The Plan

INTRODUCTION

The Big Creek Watershed is one of the most highly urbanized watersheds within Cuyahoga County and the entire Lake Erie Basin. Big Creek serves as a major tributary to the Cuyahoga River, entering the river approximately 7 river miles south of the mouth. Big Creek drains nearly 39 square miles with a total stream length of 12.0 miles, flowing through seven communities including Cleveland, Brooklyn, Linndale, Parma, Parma Heights, Brook Park, and North Royalton.

The Cuyahoga River Community Planning Organization (CRCPO) received a grant from the Ohio Coastal Management Assistance Grants Program to develop a Watershed Action Plan for Big Creek. That plan would address water quality by focusing on physical, biological and chemical impacts on local water resources. In such an urbanized, built-out watershed as Big Creek, it is also important to tackle the issues of land use and economic development alongside those of conservation.

This Balanced Growth Plan provides that part of the overall Action Plan, as it focuses primarily on land cover and characteristics, and land use, and has been developed under the guidance of the Ohio Balanced Growth Initiative (BGI). The Big Creek BGI Plan is a community driven land suitability plan that will assist in balancing economic development while conserving and restoring critical natural resources that benefit the watershed communities.

The Big Creek Balanced Growth Plan is a resource for community decision makers to evaluate the potential impacts of land use changes in the watershed. The plan identifies Priority Conservation Areas (PCAs), Priority Development Areas (PDAs) and, in some cases, PCAs that are prime candidates for stormwater retrofit projects.

CRCPO is doing this work in cooperation with the Friends of Big Creek and with official support from the cities of Cleveland, Brooklyn, Brook Park, Parma and Parma Heights. For additional information on the Balanced Growth Initiative, go to the program website at http://balancedgrowth.ohio.gov .

The Ohio Lake Erie Commission (OLEC) is coordinating with State agencies to develop state incentives and funding opportunities to assist communities in implementing these watershed plans. Integrating the Big Creek Plan into a community's comprehensive plan is an important step in managing and improving floodplains, wetlands, and open spaces that are currently providing flood control, erosion control and water quality protection.

Going forward, the Friends of Big Creek will continue in its role as the lead organization to manage the implementation of the Plan and communication among the Partnership governments and assisting agencies.

This Plan provides the roadmap that the Partnership will follow, as well as the toolkit they can use to build a healthy watershed.

GOALS of the BIG CREEK BALANCED GROWTH INITIATIVE PLAN

1. Preservation, Restoration & Enhancement of existing watershed features
2. Promote Development & Redevelopment that balances economic growth and watershed function.
3. Recommend Best Land Use Practices to avoid or minimize impacts from development.

The Big Creek Balanced Growth Plan is a community driven land suitability plan that will assist in balancing economic growth while conserving critical natural resources that benefit the watershed communities.

Every portion of the earth's landscape is characterized by a different set of features that render it more suitable for certain uses than others. Since all the earth's surface is divided into drainage areas, or watersheds, the concept of land suitability applies to watersheds as well. That is, different areas of a watershed are characterized by different sets of features that render them more suitable for certain uses and less suitable for others.

The objective of a land suitability process such as this is to direct development to an area that is capable of handling this type of land use and, on the other hand, avoiding or minimizing development in areas that could prove hazardous. This concept emphasizes that land use planning and development should recognize watershed functions and other natural processes.

PROJECT SCOPE

- Organize the Big Creek Watershed Planning Partnership representing communities, organizations, agencies and residents.
- Gather and analyze GIS data of critical natural watershed features
- Identify and evaluate community issues and desires
- Develop and agree on criteria and create a model for designating Priority Development / Redevelopment Areas (PDAs) and Priority Conservation Areas (PCAs)
- Identify undeveloped land for potential conservation / restoration sites in relation to natural features
- Designate Priority Conservation Areas & Priority Development Areas
- Identify ordinances, strategies and tools for stewardship
- Support adoption of the BGI Plan and implementation of strategies.

PCA

Priority Conservation Areas

Priority conservation areas are locations where land use change is predicted to have a high impact on the watershed in terms of flooding, erosion, and water quality, based on the analysis of several data sets representing criteria that the watershed planning partners determined were of interest.

PDA

Priority Development Areas

Priority development areas are locations where land use changes are predicted to have minimal impact on the watershed and where conditions suggest that additional development may be appropriate.

BALANCED GROWTH INITIATIVE

"Linking Land Use Planning to the Health of Watersheds"

Balanced Growth is a strategy being led by the Lake Erie Commission to protect and restore Lake Erie and its watersheds in order to assure long-term economic competitiveness, ecological health and quality of life.

Lake Erie is Ohio's greatest natural resource and provides tremendous natural and economic benefits. Despite this, Lake Erie's watershed has endured and continues to face many challenges. Urban Sprawl is one of the greatest of these.

Total population in northeast Ohio has remained relatively stable. However, we continue to expand and develop. While development and community growth is encouraged, it is the manner in which the development occurs that is the most damaging. Of the 11,649 square mile area comprising the Ohio Lake Erie Watershed, over 78% has been altered from its original form, leaving only 22% relatively intact.

As a result of these ongoing problems, the Ohio Lake Erie Commission recognized the need to encourage communities to use their natural resources efficiently to benefit the economy and quality of life.

The Balanced Growth Initiative is both a response to this need and a framework around which can be built elements that will support watershed stewardship and land use management for the future:

- Communities setting priorities in a watershed context
- Whole-watershed collaborations on land use planning, and
- Consistency among ordinances and municipal operations.

KEY BGI GUIDELINES

- Use a regional focus in land use and planning.
- Create local Watershed Planning Partnerships to designate Priority Conservation Areas and Priority Development Areas.
- Adopt Watershed Plans and implement recommended model regulations to help promote best local land use practices that minimize impact on water quality and provide for well-planned development efficiently served by infrastructure.
- Align state policies, incentives, funding, and other resources to support watershed balanced growth planning and implementation.

BGI LONG-TERM INTERESTS

- Sustaining and restoring natural systems in the Lake Erie basin.
- Encouraging the reuse and redevelopment of urban lands
- Maximizing the efficient use of infrastructure
- Conserving farmland
- Providing open space and recreational opportunity
- Promoting compact development patterns
- Helping local governments plan for economic development opportunities and stream-lined decision making
- Providing consistency and predictability for private and public development decisions

Big Creek
Planning By Watershed

Ohio is a home rule state and much of the land use decisions are made at the local level. However, local officials are often faced with pressing issues, such as flooding that cannot effectively be addressed within the context of political jurisdictions.

Flooding and water quality problems transcend community boundaries. Multi-community cooperation and planning by watersheds is imperative in order to address these problems. Watershed planning also helps to leverage resources and complement regulatory programs (ex. NPDES Phase II) of local and state agencies.

WATERSHEDS

Watersheds are complex systems of soils, waterways, water storage areas and vegetation that work together to manage the precipitation falling as rain or snow within a geographic area. All the water in a single watershed that does not evaporate into the air will eventually drain to a single stream, river or lake.

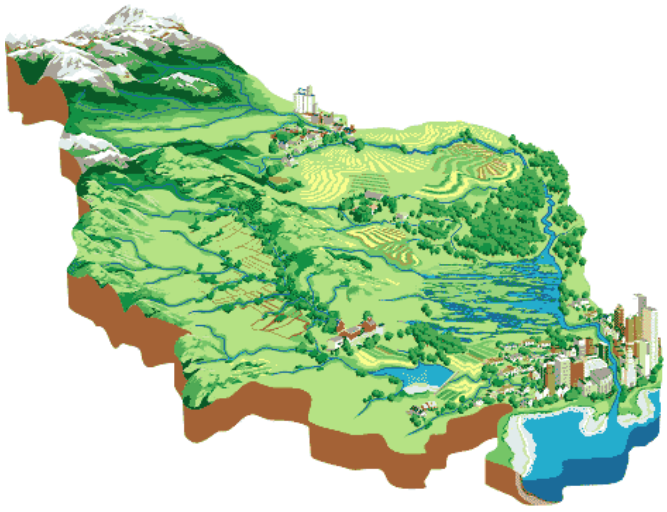
Watersheds function by:

- Pooling water to evaporate
- Soaking water into the soil
- Gathering surface water into streams

Streams and watersheds work together.

