening Primrose
	<i>Oxalis europaea</i>	Yellow Wood Sorrel
	<i>Penthorum sedoides</i>	Ditch Stonecrop
	<i>Phytolacca americana</i>	Pokeweed
	<i>Polygonum hydropiperoides</i>	False Water-pepper
	<i>Polygonum sagittatum</i>	Arrowleaf Tearthumb
	<i>Rhus typhina</i>	Staghorn Sumac
	<i>Sagittaria latifolia</i>	Broadleaf Arrowhead
	<i>Salix fragilis</i>	Crack Willow

<i>Scirpus atrovirens</i>	Green Bulrush
<i>Sericocarpus asteroides</i>	Toothed White-topped Aster
<i>Silphium perfoliatum</i>	Cup Plant
<i>Solanum interius</i>	Deadly Nightshade
<i>Tovara virginiana</i>	Jumpseed
<i>Toxicodendron radicans</i>	Poison Ivy
<i>Typha X glauca</i>	Hybrid Cattail
<i>Typha angustifolia</i>	Narrow-leaved Cattail
<i>Verbesina alternifolia</i>	Wingstem

Birds

<i>Agelaius phoeniceus</i>	Redwinged Blackbird
<i>Aix sponsa</i>	Wood Duck
<i>Anas platyrhynchos</i>	Mallard Duck
<i>Archilochus colubris</i>	Ruby-throated Hummingbird
<i>Ardea herodias</i>	Great Blue Heron
<i>Bombycilla cedrorum</i>	Cedar Waxwing
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Butorides virescens</i>	Green Heron
<i>Cardinalis cardinalis</i>	Northern Cardinal
<i>Carduelis tristis</i>	American Goldfinch
<i>Ceryle alcyon</i>	Belted Kingfisher
<i>Chaetura pelagica</i>	Chimney Swift
<i>Columba livia</i>	Rock Pigeon
<i>Contopus virens</i>	Eastern Wood Pewee
<i>Cyanocitta cristata</i>	Blue Jay
<i>Dumetella carolinensis</i>	Gray Catbird
<i>Melanerpes carolinus</i>	Red-bellied Woodpecker
<i>Melospiza melodia</i>	Song Sparrow
<i>Phalacrocorax auritus</i>	Double-crested Cormorant
<i>Picoides pubescens</i>	Downy Woodpecker
<i>Picoides villosus</i>	Hairy Woodpecker
<i>Poecile atricapillus</i>	Black-capped Chickadee
<i>Quiscalus quiscula</i>	Common Grackle
<i>Sitta carolinensis</i>	White-breasted Nuthatch
<i>Turdus migratorius</i>	American Robin
<i>Vireo olivaceus</i>	Red-eyed Vireo
<i>Zenaida macroura</i>	Mourning Dove

Insects

Butterflies/Moths

<i>Colias philodice</i>	Clouded Sulphur
<i>Danaus plexippus</i>	Monarch
<i>Epargyreus clarus</i>	Silver Spotted Skipper
<i>Erynnis horatius</i>	Horace's Duskywing
<i>Eudryas unio</i>	Pearly Wood Nymph Moth
<i>Papilo glaucus</i>	Tiger Swallowtail

	<i>Pieris rapae</i>	Cabbage White
	<i>Polites peckius</i>	Pecks Skipper
	<i>Spilosoma virginica</i>	Virginian Tiger Moth
	<i>Vanassa atalanta</i>	Red Admiral
Dragons & Damsels	<i>Anax junius</i>	Green Darner
	<i>Ischnura posita</i>	Fragile Forktail
	<i>Ischnura verticalis</i>	Eastern Forktail
	<i>Pachydiplax longipennis</i>	Blue Dasher
	<i>Perithemis tenera</i>	Eastern Amberwing
	<i>Plathemis lydia</i>	Common Whitetail
	<i>Tramea lacerata</i>	Black Saddlebag
Other	<i>Anaxipha exigua</i>	Say's Trig
	<i>Apis mellifera</i>	Honey Bee
	<i>Bombus sp</i>	Bumble Bee
	<i>Conocephalus brevipennis</i>	Short-winged Meadow Katydid
	<i>Eunemobius carolinus</i>	Carolina Ground Cricket
	<i>Musca domestica</i>	Housefly
	O. Chilopoda	Centipede
	O. Coleoptera	Ground Beetle
	O. Hemiptera	Water Strider
	O. Homoptera	Aphid
	O. Hymenoptera	Ichneumon Wasp
	O. Opiliones	Harvestman
	<i>Oncopeltus fasciatus</i>	Milkweed Bug
	<i>Orchelimum nigripes</i>	Black-legged Meadow Katydid
	<i>Popillia japonica</i>	Japanese Beetle
	<i>Tibicen linnei</i>	Linnes Cicada
	<i>Tibicen lyricen</i>	Lyric Cicada
	<i>Tibicen tibicen</i>	Swamp Cicada
	<i>Tipula sp</i>	Cranefly species
	<i>Vespula spp</i>	Yellow Jacket
	<i>Xylocopa sp.</i>	Carpenter Bee
Other Invertebrates	C. Gastropoda	Snail species
	<i>Leucauge venusta</i>	Orchard Orb Weaver
	O. Isopoda	Sow Bug
	P. Annelida	Night Crawler
Vertebrates		
Fish	<i>Campostoma anomalum</i>	Stoneroller minnow
	<i>Carassius auratus</i>	Goldfish
	<i>Lepomis cyanellus</i>	Green Sunfish
	<i>Rhinichthys atratulus</i>	Blacknose Dace

	<i>Semotilus atromaculatus</i>	Creek Chub
Other	<i>Marmota monax</i>	Ground Hog
	<i>Odocoileus virginianus</i>	White-tailed Deer
	<i>Procyon lotor</i>	Raccoon
	<i>Rana clamitans</i>	Green Frog

Appendix E. Doan Brook Watershed Partnership Bylaws

REGULATIONS OF DOAN BROOK WATERSHED PARTNERSHIP

ARTICLE I TRUSTEES

Section 1. NUMBER.

The affairs and business of the Corporation shall be managed by a Board of Trustees, composed of no more than sixteen (16) persons who shall be appointed as follows: two (2) Trustees, one an elected official, the other a staff member, appointed by the City Council of Cleveland Heights; two (2) Trustees, one an elected official, the other a staff member, appointed by the Mayor of Shaker Heights; two (2), one an elected official, the other a staff member, appointed by the Mayor and City Council of Cleveland; one (1) Trustee appointed by University Circle, Inc.; one (1) Trustee appointed by the Northeast Ohio Regional Sewer District; one (1) Trustee appointed by the Nature Center at Shaker Lakes; one (1) Trustee appointed by the Cuyahoga RAP; one (1) Trustee appointed by the Cleveland Museum of Natural History; one (1) Trustee appointed by the Cleveland Botanical Gardens; and four (4) at-large Trustees, who are not representatives of any institution, to be appointed by the Board of Trustees. At least one at-large Trustee shall reside in the upper Doan Brook watershed, and at least one at-large Trustee shall reside in the lower Doan Brook watershed.