Streams are dynamic systems that adjust to compensate for changes in their watersheds and have the capacity to:

- Moderate the volume and energy of water
- Transport and deposit sediment
- Create and sustain aquatic habitat, and
- Assimilate or process a limited amount of pollutants and still achieve water quality standards.

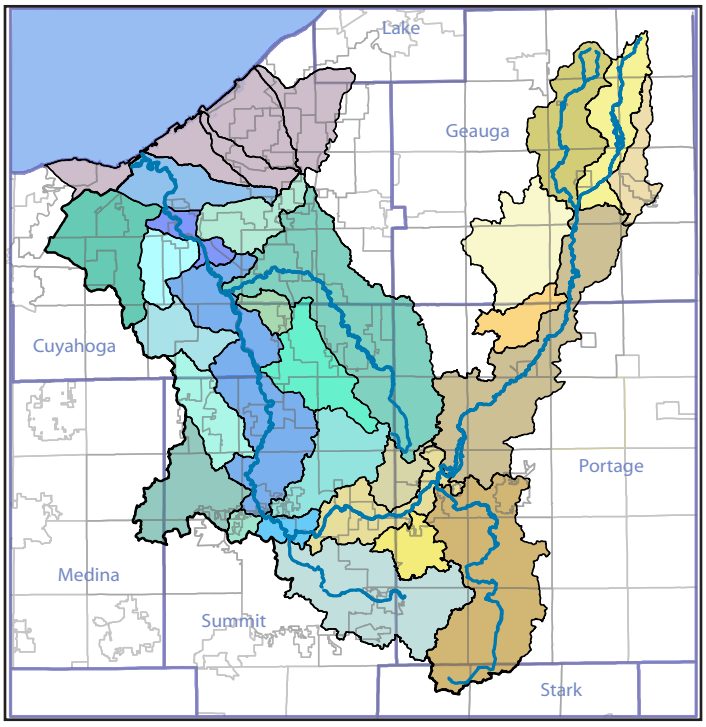


The Cuyahoga River basin drains 813 square miles and includes 1,220 stream miles spanning parts of Geauga, Medina, Portage, Summit and Cuyahoga counties, emptying into Lake Erie at Cleveland. The basin contains parts of three major physiographic provinces: the glaciated Allegheny Plateau, the till plains, and the lake plains. Most of the basin occurs in the glaciated Allegheny Plateau, and owes its topographic and hydrologic features to a complex glacial history. A small portion of the basin in southwest Cuyahoga County lies within the till plains, a relatively flat area more characteristic of north central and northwestern Ohio. The Cuyahoga River basin also cuts through the narrow border of the nearly level lake plains that surround Lake Erie and represents the ancient bottom of the predecessors to Lake Erie.

The Cuyahoga basin is situated within the Erie/Ontario Lake Plain (EOLP) ecoregion, a glacial plain that lies between the unglaciated Western Allegheny Plateau (WAP) ecoregion to the southeast and the relatively flat Eastern Corn Belt Plains (ECBP) ecoregion to the west and southwest. The EOLP ecoregion is characterized by glacial formations that can have a significant local relief of up to 300 feet and exhibits a mosaic of cropland, pasture, woodland, and urban areas.

Soils are mainly derived from glacial till and lacustrine deposits and tend to be light colored, acidic, and moderately to highly erodible. Many glacial features characteristic of the EOLP ecoregion are found in the Cuyahoga River basin. The northern and eastern boundaries of this v-shaped watershed are largely defined by the terminal moraines left by two fingers of glacial ice. Retreating glaciers then buried the ancient river valleys with glacial outwash. The headwaters originate in northeastern Geauga County and flow southwest to Akron through relatively hilly knob and kettle topography. The river generally follows the course of the buried valleys, but does traverse a ridge of erosion resistant sandstone, resulting in the falls and cascades of Cuyahoga Falls. The river turns sharply to the northwest at the confluence with the Little Cuyahoga River in north Akron, then winds through outwash terraces, till plains, and till ridges before reaching the flat lake plain of the Cleveland area.

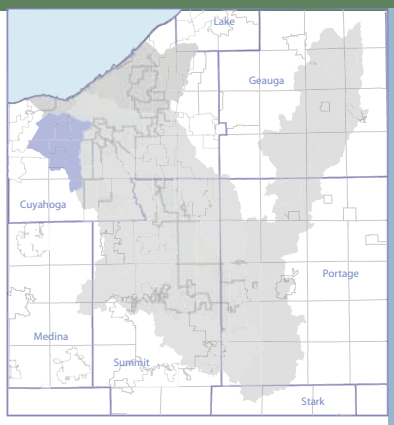
Land cover information from the 2003 Lower Cuyahoga TMDL report shows that approximately 36% of the watershed is covered by deciduous forest. 28% of the watershed is residential, 16% is pasture/hay/row crop agriculture, 11% is industrial/commercial/transportation, and 2% urban/recreational grasses. Slightly over 3% is determined to be woody or emergent herbaceous wetlands.



Land use patterns vary greatly from the upper basin that is primarily agricultural, to the lower basin which is among the most densely populated and industrialized urban areas in the state. Agriculture is the predominant land use in the upper basin, and while less prevalent in the middle basin, the soils are highly erodible and can result in significant sedimentation and nutrient loadings. Resource extraction and hydromodification are localized throughout the basin. The waters of the heavily populated areas of the middle and lower basin are influenced by urban and construction site runoff, combined/sanitary sewer overflows, and land disposal.

Part of the upper Cuyahoga River is a designated State Scenic River and several stream segments within the basin have been designated as State Resource Waters. The Cuyahoga River, from the Ohio Edison Dam to the mouth and the nearshore area two miles west to ten miles east of the mouth has been identified as an Area of Concern by the International Joint Commission. Twenty-two miles of the lower Cuyahoga River flow through the Cuyahoga Valley National Park. Additionally both the Cleveland Metro Parks and MetroParks Serving Summit County have waterways contained in their respective holdings. The Cuyahoga River was designated an American Heritage River in 1998.

Big Creek



Big Creek is the northernmost, and one of the most urbanized, of the major tributaries to the Cuyahoga River. It joins the river approximately 7 miles south of the river's mouth at Lake Erie. The entire drainage area of Big Creek encompasses nearly 39 square miles, with a total stream length of 12.0 miles.

The creek travels through seven communities, including Cleveland, Brooklyn, Linndale, Parma, Parma Heights, Brook Park, and North Royalton.

Typical of many urban streams, Big Creek has been subject to the effects of extensive urbanization for more than 150 years. Its original drainage patterns, wetlands, floodplains and riparian areas have been severely altered and fragmented as a result of channelization, spillway structures, culverts, and land uses encroaching on the stream. This has increased flow volumes, decreased diversity and livability of habitat and limited the recovery potential of the stream.

Water quality in Big Creek is degraded, limiting the usability of this stream for recreational purposes. Bacteria levels frequently exceed water quality standards. Ecological water quality conditions are typical of those within an urban area with fish habitat in the fair range, poor fish communities but improving and macroinvertebrate communities are also poor but improved from grossly polluted conditions of twenty years ago. The degraded water quality is a result of urban runoff, alteration and encroachment on the stream.

Big Creek is part of the Cuyahoga River Area of Concern, a designation reflecting its polluted nature. At the same time, this helps those who would improve the watershed to garner Federal and State commitments to cooperate with local entities to ensure that Remedial Action Plans are developed and implemented.

Approximately 1,570 acres (or 6%) of open space remains undeveloped. Many of these areas hold important watershed resources that are valuable examples of nature in the city and may offer excellent opportunities for restoration.

The keys to improving Big Creek include properly conserving these natural resources as communities continue to develop and also restoring areas that have been impacted in the past.

MAJOR ISSUES IN THE BIG CREEK WATERSHED

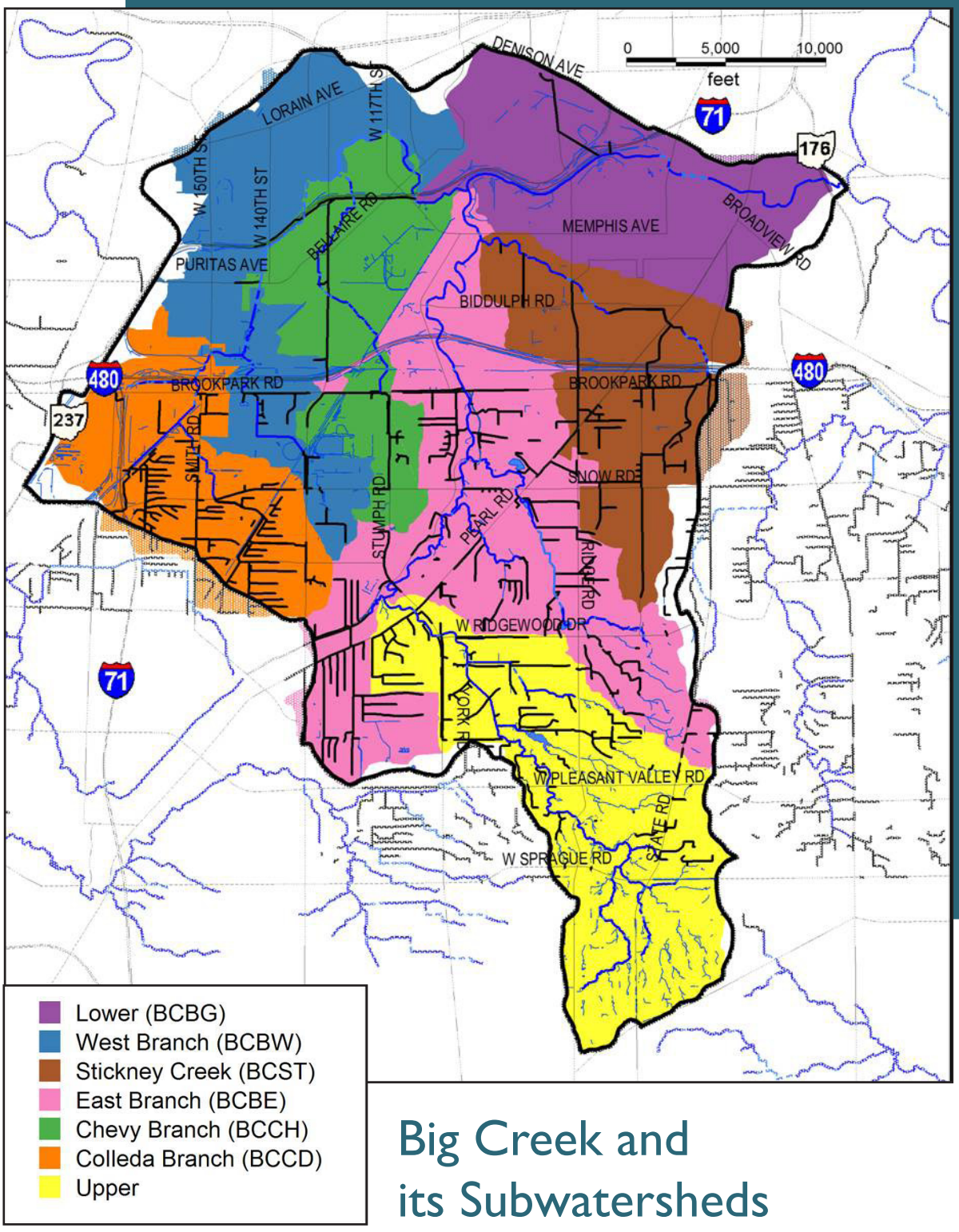
- A large, urban watershed with high impervious coverage (39%) and one of the densest populations in the region.
- Watershed communities are susceptible to flooding, erosion and water quality effects.
- Need for improved stormwater management through retrofits and restoration.
- Remnant greenspaces or natural areas present opportunities for preservation / restoration; these areas have community value as examples of nature in the city.
- Integrating balanced growth recommendations into local community master plans and regulations.

WATER QUALITY & BIOLOGICAL INTEGRITY

Big Creek is designated by Ohio EPA as a "Primary Contact" and "Warm Water Habitat" stream. These designations mean that Big Creek should have bacteria concentrations within a reasonable limit to allow safe recreational contact and be able to support a well-balanced population of fish and aquatic insects.

Water quality in Big Creek is degraded, limiting the usability of this stream for recreational purposes. Fecal bacteria levels frequently exceed water quality standards, indicating that sewage contamination is present.

Biological conditions are typical of those within an urban area. Fish and aquatic insect communities are poor but improving from grossly polluted conditions of twenty years ago. The degraded biological community is a result of the presence of combined sewer overflows, sanitary sewer overflows, urban runoff and alteration of and encroachment on the stream.



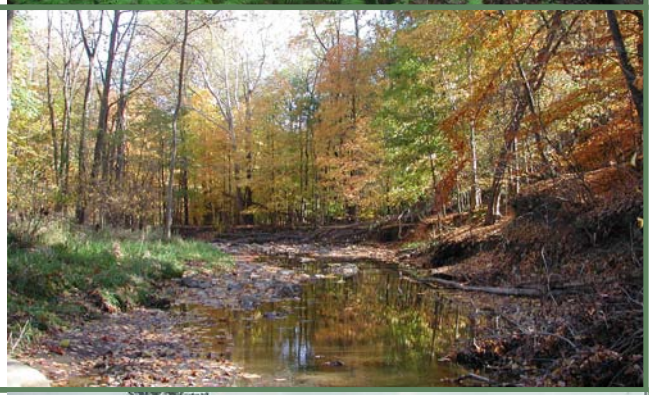
Big Creek and its Subwatersheds

WETLANDS are nature's way of trapping water, storing it, dissipating its energy, filtering out impurities, and slowly releasing it into streams and groundwater supplies. Wetlands store excess water that would otherwise contribute to flooding and stream bank erosion.

Wetlands provide critical habitat - food, shelter and nursery - for a wide variety of plants, birds, amphibians, insects and fish, all of which are necessary in order for ecosystems to thrive. Filling in and paving over wetlands eliminates these important functions and forces the water to flow headlong and unfiltered into streams.

RIPARIAN ZONES are heavily vegetated lands along streams that absorb water and dissipate energy. Leaves, soil and roots absorb water, reduce erosion and stabilize banks.

Vegetated corridors along streams provide for fish and wildlife migration: shade and cool water allowing more oxygen retention; and support habitats by providing nutrients and woody debris and cleaner runoff by filtering pollutants. Natural riparian zones are essential to stream function and need to be preserved.



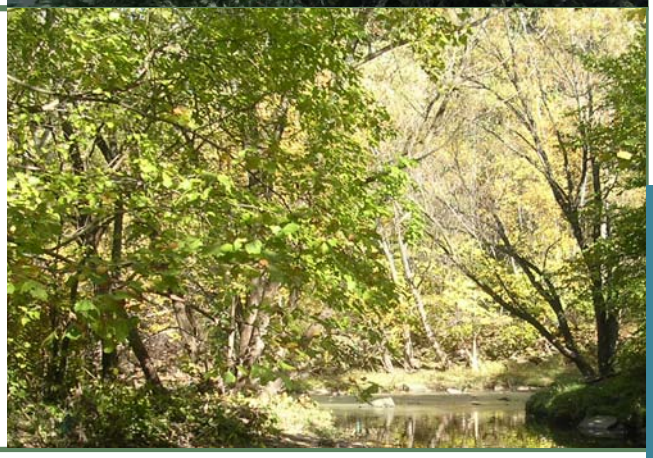
FLOODPLAINS are natural rights-of-way and temporary storage areas for flooding events.