Section 2. GOVERNING POWERS.

The Board of Trustees shall have all the powers and duties necessary or appropriate for the administration of the affairs of the Corporation.

Section 3. ELECTION AND TERM OF OFFICE.

A Nominating Committee shall be appointed annually by the Board of Trustees at a meeting two (2) meetings prior to the Annual Meeting. The Nominating Committee shall annually prepare a slate of nominees for all expiring Board seats, including those seats for which an incumbent is being re-nominated. Regarding appointed Trustees, this shall be accomplished by a member of the Nominating Committee communicating via letter, email, or phone to the appointing body of any Trustee whose term is expiring, notifying said body of its need to appoint or reappoint a Trustee by a specified date. Regarding at-large Trustees, the Nominating Committee, through consultation with and suggestions from the Board of Trustees, shall prepare a slate of candidates for expiring at-large seats. The entire slate for appointed and at-large seats shall be submitted to the Board of Trustees for election at the meeting prior to the Annual Meeting, provided a quorum is in attendance. Trustees shall be sworn in at the Annual Meeting. The term of each Trustee shall be for a three (3) year period and shall expire when their successors have been elected. Terms shall be staggered in order that no more than one third (1/3) of the Board of Trustees shall turn over in any given year by regular election. Successive terms shall be permitted.

Section 4. QUORUM.

Except as otherwise provided by law or these Regulations, a majority of the Trustees who have been duly appointed at any given time and whose names and addresses have been recorded by the Secretary of the Corporation and who have not resigned shall be necessary to constitute a quorum for a meeting of the Trustees; provided, if at any meeting of the Trustees there shall be present less than a quorum, a majority of those present may adjourn the meeting from time to time without any notice other than by announcement at the meeting of the time and place to which the meeting is adjourned until a quorum shall attend.

Section 5. MEETINGS.

(a) Regular meetings of the Board of Trustees shall be held on such dates and at such times and places within the State of Ohio as the Board may designate. There shall be at least three (3) Regular meetings per calendar year. There shall be no compensation from the Corporation for time and travel to meetings.

(b) A Special Meeting of the Board of Trustees may be called by the Chair, President, Secretary, Treasurer or any three (3) Trustees, on such date and at such time and place within the State of Ohio as shall be specified in the call thereof.

(c) Written notice of each meeting of the Board of Trustees, whether regular or special, shall be given to each Trustee by personal delivery or by mail or facsimile or electronic mail (with return receipt requested), at least two (2) days before the time of such meeting (which notice need not specify the purposes of the meeting). Notice of any meeting may be waived by any Trustee before or after the meeting by a signed writing and shall be deemed to be waived by any Trustee who shall attend such meeting in person without protesting, prior to or at the commencement of the meeting, the lack of proper notice. Any meeting of the Board of Trustees shall be a legal meeting without notice having been given if attended by all the members of the Board.

Section 6. VOTING.

The act of a majority of the Trustees present at a meeting at which a quorum is present is the act of the Board, unless the act of a greater number is otherwise required by these Regulations or by law. A Trustee's designated representative shall be allowed to vote for the Trustee if written proof of such designation is evident at the time of vote. In the event of a tie, the Board Chair shall cast the deciding vote. A vote may be conducted by email in the event that immediate action needs to be taken on a specific issue; such a vote shall be at the discretion of the Board President or Chair.

Section 7. RESIGNATION AND REMOVAL.

Any Trustee may resign at any time by notice in writing or via email to the Board of Trustees with a copy to the Trustee's appointing authority, which resignation shall take effect at the time of receipt by the Board, or at such other time as may be specified in said notice. Any Trustee who is absent from any three (3) consecutive Board of Trustee meetings or more than

half of the meetings within one calendar year, shall be considered to have resigned as a Trustee; exceptions shall be at the discretion of the Executive Committee. Any Trustee may be removed from office by a 2/3 majority vote of the Trustees at a meeting at which a quorum is present. Notice of such pending resignation or removal shall be made in writing to the Trustee and the Trustee's appointing authority.

Section 8. VACANCIES.

A vacancy in the office of a Trustee shall be filled by the appointing authority for the unexpired portion of such Trustee's term of office.

Section 9. BOARD COMMITTEES.

The Board of Trustees may appoint an Executive Committee and any other committee of the Trustees, each such committee to consist of not less than two (2) Trustees, and, except as otherwise provided by law or these Regulations, may authorize the delegation to any such committee of any of the authority of the Trustees. All committees so appointed shall be subject to the control and direction of the Board of Trustees, shall serve at the pleasure of the Board of Trustees, shall act only in intervals between meetings of the Board of Trustees, and shall record regular minutes of their transactions in books kept for that purpose and report the same to the Board of Trustees at its next meeting; provided, however, that the failure of any committee so to report not invalidate any lawful action taken by it within the scope of its authority. Any act or authorization of an act by any such committee within the authority delegated to it shall be effective for all purposes as the act or authorization of the Board of Trustees.

Section 10. TELEPHONE CONFERENCES.

Meetings of the Board of Trustees or any committee thereof may be held through any communications equipment if all persons participating can hear each other, and participation in such a meeting shall constitute presence at such meeting.

ARTICLE II
OFFICERS

Section 1. COMPOSITION.

The officers of the Corporation shall include a Chair, President, Vice President, Secretary and Treasurer and such other officers as the Board of Trustees may consider necessary or appropriate. The Board of Trustees may also appoint such other subordinate officers, employees and agents as it shall deem necessary, who shall have such authority and perform such duties as from time to time shall be prescribed by the Board. The same person may hold more than one office other than the offices of Chair, President, Vice President or Secretary.

Section 2. ELECTION AND TERM OF OFFICE.

In alternate years the Nominating Committee (Article I, Section 3) shall prepare a slate of officers, consisting of a nominee for each expiring office, including those for which an

incumbent is being re-nominated. The slate shall be submitted to the Board of Trustees at the meeting prior to the Annual Meeting. All officers shall be elected by the affirmative vote of a majority of Trustees present at a meeting at which a quorum is in attendance, to hold office for two (2) years and until their respective successors are duly elected and qualified, or until the earlier of their resignation, removal from office or death. Successive terms shall be permitted.

Section 3. RESIGNATION AND REMOVAL.

Any officer elected by the Board of Trustees may resign at any time by notice in writing or via email to the Board of Trustees, which resignation shall take effect at the time of receipt by the Board or at such other time as may be specified in said notice. Any officer may be removed at any time either with or without cause by the affirmative vote of a majority of the Board of Trustees, present at a meeting at which a quorum is in attendance. Any other officer or employee of the Corporation may be removed at any time by vote of the Board of Trustees present at a meeting at which a quorum is in attendance.

Section 4. VACANCIES.

In the event of the occurrence of any vacancy in the office of any officer, whether created by death, removal, resignation or otherwise, the vacancy so created shall be filled for the unexpired portion of the term by the Board of Trustees.