Floodplains are relatively flat areas along stream banks that absorb floodwaters, allowing for the slow release of water back into the stream.

Floodplains enhance biological productivity by supporting a high rate of plan growth. Floodplains provide excellent habitats for fish and wildlife by serving as breeding and feeding grounds. This helps to maintain biodiversity and the integrity of ecosystems.

Floodplains need to be kept undeveloped to allow for stormwater release and space for streams to meander.

PRIMARY HEADWATER STREAMS:
Every stream begins somewhere. That somewhere is its headwaters, the network of small streams that blanket the landscape of every watershed. Primary headwater streams are like the capillary system of a blood supply network- just as the health of whole organism depends upon a functioning capillary system, the health of larger streams and rivers depend upon an intact primary headwater system. These small streams help control the flow of storm water, sediment and nutrients to larger streams. Headwaters are typically impacted the most during development and need protection.



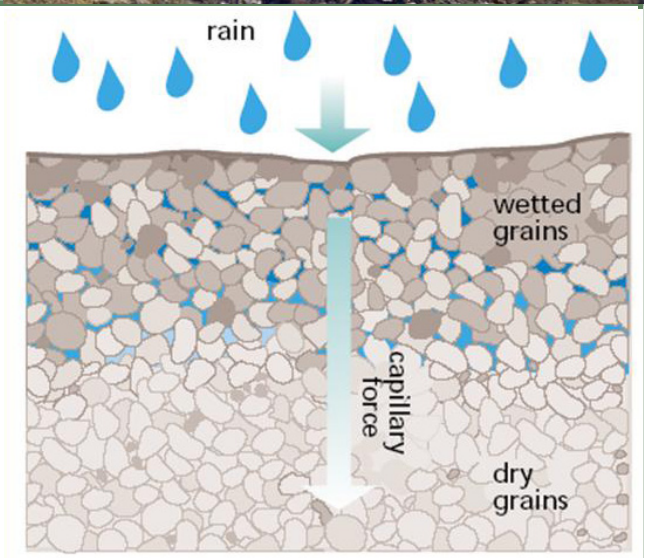
STEEP SLOPES are features of stream valleys and need to be protecterd. Any significant disturbance to the hillside's environment may result in landslides or land instability, alteration in drainage patterns; and loss of scenic value. When development takes place on or near steep slopes (15% or greater), vegetative cover is greatly reduced, significantly increaseing soil instability and erosion. Soil erosion and sedimentation into waterways poses several threats to public health and safety, including increased potential for flooding, that are difficult and expensive to correct. Property damage is commonly associated with development on steep slopes.

CRITICAL SOILS

Porous soils such as sand and gravels provide an opportunity for groundwater recharge by stormwater and should be preserved as a potential stormwater management option. *Unstable or easily erodible soils* should be managed carefully with proper erosion and sedimentation practices.

Infiltration of stormwater into the soil reduces both the volume and peak discharge of runoff from a given rainfall event, and also provides for water quality treatment and groundwater recharge. Soils with maximum permeabilities (moderate infiltration and well drained soils) allow for the most infiltration of runoff into the subsoil.

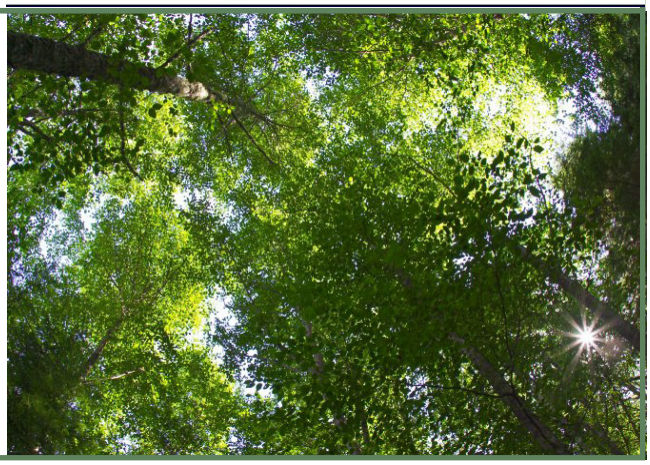
Thus, areas of a site with these soils should be conserved as much as possible and these areas should ideally be incorporated into undisturbed natural or open space areas.



FOREST COVER supports a community's quality of life by maintaining the proper functions of watersheds. Wooded areas support water quality, stream health and aquatic habitat and keep soils in place, reducing sediment.

A healthy forest system can reduce communities' storm water infrastructure costs by intercepting rain, increasing ground absorption and slowing the rate of runoff. Other community benefits include: protecting drinking water supplies, enhancing property values and reducing household energy costs.

Communities need to develop forest cover programs that help maintain and restore tree cover to beneficial levels.

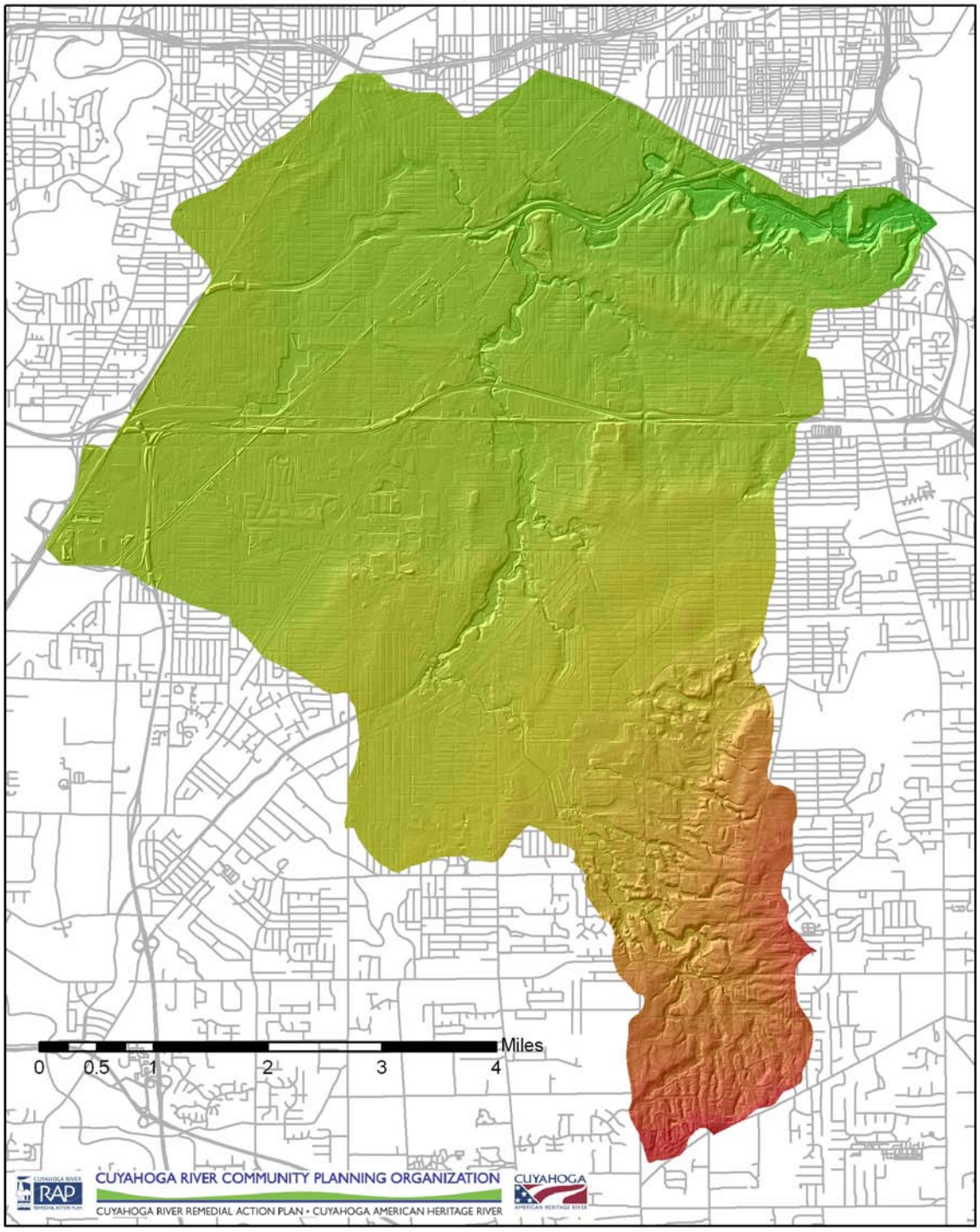


These watershed features reflect long-term geologic, climatic and vegetative patterns.

They exist in the watershed to fulfill a specific need, and any disruption to this system often results in downstream costs.

These impacts must be carefully balanced through mitigation or avoidance.

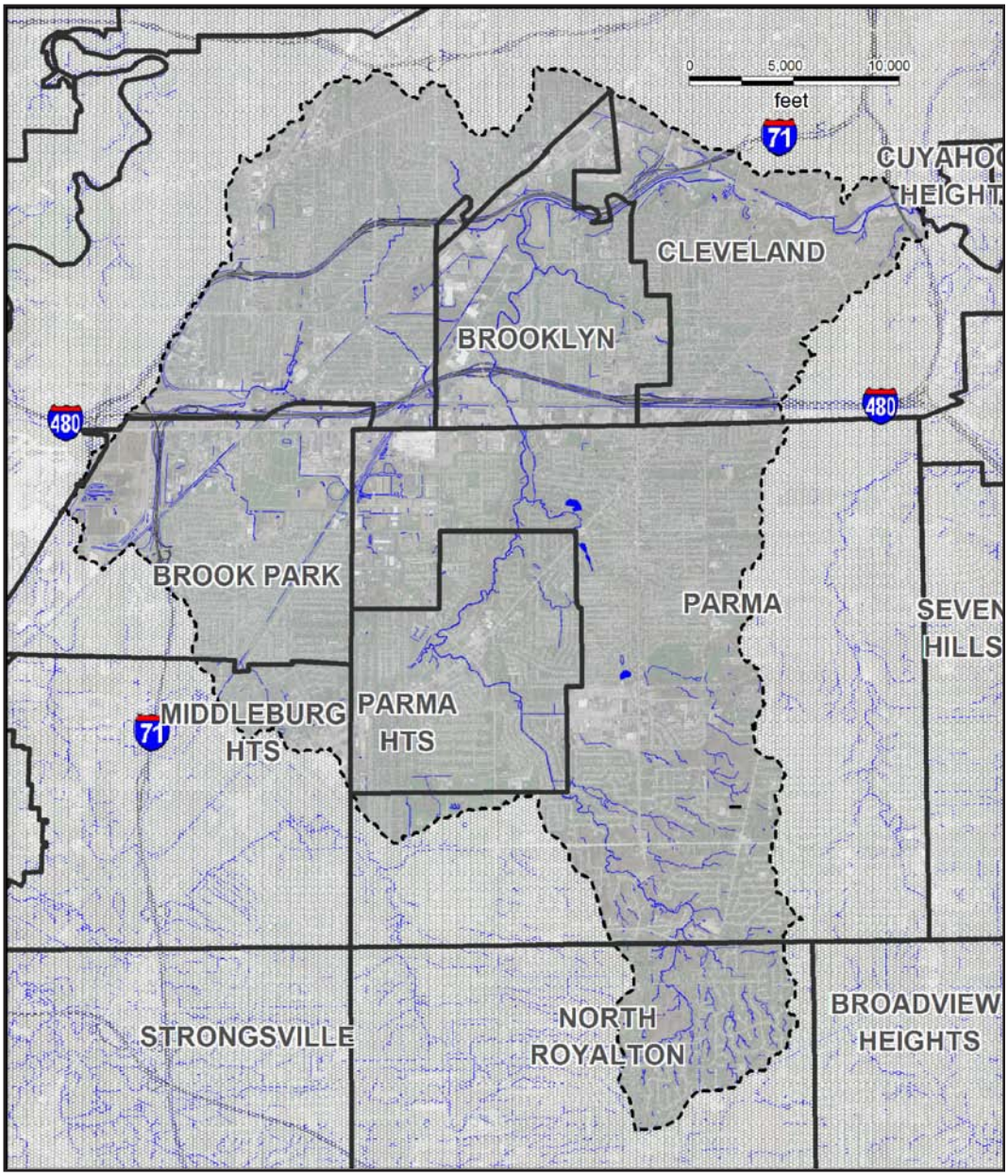
Big Creek Elevation



Most of Big Creek has a relatively flat profile, except for
- the Upper Creek at the south end where a cluster of headwater streams deeply incise the land,
- the large East Branch cutting up through the center of the watershed and
- the Lower Creek where high cliffs surround the creek as it meets the Cuyahoga River.

The drop in elevation from approximately 780 - 800 feet above sea level in the upland areas to 577 feet at the mouth of the creek happens primarily along these ridges.

Big Creek Political Boundaries



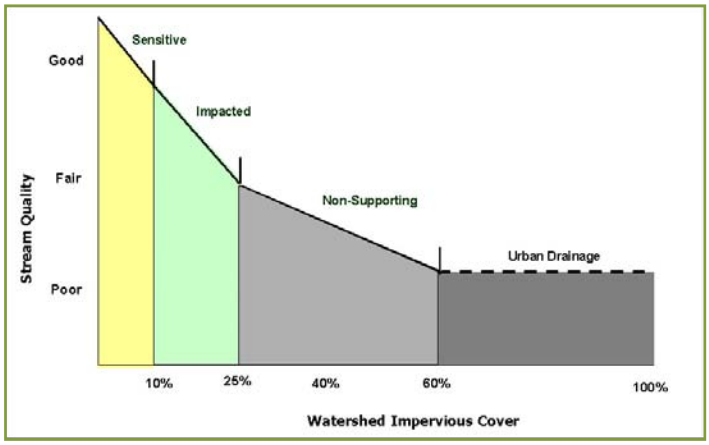
Municipal Composition of Big Creek Watershed

Brooklyn	11%	Linndale	0.2%
Brook Park	10%	North Royalton	5%
Cleveland	33%	Parma	29%
Parma Heights	11%		

Big Creek
Impervious Cover and Watershed Quality

The most important hydrologic characteristic affecting storm water runoff is impervious cover. Impervious surfaces are hard surfaces (ex. roads, rooftops) that do not allow stormwater to infiltrate into the ground, causing the runoff to flow directly into drainage systems. The amount of imperviousness in a watershed correlates directly with frequent flooding and poor water quality. Highly urbanized areas, where much of the land surface has been either paved or covered with buildings, are considered highly impervious. Rural areas tend to have low imperviousness, in which case stormwater infiltration and runoff is controlled by the surrounding soil type.

Diagram: As impervious surface increases, stream quality decreases



IMPERVIOUS COVER MODEL

The Center for Watershed Protection (CWP) has summarized research findings and created an Impervious Cover Model (ICM). The ICM predicts that most stream quality indicators show a decline as the total impervious cover within a watershed increases. (Source: Center for Watershed Protection)

Watershed Impervious Cover 0-10%- these streams usually sustain a high quality, and are often typified by stable channels and healthy biotic communities. The streams may not experience as frequent flash flooding as other urbanized streams.