ARTICLE III
DUTIES OF OFFICERS

Section 1. CHAIR.

The Chair shall serve as senior advisor in all affairs of the corporation and shall have overall organizational oversight of the Corporation. The Chair shall preside at meetings of the Board and execute all documents for and on behalf of the corporation. The Chair shall maintain contacts with key community leaders on behalf of the corporation.

Section 2. PRESIDENT.

The President shall be the Chief Executive officer of the Corporation, shall have general supervision of the business affairs and property of the Corporation and over its several officers, and shall do all acts on behalf of the Corporation, necessary, proper or incidental to all matters relating to the Corporation. The President shall perform such duties as are prescribed by law, such duties as are usually performed by presidents of like corporations and such other duties as may be assigned him from time to time by the Board of Trustees.

Section 3. VICE PRESIDENT.

The Vice President or, if there be more than one, the Vice Presidents designated by the Board of Trustees shall, in the event of a vacancy in the office of President or in the event of the disability or absence of the President, perform the duties and exercise the powers of the President. The Vice Presidents shall have such further powers and perform such other duties as may be assigned to them from time to time by the Board of Trustees or President.

Section 4. SECRETARY.

When and as required by the Board, the Secretary shall attend all meetings of the Board, shall keep minutes of all the proceedings thereof, and shall record all votes and the minutes of all of the proceedings in a book to be kept for that purpose. He/she shall perform like duties for committees of the Corporation when so required. He/she shall give, or cause to be given, notice of all meetings of the Board of Trustees. The Secretary and President shall sign the records of the Trustees' meetings. The Secretary or the Treasurer shall execute for or in the name of the Corporation all endorsements, assignments, transfers, share powers or perform such other duties usually incident to the office of Secretary, and such further duties as shall from time to time be prescribed by the Board of Trustees or President. At any meeting of the Board of Trustees at which the Secretary is not present, a secretary pro tempore may be appointed.

Section 5. TREASURER.

The Treasurer shall, subject to the directions of the Board of Trustees, have custody of the corporate funds and securities and shall keep full and accurate accounts of receipts and disbursements in books belonging to the Corporation. He/she shall deposit all monies and other valuable effects in the name of and to the credit of the Corporation, in such depositories as may be designated by the Board of Trustees. The Treasurer shall, whenever required by the Board of Trustees, make and render a statement of accounts and such other statements as may be required. The treasurer or Secretary shall execute for or in the name of the Corporation all endorsements, assignments, transfers, share powers or other instruments of transfer of securities. The Treasurer shall perform such other duties usually incident to the office of Treasurer and such other duties as may be prescribed by the Board of Trustees or President.

ARTICLE IV
NOTICES

Section 1. NOTICE BY MAIL.

Whenever, under the provisions of these Regulations, notice is permitted to be given to any Trustee by mail or facsimile or electronic mail (with return receipt requested), it may be given by depositing the same in the post office or letter box addressed to the Trustee or by faxing or by electronic mailing, at such address as appears on the books of the Corporation, or in default of such address, at his place of residence or usual place of business, last known to the Corporation; and such notice shall be deemed to be given at the time when the same shall be deposited in the mail or is faxed to the fax address appearing in the books of the Corporation.

ARTICLE V
FISCAL YEAR

The fiscal year of the Corporation shall be the calendar year, January 1 through December 31.

ARTICLE VI
SEAL

The Corporation shall have no seal.

ARTICLE VII
INDEMNIFICATION

Section 1. INDEMNIFICATION

The Corporation shall indemnify, to the full extent then permitted by law, any person who was or is a party or is threatened to be made a party to any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative by reason of the fact that he is or was a Trustee, officer, employee or agent of the Corporation, or is or was serving at the request of the Corporation as a Director, Trustee, officer, employee or agent of another corporation, domestic or foreign, nonprofit or for profit, partnership, joint venture, trust, or other enterprise; provided, however, that the Corporation shall indemnify any such agent (as opposed to any such Trustee, Director, officer or employee) to an extent greater than required by law only if and to the extent that the Trustees may, in their discretion, so determine.

Section 2. ADVANCE PAYMENT OF EXPENSES.

Expenses, including attorneys' fees, incurred in defending any action, suit or proceeding referred to in Section 1 of this Article may be paid by the Corporation in advance of the final disposition of such action, suit or proceeding as authorized by the Trustees in the specific case upon receipt of an undertaking by or on behalf of the Trustee, Director, officer, employee or agent to repay such amount, unless it shall ultimately be determined that he is entitled to be indemnified by the Corporation as authorized in this Article.

Section 3. NONEXCLUSIVE.

The indemnification provided in this Article shall not be deemed exclusive of any other rights to which those seeking indemnification may be entitled under any law, the Articles of Incorporation, this Code of Regulations, or any agreement, vote of disinterested Trustees or otherwise, both as to action in official capacities and as to action in another capacity while he is a Trustee, Director, officer, employee or agent, and shall continue as to a person who has ceased to be a Trustee, Director, officer, employee or agent and shall inure to the benefit of heirs, executors and administrators of each such person.

Section 4. INSURANCE.

The Corporation may, to the full extent then permitted by law, purchase and maintain insurance on behalf of any person who is or was a Trustee, officer, employee or agent of the Corporation or is or was serving at the request of the Corporation as a Director, Trustee, officer, employee or agent of another corporation, domestic or foreign, non-profit or for profit, partnership, joint venture, trust, or other enterprise against any liability asserted against him and

incurred by him in any such capacity, or arising out of his status as such, whether or not the Corporation would have the power to indemnify him against such liability.

ARTICLE VIII CONFLICTS OF INTEREST

Section 1.

No member of the Board of Trustees or officer of the Corporation shall have any personal financial interest in any contract relating to the operations of the Corporation, nor in any contract for furnishing supplies thereto, unless authorized by the Board of Trustees.

Section 2.

Any Trustee having a duality or possible conflict of interest on any matter shall not vote or use his/her personal influence on the matter, and he/she shall not be counted in determining the quorum for the meeting, even where permitted by law. The minutes of the meeting shall reflect that a disclosure was made, the abstention from voting, and the quorum situation.

Section 3.

The foregoing requirements shall not be construed as preventing the Trustee from briefly stating his or her position in the matter, nor from answering pertinent questions of other Board members since his knowledge may be of great assistance.

ARTICLE IX NON-DISCRIMINATION

The selection of Trustees, officers, and employees of the Corporation, and the conduct of its activities, shall be without discrimination based upon sex, sexual orientation, color, race, religion and national or ethnic origin.

ARTICLE X AMENDMENTS

The Articles of Incorporation, and the Code of Regulations, may be amended from time to time by the affirmative vote of two-thirds (2/3) of the voting members following a minimum 30 day notification and comment period.