Watershed Impervious Cover 11-25%- these streams are described as impacted and flooding will occur more frequently. Watershed urbanization may cause stream degradation and alter the stream geometry as a result of increased storm flow and erosion. Some sensitive species may also disappear from the stream.

Watershed Impervious Cover >25%- streams are described as damaged with more frequent flooding and poor water quality. This category of stream becomes unstable and experiences severe erosion and channel widening. Aquatic life becomes dominated by a small variety of pollution tolerant fish and insects.

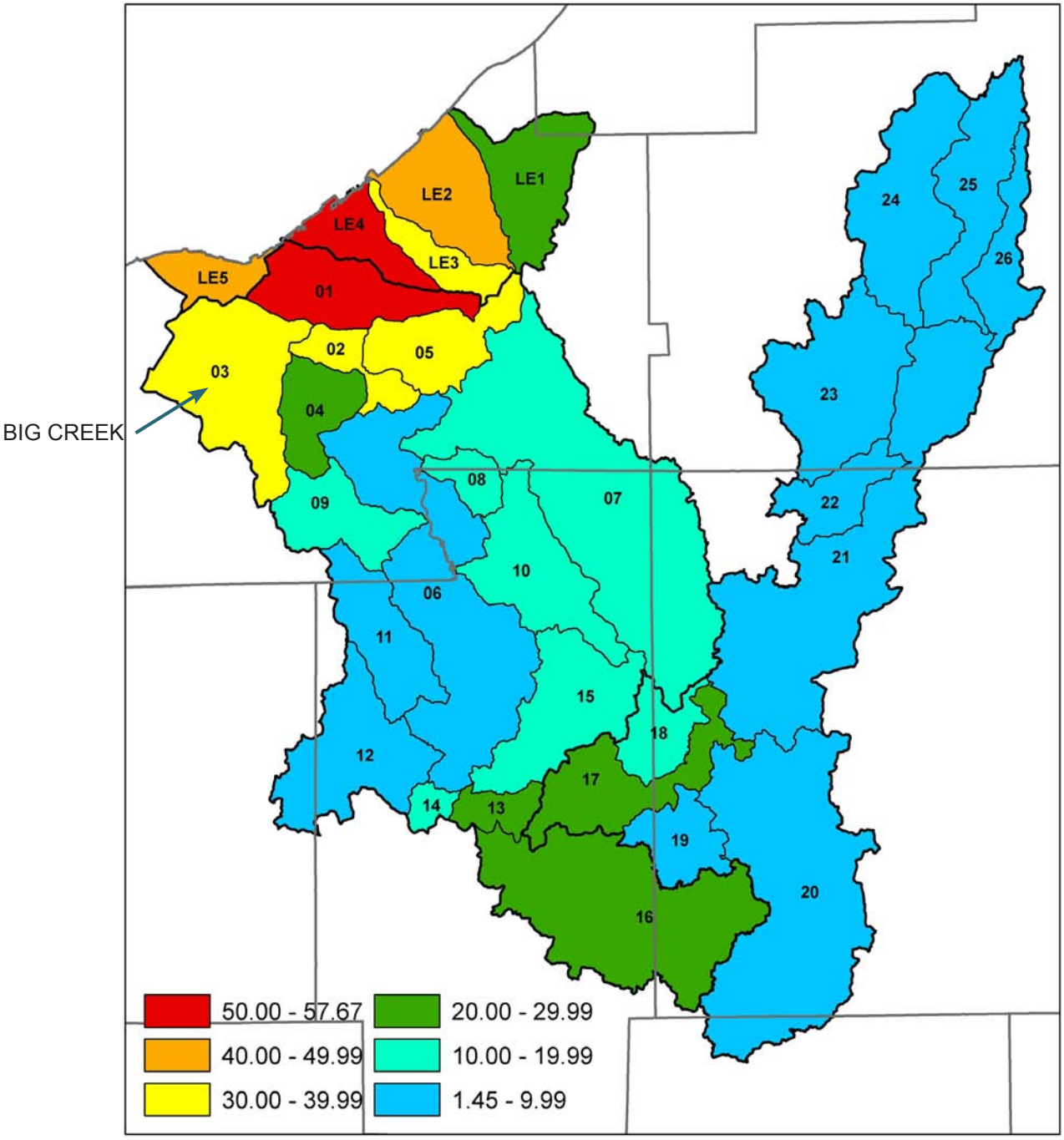
IMPERVIOUS COVER MAPPING

allows communities to gain an idea of how impacted their watersheds currently are, allows them the opportunity to evaluate potential impacts from future development and provides a means to make better-informed site-design decisions.

Understanding the link between impervious cover and watershed quality is essential for communities, organizations and agencies to appropriately deal with the issues of watershed and stream degradation now and in the future.

Impervious Cover in the Cuyahoga River Watershed

The map below shows the overall imperviousness of the Cuyahoga River tributary watersheds. From the headwaters on the right, in blue, the river travels south through areas that are still primarily rural. At the southeast edge of the "V" it encounters Akron's northern outskirts and passes through the Cuyahoga Valley National Park, still within areas with less than 20% impervious cover. As it reaches Big Creek the overall imperviousness increases to more than 25%, the tipping point above which stream quality, form and function will permanently suffer.