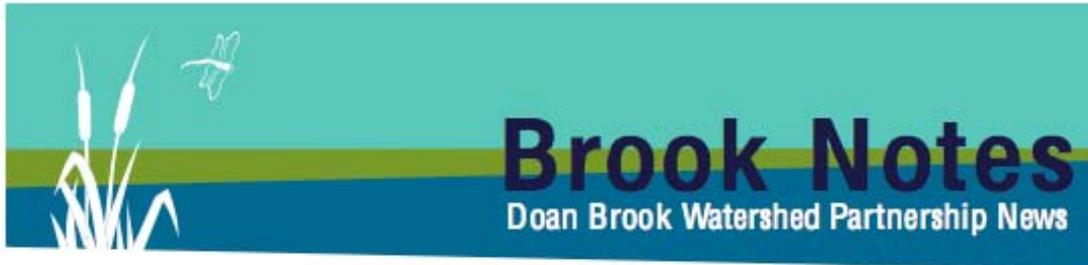
ARTICLE XI MISCELLANEOUS

The Secretary of the Corporation shall keep or cause to be kept a record, which may be included in the book containing the minutes of the proceedings of the Board of Trustees and in which

shall be recorded the names and addresses of all Trustees and the Trustees' appointing authority. There shall also be recorded therein the date upon which each Trustee became such, and upon termination of any trusteeship, the facts relating thereto, together with the date of termination. Each Trustee, upon his/her becoming such, shall forthwith advise the Secretary of his/her then current address and likewise shall promptly report to the Secretary any change in his/her address.

Original 12/05/01; Amended 6/28/12

Appendix F. Sample DBWP Newsletter



Fall, 2011

Improving and Protecting the Brook

From the Northeast Ohio Sewer District

The Doan Brook Watershed Partnership is working with the Northeast Ohio Regional Sewer District to enhance and restore portions of the lower Doan Brook.

The Doan Brook Stream Enhancement Project focuses on the section of the brook between East 105th Street at Martin Luther King Jr. Boulevard and Wade Park Avenue. Required by the Ohio Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE), this enhancement project will mitigate impacts to Abram Creek from the Cleveland Hopkins International Airport expansion project. The District has a long term interest in the ecological restoration of Doan Brook and is this project's manager for design and implementation.

In late 2010, the District hired the services of CT Consultants to complete the design of the Doan Brook Stream Enhancement Project. Throughout the design process, stakeholder input will be requested through Stakeholder Meetings—such as the one conducted on January 18, 2011—to share information about the updated project and to explore stakeholder ideas in advance of any technical design work commencing.

The design team used input from this meeting with technical information about the brook to begin the stream

enhancement design. Because this project involves the use of federal funds, through the Federal Aviation Administration (FAA), and potentially impacts historic properties (e.g., Rockefeller Park), Section 106 of the National Historic Preservation Act (NHPA) applies. The District also retained the services of Mannik & Smith for the Section 106 Consultation Process and Stakeholder Involvement for the project.

A second Stakeholder Meeting was held on May 24, 2011 to review the conceptual stream restoration design. At this meeting the design

team and the District detailed plans to focus the current enhancement project on the section of stream from E. 105th to the crossing under MLK near the lagoon.

Throughout the design process the design team has been evaluating the size and shape of the stream channel to ensure a stable stream channel is created at the end of the project. A stable stream channel will reduce the amount of erosion along the stream banks, provide a low flow channel so water does not stagnate during dry months, and allow areas where the stream can safely access a floodplain. To create a stable stream

CONTINUED ON PAGE 2



The red line indicates the project limits as of August 24, 2011.

Improving and Protecting the Brook continued

channel, the design will address existing stream bank erosion, failing and deteriorating walls, and creation of stream features called pools and riffles that provide stability and habitat for aquatic bugs and fish—thus improving the ecology and life of this stream.

Plans are being developed and the designers will be submitting preliminary plans within the upcoming weeks to NEORS and DBWP. The project team will be reviewing the plans with the regulatory agencies and stakeholders again prior to final plans being approved by the District. Construction will begin in the late spring of 2012 and is anticipated to be completed by end of the year.

LEARN MORE: neorsd.org/doanbrook or call Victoria Mills at 216.321.5935 x234.

The Northeast Ohio Regional Sewer District also is working to address combined sewer overflows in the area through its 25-year Project Clean Lake initiative. Homeowners can help improve the water quality of Doan Brook, too:

- Collect rainwater with rain barrels
- Keep pollutants and trash out of storm drains
- Limit the use of herbicides, pesticides and fertilizers

More information on home tips to improve the Doan Brook can be found on the District's web page at neorsd.org/rainworkingforyou.php and through the Doan Brook Watershed Partnership at doanbrookpartnership.org.



Native Plant Society Grant expands Riparian Zone Diversity along Doan South Branch

The Doan Brook Watershed Partnership completed a 400' stream restoration project on the South Branch of the Doan in 2006. The project re-established the in-stream habitats that had been destroyed by channelization, entrenchment and culverting — creating meanders, re-connecting the stream with its floodplain and establishing a narrow riparian corridor with native plants.

The fact that this project site is on a campus shared by three Shaker Heights public schools made it a priority for the Partnership. Not only did we achieve ecological improvement through the stream reconstruction, but a very important educational benefit was also realized.

Fast forward to 2011: Thanks to a grant from the Native Plant Society and matching funds from the Shaker Schools Facilities Department, the Stream Corridor Project will expand the width of the corridor from 25' to 50' on either side of the Doan Brook as it traverses the Shaker Campus, with native trees, shrubs and plants. The expanded riparian corridor will increase its ecosystem services,

including filtering pollutants, diminishing erosion, increasing biodiversity and cooling in-stream water temperatures.

Since the first phase of the stream restoration at this site, teachers from Shaker Heights High School, Woodbury and Onaway Elementary have utilized the stream and its corridor as a land-lab for science classes. By expanding the width and diversity of the site, the quality of the land lab will also be increased.

With the Cleveland Museum of Natural History, DBWP hosted a bioblitz at the stream site in September. Over 120 high school students from five classes took an inventory of plants and animals in the stream and along its banks. This bioblitz created a baseline data set to compare with inventories in future years, which we hope will show more biodiverse results after the riparian corridor is expanded.

Despite cold and rainy conditions, Shaker student volunteers assisted with the expansion and planting on Wednesday, October 18.

Record attendance at September Family Fishing Day

About 500 people of all ages enjoyed angling for bluegill, catfish and bass as part of the 10th annual DBWP Family Fishing Day, held at Rockefeller Lagoon in University Circle on Saturday, September 3. Thanks to funding from Holden Parks Trust, the Lagoon was stocked with keeper-size fish four times this summer, enabling local residents to take pleasure in the sport of fishing as well as bring home a healthy meal.

The day also featured live entertainment by Radio Disney, kids' casting activities and instruction, face painting, free lunch, water quality testing activities, rain barrel education and give-aways, plus an afternoon derby complete with prizes for the largest fish, smallest fish, and most fish caught.

Credit for the very successful day goes to our co-sponsors, The North Coast Black Bass Anglers' Association, PluggOne Outdoors, Northeast Ohio Regional Sewer District, the City of Cleveland and Ward 8, The Nature Center at Shaker Lakes, Hooked on Fishing: Not on Drugs, and University Circle.



Lower Shaker Lake Bioswale: a Green Approach to Stormwater Runoff

If you've walked, driven or bicycled along South Park after a rainfall, you may have noticed standing water along the muddy edge of the road. The DBWP, with partners NEORS, Burning River Foundation and the City of Shaker Heights, have recently chosen the site as a demonstration for a new remedy to stormwater challenges. The solution, a bioswale, is an example of an innovative category of stormwater management called green infrastructure.

The primary function of the new bioswale is to ease stormwater volume and filter sediment for 80% of rain events. Secondly, the swale is effective in removing hydrocarbon-based non-point source pollution such as oil or grease from vehicles, and adding biodiversity. The open, vegetated channel temporarily holds stormwater, allowing sediment and pollutants to settle in the swale's unique soil mixture, releasing clean water from the system. The soil bed consists of native soils and a hardwood mulch that have been laboratory tested to ensure its particle size will neither fall through the system, nor become compacted. So swing by, preferably in the rain, to monitor how this new approach takes on local stormwater!

October Photo Hike explores Doan Gorge

An enthusiastic group of nine nature lovers explored one of Cleveland's natural treasures--the Doan Brook Gorge in Cleveland Heights--with camera in hand during a guided autumn hike with noted local photographer David Perelman-Hall on Saturday, October 8.

Starting by the western edge of Lower Shaker Lake, participants walked to three scenic sections of the gorge, learned technical and compositional tips, and explored what makes certain sections of the Brook so photogenic.

Check the DBWP Facebook page for a few of the photos from the day and future event listings. A winter photo hike is in the plans for January/February, 2012. Some of David's breath-taking images of Doan Brook and Shaker Lakes can be seen at www.exceptionallight.com.



Doan Brook Watershed Partnership News

Y ' v te t p
**Annual Celebration of the Place
we call HOME... t Do Br W tr e**

**Wednesday, November 16, 2011
7:00pm**

N r C tr Sh k r L k

Mix & mingle over desserts & wine

Honor our Annual Watershed Hero

Get the latest on Partnership projects
in our communities of Cleveland Heights,
Shaker Heights, and eastern Cleveland.

We'll also travel back in time with archeologist, Dr. Roy Larick, to learn how the Doan Brook was formed, how the stream evolved and changed from tropical sea to glacial ice age, and to the woodland neighborhood that surrounds us.

Dr. Larick offers a rare, engaging look at the natural history of the Heights landscape and how it continues to shape our lives and community to this day.



Please RSVP to Victoria Mills 216-321-5935 x234



The Doan Brook Team Welcomes Mary Ryan!

We are thrilled to have new colleague, Mary Ryan, join our team. Mary brings a well-rounded skill-set to the Partnership, having previous

experience as a grant writer, program developer, graphic artist, and educator at the Cleveland Museum of Art.

But no resume is as impressive as an actual job well done. Mary has been invaluable since she started, wearing the many hats required to run a small non-profit. At our home at the Nature Center at Shaker Lakes, Mary was quickly embraced as a member of the family. Then again, with a love of nature photography and rowing on the Cuyahoga, how could she not join our mission seamlessly? Come to our Annual Meeting on November 16 to meet our newest addition.

Tori Mills, Executive Director

Doan Brook Watershed Partnership

2600 South Park Boulevard, Cleveland,
OH 44106

www.doanbrookpartnership.org
ph: 216.321.5935 ext. 234

Victoria Mills, Executive Director mills@shakerlakes.org

Mary Ryan, Program Assistant ryan@shakerlakes.org

Brook Notes is published and distributed semi-annually, thanks to a generous grant from the Dominion Foundation. It is also available via email! Contact us if you'd prefer to receive the electronic version.

The nonprofit Doan Brook Watershed Partnership's 16 member Board of Trustees provides for broad representation throughout the watershed and includes:

Chairman Darnell Brown, City of Cleveland

President Nancy Moore, City of Shaker Heights

Vice President Karen Knittel, City of Cleveland Heights

Secretary Chris Bongorno, University Circle, Inc.

Treasurer Laura Gooch, citizen at-large, upper watershed

Dorothy Adams, citizen at-large, lower watershed

David Beach, Cleveland Museum of Natural History

Bill Boag, City of Shaker Heights

Bonnie Caplan, Cleveland Heights City Council

Kay Carlson, Nature Center at Shaker Lakes

Nancy Dietrich, citizen at-large, upper watershed

Je Johnson, Cleveland City Council, Ward 8

Stacey Polk, citizen at-large, lower watershed

Geri Unger, Cleveland Botanical Garden

Jane Goodman, Cuyahoga River Community Planning Organization

Betsy Yingling, Northeast Ohio Regional Sewer District (NEORS)D

Appendix G. Watershed Goals

The goal set that follows is organized to reflect a comprehensive approach to improving water quality in the Doan Brook watershed. Problem Statements are followed by Goals/Objectives, Actions, Partners, Measurable Outcomes, and Costs and Funding.

Doan Brook Watershed Action Plan Goals	
Problem Statement	Goal/Objective
A) Degraded Streambanks & Riparian Corridor: The streambanks and riparian corridor of the Doan Brook have been altered and/or eroded, as well as denuded of vegetation intermittently along its course. These issues impair the riparian and aquatic species populations.	A.1 Plant native plants in riparian areas
	A.2 Implement the Parklands Management Plan
	A.3 Remove/treat Invasive Species in riparian areas and floodplains
B) Altered Stream Hydrology: Manmade alterations to the Doan Brook channel and increased impervious surface due to urbanization have significantly altered the natural flow regime. This results in significant flooding and erosion, impacted fish migration, and degraded habitat for aquatic species.	B.1 Remove barriers to fish migration
	B.2 Maintain hydrology of the stream
	B.3 Daylight culverted sections of the stream
C) Lakes Management: Four man-made lakes in the Upper Watershed have the following problems; dams in need of repair, eutrophication, sedimentation, and impaired recreational opportunities.	C.1 Repair dams at Horseshoe and Green Lakes to comply with ODNR standards
	C.2 Create Lakes Management Plans for Green, Marshall, Horseshoe and Lower Lakes
D) Urbanization: Intensive development of the watershed has increased runoff volume and velocity, as well as non point and point source pollution.	D.1 Reduce Impervious Cover and Implement Green Infrastructure Stormwater Controls to slow stormwater flows.
	D.2 Reduce nonpoint source pollution on residential properties
	D.3 Reduce nonpoint source pollution on commercial properties
	D.4 Reduce sanitary sewer overflows to Doan Brook
	D.5 Implement Long Term Control Plan for combined sewer overflows
	D.6 Promote Hazardous Waste Reduction and Recycling
E) Education, Information, and Involvement: Decision-makers and the public are in constant need of new information, education and data to better inform choices and actions that promote watershed health.	E.1 Increase publications and multimedia
	E.2 Expand stewardship opportunities
	E.3 Organize and participate in Educational Events

A) Degraded Streambanks & Riparian Corridor: The streambanks and riparian corridor of the Doan Brook have been altered and/or eroded, as well as denuded of vegetation intermittently along its course. These issues impair the riparian and aquatic species populations.

Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
A.1 Plant Native Plants in Riparian Areas	A.1.1 Plant native plants, shrubs and trees along 2000 feet of stream bank through the Rockefeller Park Subwatershed.	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) DBWP	2000 LF of habitat improvement	\$40,000 funding: grants
	A.1.2 Plant native plants, shrubs and trees along 800 feet of stream bank along the South Branch at Woodbury School. Lower Lake and Horseshoe Lake Subwatershed.	a) Shaker Hts. Schools b) City of Shaker Hts. c) DBWP	800 LF of habitat improvement	\$16,000 funding: grants
	A.1.3 Plant and maintain native plants, shrubs and trees in 10 acres of the Marsh at the Nature Center at Shaker Lakes. Lower Lake and Horseshoe Lake Subwatershed.	a) Nature Center at Shaker Lakes b) Ohio EPA c) DBWP d) The Nature Conservancy e) Citizen Volunteers	10 acres of habitat improvement	\$90,000 funding: grants
A.2 Implement the Parklands Management Plan	A.2.1 Complete Review and Update of the Existing Parklands Management Plan	a) Nature Center at Shaker Lakes b) City of Cleveland c) City of Cleveland Hts. d) City of Shaker Hts. e) DBWP	Updated Parklands Management Plan for more effective management of riparian and floodplain habitats	In-kind support from partners
	A.2.2 Host the Parklands Management Committee Regularly to ensure best management of the Parklands, address issues and review scientific studies	a) Nature Center at Shaker Lakes b) City of Cleveland c) City of Cleveland Hts. d) City of Shaker Hts. e) DBWP	Collaboration for more effective management of riparian and floodplain habitats	In-kind support from partners
A.3 Remove/treat Invasive Species in riparian areas and floodplains	A.3.1 Remove invasive species along stream bank throughout Rockefeller Park Subwatershed	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) DBWP d) Volunteers	4 acres of invasive species removal	\$8,000 funding: grants
	A.3.2 Continued Control of invasive species at the Nature Center at Shaker Lakes. Targeted species include Crack Willows, Celandine and Narrow Leaf Cattail. Replant with native wetland species. Lower Lake and Horseshoe Lake Subwatershed.	a) Nature Center at Shaker Lakes b) Ohio EPA c) DBWP d) The Nature Conservancy e) Citizen Volunteers	2 acres of invasive species removal	\$4,000 funding: grants
	A.3.3 Inventory the Shaker Parklands for Invasive Hot Spots	a) Nature Center at Shaker Lakes b) Cleveland Botanical Garden c) Cleveland Museum of Natural History d) The Nature Conservancy e) Holden Arboretum	A map of Invasive Hot Spots to target future removal projects	In-kind support from partners

B) Altered Stream Hydrology: Manmade alterations to the Doan Brook channel and increased imperious surface due to urbanization have significantly altered the natural flow regime. This results in significant flooding and erosion, impacted fish migration, degraded habitat for aquatic species.

Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
B.1 Remove barriers to fish migration	B.1.1 Remove check dams in Rockefeller Park	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) DBWP	1,000 LF of instream habitat improvement. 3.5 lbs of phosphorus, 20 lbs of nitrogen, 2550 lbs of TSS per year will be removed.	\$700,000 funding: NEORS, grants
B.2 Maintain Hydrology of the Stream	B.2.1 Perform Stormwater Master Plan of the Doan Brook Watershed	a) Northeast Ohio Regional Sewer District b) City of Shaker Heights c) City of Cleveland Heights d) City of Cleveland e) DBWP	A Plan for future maintenance and construction projects to manage stormwater.	\$2 million funding: NEORS
	B.2.2 Complete 2,000 feet of stream enhancement through Rockefeller Park between E. 105th St. and Wade Park Ave, including bank stabilization of 1,000 feet. Rockefeller Park Subwatershed	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) DBWP	2,000 LF of instream habitat improvement. 7 lbs of phosphorus, 40 lbs of nitrogen, 5100 lbs of TSS per year will be removed.	\$2.5 million funding: City of Cleveland
	B.2.3 Reconstruct a stable stream channel in Rockefeller Park with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) DBWP	3,000 LF of instream habitat improvement. 10.5 lbs of phosphorus, 30 lbs of nitrogen, 7650 lbs of TSS per year will be removed.	\$2.1 million funding: Great Lakes Restoration Fund, NEORS
	B.2.4 Reconstruct a stable stream channel through the Upper Watershed (North, Middle, South Branches) with the proper dimension, pattern, and profile that reduces erosion, provides habitat, and will reconnect stream to floodplains when possible	a) Northeast Ohio Regional Sewer District b) City of Shaker Heights c) City of Cleveland Heights d) DBWP e) Schools/Country Clubs	1,000 LF of instream habitat improvement. 3.5 lbs of phosphorus, 20 lbs of nitrogen, 2550 lbs of TSS per year will be removed.	\$600,000 funding: Shaker Country Club, NEORS, grants
	B.2.5 Perform streambank stabilization/restoration in area of severe erosion near trash rack on Doan Brook at MLK Blvd. Perform routine maintenance.	a) Northeast Ohio Regional Sewer District b) City of Cleveland Heights c) City of Cleveland	400 LF of instream habitat improvement. 1.4 lbs of phosphorus, 8 lbs of nitrogen, 1020 lbs of TSS per year will be removed.	\$24,000 + ongoing maintenance costs funding: City of Cleveland Heights, NEORS
	B.2.6 Perform routine culvert maintenance	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) City of Shaker Heights	No nonpoint source pollution reduction outcome	variable costs funding: NEORS, City of Cleveland, City of Shaker Heights
B.3 Daylight Culverted Sections of the Stream	B.3.1 Evaluate the feasibility of various day-lighting alternatives at Cleveland Lakefront Nature Preserve. Include design and construction parameters and a habitat benefit analysis for the existing culvert (the portion of the culvert through the Preserve is 1900 feet, about half of the entire 3,300 foot culvert).	a) Northeast Ohio Regional Sewer District b) City of Cleveland c) DBWP d) ODNR e) Port of Cleveland	A recommendation for how, or if, to move forward with removing a culvert at Cleveland Lakefront Nature Preserve.	Costs and funding to be determined but an estimate is \$20,000. This project can potentially be completed as part of the NEORS Master Plan.

C) Lakes Management: Four man-made lakes in the Upper Watershed have the following problems; dams in need of repair, eutrophication, sedimentation, and impaired recreational opportunities.

Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
C.1 Repair dams at Horseshoe and Green Lakes to comply with ODNR standards	C.1.1 Construct improvements for Horseshoe Lake dam	a) Northeast Ohio Regional Sewer District b) City of Shaker Heights c) City of Cleveland Heights	Compliance with ODNR Class 2 Dam Standards	\$2 million funding: NEORSD
	C.1.2 Construct improvements for Green Lake dam	a) Northeast Ohio Regional Sewer District b) City of Shaker Heights	Compliance with ODNR Class 2 Dam Standards	\$800,000 funding: NEORSD
C.2 Create Lakes Management Plans for Green, Marshall, Horseshoe and Lower Lakes	C.2.1 Examine short-term maintenance options for each of the Shaker Lakes.	a) Northeast Ohio Regional Sewer District b) City of Cleveland Hts. c) DBWP d) City of Shaker Hts. e) Nature Center at Shaker Lakes f) City of Cleveland	Recommendations for necessary maintenance of man-made lakes.	In-kind support from partners
	C.2.2 Create a long-range management plan for each of the Shaker Lakes	a) Northeast Ohio Regional Sewer District b) City of Cleveland Hts. c) DBWP d) City of Shaker Hts. e) Nature Center at Shaker Lakes f) City of Cleveland	Recommendations for sustainable maintenance of man-made lakes.	In-kind support from partners

D) Urbanization: Intensive development of the watershed has increased runoff volume and velocity, as well as non point and point source pollution.				
Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
D.1 Reduce Impervious Cover and Implement Green Infrastructure Stormwater Controls to slow stormwater flows.	D.1.1 Host Rain barrel workshops with Community Partners	a) DBWP b) Nature Center at Shaker Lakes c) Cuyahoga SWCD d) Cleveland Botanical Garden e) Cleveland Museum of Natural History f) NEORSD	35 individuals to install a rainbarrel.	\$3500, funding by home owners
	D.1.2 Promote Urban Forestry within the watershed by Partnering in the Cuyahoga ReLeaf Forest Canopy Initiative	a) DBWP b) Cuyahoga SWCD c) Cuyahoga RAP	100 new trees planted in the watershed.	
	D.1.3 Support YOU Program to teach summer student employees to fabricate, donate and install rainbarrels	a) City of Cleveland b) UCI c) CDC's	35 individuals to install a rainbarrel.	\$3,500 funded by the City of Cleveland
	D.1.4 Incorporate stormwater management feature to E 105th St./MLK intersection redesign.	a) Cuyahoga County Engineering b) UCI	0.37 acres of impervious surface to be directed to stormwater control measures that provide water quality benefit. 0.6 lbs of phosphorous, 3.0 lbs of nitrogen, 209 lbs of TSS will be removed.	Funded by Cuyahoga County, Federal Safety Grant
	D.1.5 Install rain garden and other stormwater management filters at envisioned Ashbury Avenue Greenway.	a) DBWP b) Let It Bee Gardens c) Famicos d) City of Cleveland	0.28 acres of impervious surface to be directed to stormwater control measures that provide water quality benefit. 0.5 lbs of phosphorous, 2.3 lbs of nitrogen, 158 lbs of TSS will be removed.	Burning River Foundation, Hawken School in-kind, pending Shaker Lakes Garden Club
	D.1.6 Promote Green Infrastructure in new or redevelopment projects.	a) DBWP b) Nature Center at Shaker Lakes c) City of Cleveland d) City of Cleveland Heights e) City of Shaker Heights f) NEORSD	20 acres of impervious surface to be directed to stormwater control measures that provide water quality benefit. 25 lbs of phosphorous, 149 lbs of nitrogen, 10,626 lbs of TSS will be removed.	Property owners and potential grant sources, including, SWIF, GLIF, & Section 319
	D.1.7 Evaluate and prioritize stormwater retrofit list generated by the previous studies (See Table 28 of WAP)	a) DBWP b) Nature Center at Shaker Lakes c) City of Cleveland d) City of Cleveland Heights e) City of Shaker Heights f) NEORSD	Prioritized list of stormwater retrofits.	Lake Erie Protection Fund, NEORSD, Burning River Foundation.
D.2 Reduce nonpoint source pollution on residential properties	D.2.1 Challenge residents to reduce fertilizer (nitrogen & phosphorous) and pesticide use throughout the growing season.	a) DBWP b) Nature Center at Shaker Lakes c) Good Nature Organic Lawn Care d) Cleveland Botanical Garden e) Cleveland Museum of Natural History f) Beyond Pesticides Ohio	50 respondents who report current phosphorous, nitrogen fertilizer use on watershed lawns/landscapes.	General operating expense for DBWP
	D.2.2 Encourage pet owners to dispose of pet waste properly	a) DBWP b) NEORSD	Distribute NEORSD PUP (pick up poop) materials available at 5 outreach events a year.	General operating expense for DBWP & in-kind donations from NEORSD

D) Urbanization: Intensive development of the watershed has increased runoff volume and velocity, as well as non point and point source pollution.				
Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
D.3 Reduce nonpoint source pollution on commercial properties	D.3.1 Employ pollution prevention and good housekeeping methods for municipal operations	a) City of Cleveland b) City of Cleveland Heights c) City of Shaker Heights	Full compliance with MCM #6 of NPDES permit for Cleveland, Cleveland Heights, and Shaker Heights.	Funded by general operating funds of Cleveland, Cleveland Hts, and Shaker Hts. Additional potential funding from the NEORS Stormwater Fee Community Cost Share.
	D.3.2 Implement construction site storm water runoff controls, e.g. sediment basins and traps, silt fences, mulching and matting seeding and sodding, storm drain inlet protections and check dams	a) Cuyahoga SWCD b) City of Cleveland c) City of Cleveland Heights d) City of Shaker Heights	Full compliance with MCM #4 of NPDES permit for Cleveland, Cleveland Heights, and Shaker Heights.	Funded by property owners and developers.
	D.3.3 Work with the Country Clubs and schools to create nutrient management plans for campuses	a) DBWP b) Shaker Country Club c) Canterbury Country Club d) Shaker Heights schools e) Cleveland Heights schools f) CWRU g) private schools h) Beyond Pesticides Ohio	Two management plans adopted by institutions.	In-kind Services
D.4 Reduce sanitary sewer overflows to Doan Brook	D.4.1 Repair/rehabilitate defective over/under invert plate manholes	a) City of Cleveland Heights b) City of Shaker Heights c) City of Cleveland	No non-point source pollution reduction outcome	No cost estimate. Funding by general operating funds or local sewer revenue of Cleveland, Cleveland Heights, and Shaker Heights.
	D.4.2 Implement regular program of sewer inspection and maintenance to ensure sedimentation, debris and blockages do not contribute to increased SSO or CSO occurrences	a) City of Cleveland b) City of Cleveland Heights c) City of Shaker Heights	No non-point source pollution reduction outcome	No cost estimate. Funding by general operating funds or local sewer revenue of Cleveland, Cleveland Heights, and Shaker Heights.
	D.4.3 Maintain flow-regulating structures (weirs and dry weather outlet pipes) to increase the retention and conveyance of combined sewer flows during wet weather	NEORS	No non-point source pollution reduction outcome	Funding by NEORS
D.5 Implement Long Term Control Plan for combined sewer overflows	D.5.1 Construct Relief Sewers and tunnels for the Long Term Control Plan	NEORS	No non-point source pollution reduction outcome	Funding by NEORS
D.6 Promote Hazardous Waste Reduction and Recycling	D.6.1 Support and Disseminate the Cuyahoga County Household Hazardous Waste Program	a) DBWP b) Cuyahoga Solid Waste District c) City of Cleveland d) City of Cleveland Heights e) City of Shaker Heights f) NEORS	No non-point source pollution reduction outcome	In-kind Services

E) Education, Information, and Involvement: Decision-makers and the public are in constant need of new information, education and data to better inform choices and actions that promote watershed health.

Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
E.1 Increase Publications and Multimedia	E.1.1 Create fact sheets on sustainable landscaping, storm-drain stenciling, Doan Brook Watershed History and Hydrology, and on-site residential stormwater management	a) DBWP b) Nature Center at Shaker Lakes c) LEAP d) Cleveland Botanical Garden e) Cleveland Museum of Natural History f) Holden Arboretum	10 fact sheets produced	General operating expense for DBWP
	E.1.2 Disseminate fact sheets on sustainable landscaping, storm-drain stenciling, Doan Brook Watershed History and Hydrology, and on-site residential stormwater management	a) DBWP b) Nature Center at Shaker Lakes c) LEAP d) Cleveland Botanical Garden e) Cleveland Museum of Natural History f) Holden Arboretum	5 festivals, fairs, symposia, etc. attended, where fact sheets are disseminated	General operating expense for DBWP
	E.1.3 Develop Project Specific Brochures	a) DBWP b) Project Specific Partners	As funding becomes available for projects, a minimum of 1 brochure per project will be developed	General operating expense for DBWP
	E.1.4 Develop Press Releases		5 press releases per year	General operating expense for DBWP
	E.1.5 Create/Maintain a Website		1 new website post per week	General operating expense for DBWP
	E.1.6 Develop Newsletters	a) Dominion Foundation	2 newsletters per year	General operating expense for DBWP
	E.1.7 Create Displays and Exhibits	TBD	1 new watershed related exhibit every 5 years	General operating expense for DBWP
	E.1.8 Install Signs	TBD	1 watershed related sign installed within the watershed boundaries per year	General operating expense for DBWP
E.2 Expand Stewardship Opportunities	E.2.1 Conduct Stewardship Field Days	a) DBWP b) Nature Center at Shaker Lakes c) LEAP d) Cleveland Botanical Garden e) Cleveland Museum of Natural History	10 volunteer stewardship projects, including stormdrain stenciling, invasive species control, replanting, green infrastructure maintenance	General operating expense for DBWP
	E.2.2 Host Annual Stream Clean Ups	a) DBWP b) Nature Center at Shaker Lakes c) Plymouth Church d) Case Western Reserve University e) City of Cleveland Hts	2 stream clean ups per year	General operating expense for DBWP
	E.2.3 Stencil Storm Drains	Organizations that request volunteer stenciling opportunities	Upon request, stenciling projects will be organized	General operating expense for DBWP
	E.2.4 Assistance to schools, communities and residents to apply for stormwater credits in local stormwater utilities	a) NEORSD b) City of Cleveland c) City of Cleveland Heights d) City of Shaker Heights	# of Citizens assisted by DBWP	General operating expense for DBWP

E) Education, Information, and Involvement: Decision-makers and the public are in constant need of new information, education and data to better inform choices and actions that promote watershed health.				
Goal/Objective	Actions	Partner	Measurable Outcomes	Costs & Funding
E.3 Organize and Participate in Educational Events	E.3.1 Attend community festivals	a) DBWP b) Nature Center at Shaker Lakes c) City of Shaker d) Cleveland Botanical Garden e) Cleveland Museum of Natural History f) Burning River Foundation	5 festivals, fairs, symposia, etc. attended	General operating expense for DBWP
	E.3.2 Host Annual Family Fishing Derby	a) DBWP b) Nature Center at Shaker Lakes c) City of Cleveland d) North Coast Black Bass Anglers Association e) UCI/Holden Parks Trust f) NEORS	1 Family Fishing Derby per year	General operating expense for DBWP
	E.3.3 Host the Lester Stumpe Memorial Boat Float	a) DBWP b) Nature Center at Shaker Lakes c) City of Cleveland Heights d) Cleveland Botanical Garden e) Cleveland Museum of Natural History f) City of Shaker Heights	1 Memorial Boat Float per year	General operating expense for DBWP
	E.3.4 Host the DBWP Annual Meeting	a) NCSL	1 Annual Meeting per year	General operating expense for DBWP
	E.3.5 Conduct Watershed Tours	a) Nature Center at Shaker Lakes b) City of Cleveland c) DBWP d) City of Shaker Heights	3 Watershed Tours per year	General operating expense for DBWP

Storm Water Retrofit Recommendations from Previous Studies (reference goal D.1.7)

In 1999, the Center for Watershed Protection conducted a retrofit inventory within three sub-watersheds in the Doan Brook watershed. The inventory focused primarily on identifying potential sites for structural retrofit concept designs addressing water quality control. The three sub-watersheds included Lower Shaker Lake, Marshall-Green and University Circle. The initial inventory identified forty potential storm water retrofit sites, half of which were eliminated in the field as unfeasible. Eight sites were selected and identified as potential sites to apply storm water retrofits in the Doan Brook watershed. Additional best practices were identified by Davey Resource Group in a study conducted in 2006 for the Green-Marshall Sub-watershed.

Table 28. Retrofit Recommendations from Previous Studies

Location	Description
Lower Shaker Lake Subwatershed	
Nature Center at Shaker Lakes	Bioretention practice at edge of Nature Center parking lot to capture and treat sheet flow.
Park at South Woodland and West Park Blvd.	Divert Flow from existing storm sewer to stormwater wetland in adjacent low lying area in public park.
Gravel lot near boat ramp on south side of Lower Shaker Lake	Divert flow from existing storm sewer to underground sand filter
South Park Blvd along Lower Shaker Lake	Dry swale to treat sheet flow from South Park Blvd. This goal was completed in 2011.
Southerly Park	Create small floodplain wetlands
Marshall-Green Subwatershed	
Shopping center on Warrensville Center Rd. and Van Aken Blvd.	Bioretention area within large parking lot to capture and treat sheet flow.
Shaker Heights Country Club	Divert stormwater from 42” and 48” storm sewers into stormwater pond. Located on golf course between fairways.
Andover Rd. in Shaker Heights	Create roadside bioswale.
University Circle Subwatershed	
Parking lot on Overlook Rd and Kenilworth	Perimeter and filter at edge of municipal parking lot to capture and treat sheet flow.
Shopping center on Cedar Road and Fairmount Blvd.	Perimeter sand filters throughout large parking lots to capture and treat sheet flows.

Appendix H. Resolutions of Support (when approved)