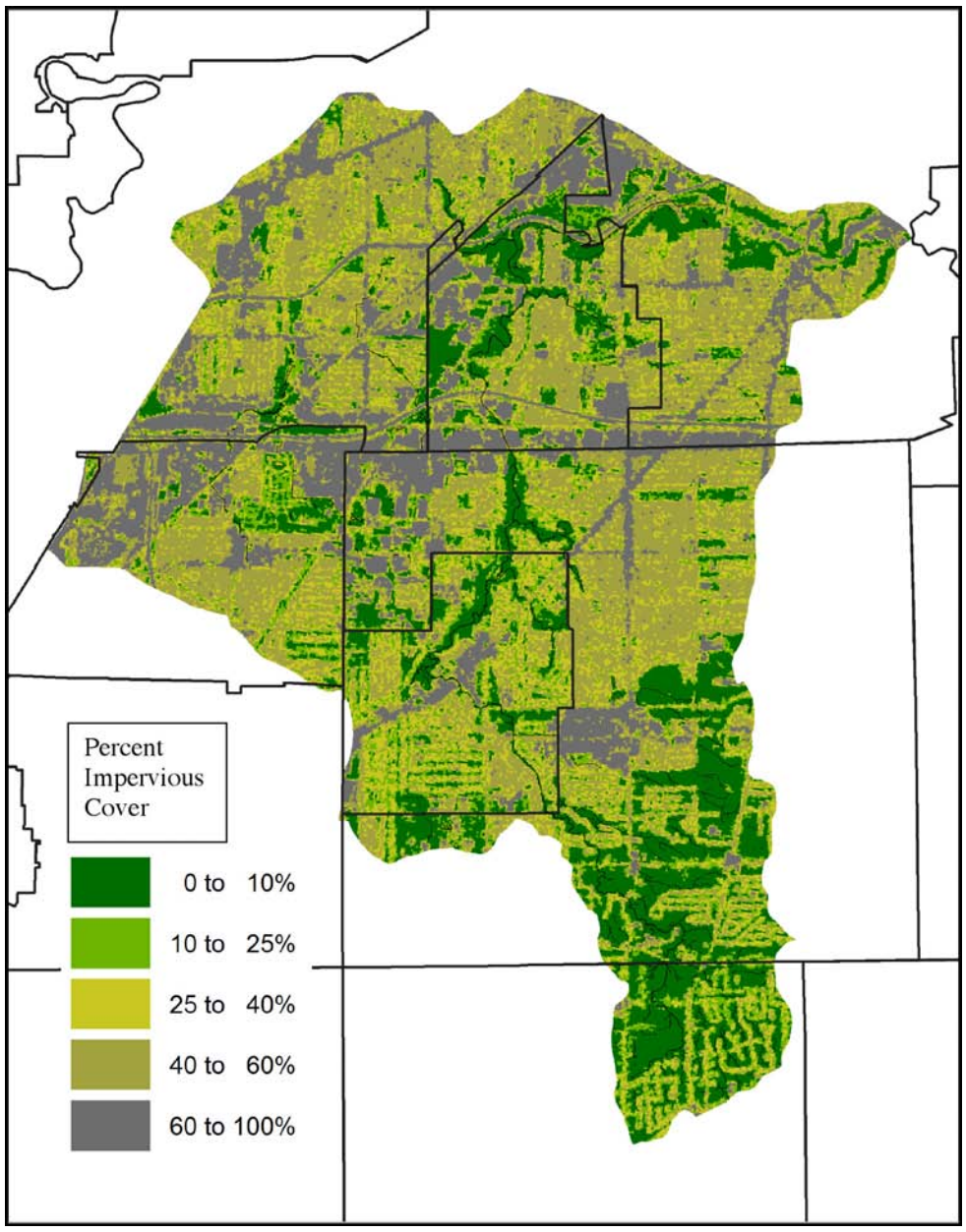


Big Creek
Overall Impervious Cover

Research indicates that 15% is the maximum percentage of impervious cover in which streams can still commonly meet aquatic life standards. However, when important watershed features exist, such as forested riparian corridors and influx of groundwater, streams may still meet attainment even at greater levels of urban land use. (Yoder et al., 2000)

Big Creek has been subjected to extensive urbanization over a period of more than 150 years. The majority of the development in the watershed occurred prior to stormwater regulations and without knowledge of storm water management.

This map shows percent impervious cover based on the analysis of satellite imagery which has a 30 meter pixel resolution (Clapham, 2001). From this overall imperviousness of the Big Creek Watershed and its subwatersheds can be determined.



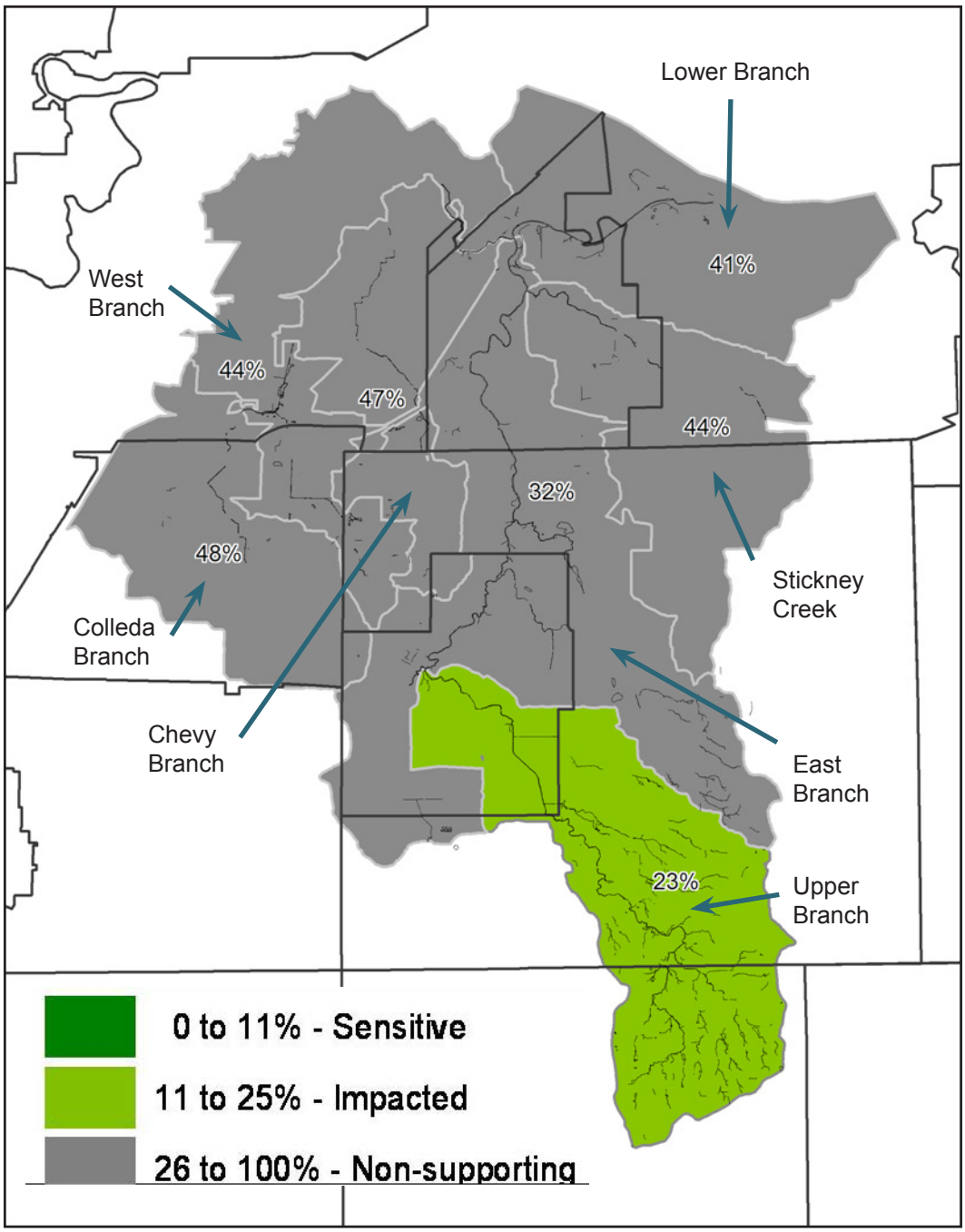
Approximately 39% of the Big Creek watershed is covered by impervious surfaces. Many of these surfaces contain no stormwater management devices and directly drain and contribute excessive runoff to receiving streams, causing downstream flooding and property erosion.

Research indicates that 26% is the maximum percentage of impervious cover in which streams can still commonly meet aquatic life standards.

The amount of impervious coverage in Big Creek, along with the long history of urban development, hinders the creek's ability to reach water quality attainment.

Redevelopment in the watershed communities can be seen as an opportunity to improve community design, stormwater management, and the overall health of Big Creek.

Impervious Cover By Subwatershed



SUBWATERSHED IMPERVIOUS COVER

Most Big Creek communities have too many stressed watershed features to restore all at once and projects must be prioritized. Big Creek was divided into smaller, more manageable subwatersheds that were analyzed for impervious coverage, which will provide insight into planning and management strategies, subwatershed priorities and feasible restoration options.

Four out of the seven subwatersheds have impervious cover levels above 40% with the Colleda Branch having the highest with 48%. The East Branch has 32% impervious cover and the Upper Branch scores the lowest with 23%.

Big Creek
Water Quality & Biological Integrity

The water quality and the health of aquatic life in Big Creek is a useful indicator of the collective land use conditions in the watershed. Problems with poor water quality or aquatic life do not simply originate from a factory effluent pipe: they originate with the way land is used throughout the watershed. The problems can often be initiated by the location of development (e.g. building in flood zones or riparian corridors) and the design of the development (e.g. development that creates large amounts of impervious cover and stormwater runoff).

USE-ATTAINMENT IN BIG CREEK

Poor water quality over the last one hundred years has limited the potential of Big Creek to become an ecological resource for the region. Urban streams nationwide struggle to retain their viability as a community resource due to impacts from urban runoff, industrial land use practices and the lack of protection of watershed resources. Water quality monitoring by the Ohio Environmental Protection Agency (Ohio EPA) and the Northeast Ohio Regional Sewer District (NEORSD) show that Big Creek is no exception to these struggles.

Big Creek is designated by Ohio EPA as a “Primary Contact” and “Warm Water Habitat” stream. These designations mean that Big Creek should have bacteria concentrations within a reasonable limit to allow safe recreational contact and be able to support a well-balanced population of fish and aquatic insects.

WATER QUALITY IN BIG CREEK WATERSHED

Water quality in Big Creek is degraded, limiting the usability of this stream for recreational purposes. Fecal bacteria levels frequently exceed water quality standards.

Fecal bacteria are microscopic organisms that are present in the intestine or feces of warm-blooded animals. They are often used as indicators of sewage contamination in streams.

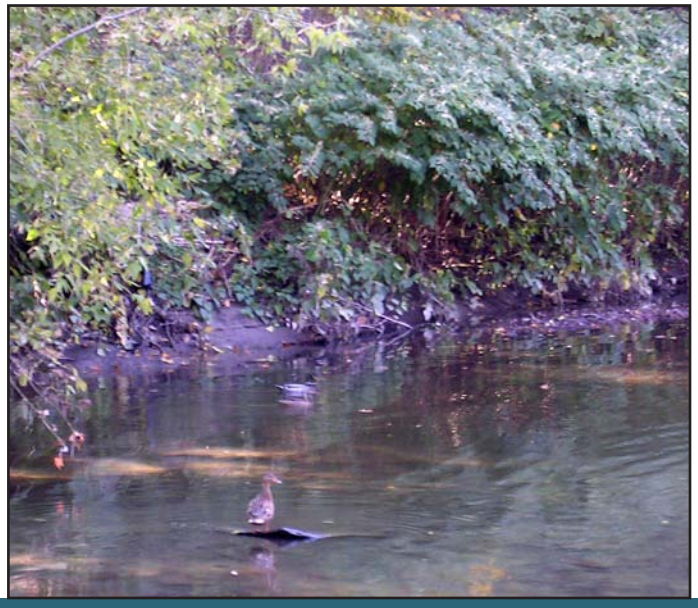
Increased counts of these bacteria are often equated with increased risk of water-borne illness if a person were to come into contact with the untreated water. The bacteria and viruses of concern in urban streams can come from humans, wildlife, and household pets.

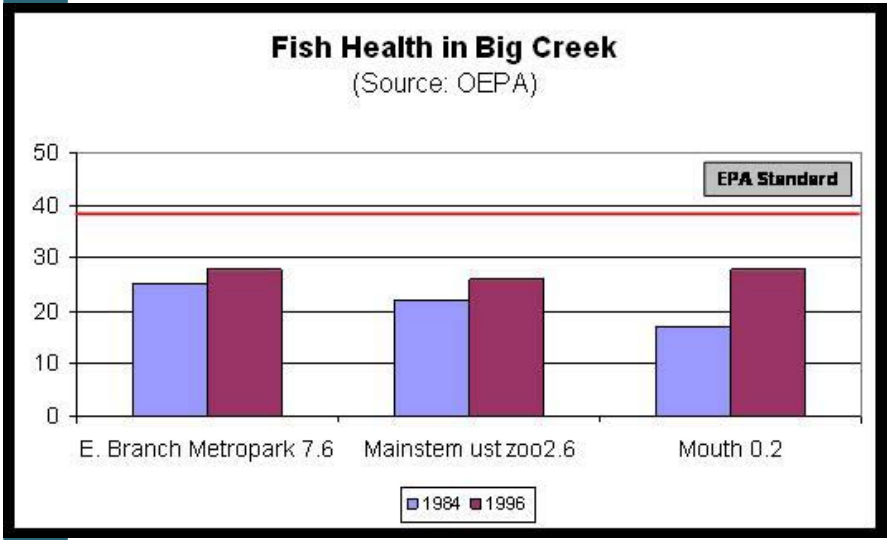
The Ohio EPA and NEORSD both report that the predominant sources of these water quality limitations include the presence of combined sewer overflows, sanitary sewer overflows and urban runoff. While the combined sewers are being remediated, the separate sanity sewers are a problem in Big Creek and other urban watersheds. Typical sanitary sewer problems are blockages or breaks in the lines. Many of these problems appear to stem from Parma and other areas in the Stickney Creek Subwatershed.

BIOLOGICAL INTEGRITY IN BIG CREEK WATERSHED

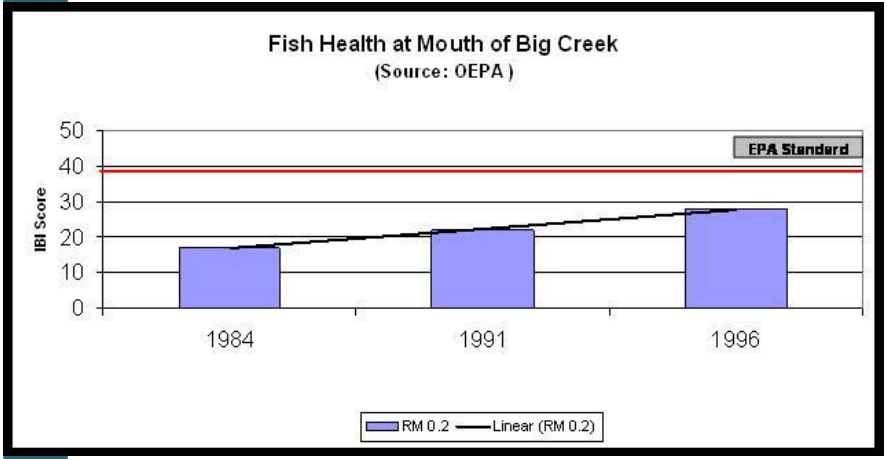
Biological conditions are typical of those within an urban area. Fish and aquatic insect communities are poor but improving from grossly polluted conditions of twenty years ago. The degraded biological community is a result of the presence of combined sewer overflows, sanitary sewer overflows, urban runoff and alteration and encroachment on the stream.

Limited biological sampling exists for Big Creek. The most recent sampling completed by Ohio EPA was 1996. NEORSD sampling is more recent but does not include a complete range of samples needed to determine stream health.

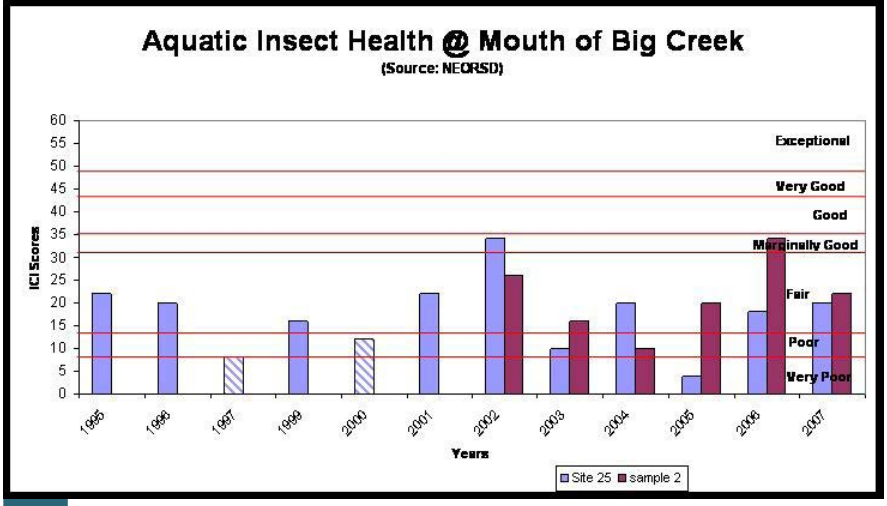




This graph indicates a slight improvement in conditions between 1984 and 1996. But all three sample sites were still below OEPA standards (red line).



This graph indicates that fish health at the Mouth of Big Creek showed improvement from 1984 to 1991 to 1996, but was still not meeting Ohio EPA standards.



This graph indicates that from 1995-2007 aquatic insect communities were below Ohio EPA standards except for 2002 and 2006. This was the first time that this section of Big Creek had indicators of attainment.