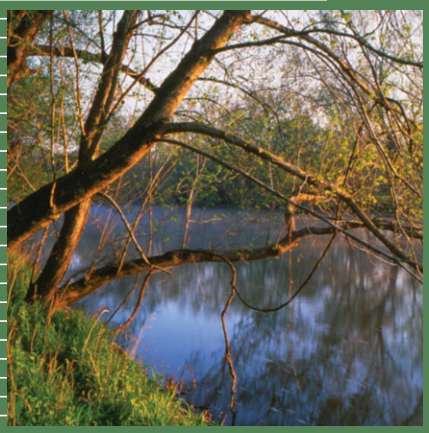

Big Darby Accord
Watershed Master Plan

Prepared for

City of Columbus
City of Hilliard
Grove City
Brown Township
Norwich Township
Pleasant Township
Prairie Township
Washington Township
Village of Harrisburg
Franklin County

EDAW

FINAL / JUNE 2006

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Acknowledgements

The Accord planning process was made possible through the coordination, input and contribution of many people and agencies that deserve recognition.

Jurisdictions
The following jurisdictions and their elected leadership joined in the conception, funding and development of the Accord. They supported the Accord through allocation of funding, staff time, facilities and other resources.

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EDAW Inc

In collaboration with
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Washington Township
Denise Frantz King, Trustee
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Charles W. Kranstuber, Trustee

Group of Four (G4)
This appointed group guided the Accord process as representatives of the member jurisdictions.

Representing Townships
Tracy Hatmaker, Prairie Township Administrator

Representing the City of Columbus
Michael Reese, Deputy Chief of Staff

Representing Franklin County
Lee Brown, Planner

Representing Suburban Communities
Clyde Seidle, Hilliard Director of Public Service

Project Coordinator
Kevin Wheeler, City of Columbus

Stakeholder and Staff Representatives

The following are among the many stakeholder representatives and agency staff that contributed to the plan's development.

- Cheryl Roberto, City of Columbus
- Vince Papsidero, City of Columbus
- Kusi Akuoko, Franklin County
- Susan Ashbrook, City of Columbus
- John Bain, Representative Property Owner
- Guy Blauser, Representative Property Owner
- Don Brosius, Township Representative
- Don Brown, Franklin County
- Steve Campbell, City of Columbus
- Pete Cass, City of Columbus
- Beth Clark, formerly of City of Columbus
- Pam DeDent, City of Hilliard
- Todd Dieffenderfer, City of Columbus
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- Dan Dudley, Ohio Environmental Protection Agency (OEPA)
- Lee Edwards, Representative Property Owner
- Jennifer Fish, Franklin Soil and Water Conservation District
- Bob Gable, Ohio Department of Natural Resources
- Mike Galloway, OEPA
- Tim Hamilton, Hilliard Schools
- Linn Horn, Representative Property Owner
- Paul Lambert, Representative Property Owner
- Joe Martin, Representative Property Owner
- Nan Merritt, Affordable Housing Trust
- Dan O'Brien, Property Owner
- John O'Meara, Metro Parks
- Tammy Noble, formerly of Franklin County
- Malcolm Porter, Building Industry Association
- Rob Pritchard, Representative Property Owner
- Tim Richardson, Brown Township
- Anthony Sasson, The Nature Conservancy
- Erin Sherer, OEPA
- Mark Sherman, Franklin County
- Tom Shockley, Franklin County
- John Tetzloff, Darby Creek Association
- Brian Williams, American Farmland Trust
- Robert Williams, Franklin County
- Planning Division, City of Columbus
- City Attorney's Office, City of Columbus
- Division of Sewerage of Drainage, City of Columbus

Meeting Space

Both Hilliard City Schools and South-Western City Schools were very generous in providing meeting space for public meetings. Each district hosted two public meetings with a total attendance of approximately 600.

In addition, Franklin County Engineer Dean Ringle hosted numerous stakeholder meetings throughout the process.

Meeting Sponsorship

In addition to the four public meetings held during the Accord process, the following organizations sponsored a panel discussion on the effort:

- 1,000 Friends of Central Ohio
- Building Industry Association of Ohio
- Darby Creek Association

Contents

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Executive Summary

The Big Darby Watershed in central Ohio is one of the most biologically diverse aquatic systems in the Midwest, home to 38 state and federally listed aquatic species. Big and Little Darby creeks have been designated as State and National Scenic Rivers.

The Big Darby Accord Plan has been prepared collaboratively among ten jurisdictions within the Franklin County portion of the watershed, covering an area 84 square miles in size. The Big Darby Accord Plan is intended to serve as a multi-jurisdictional guide for development and conservation. The Plan represents a long-term vision and general land use plan for the future that brings together multiple interests in an effort to protect and preserve the watershed while providing guidance for managed growth. The Plan allows for the lifting of a development moratorium that has been in place three and a half years.

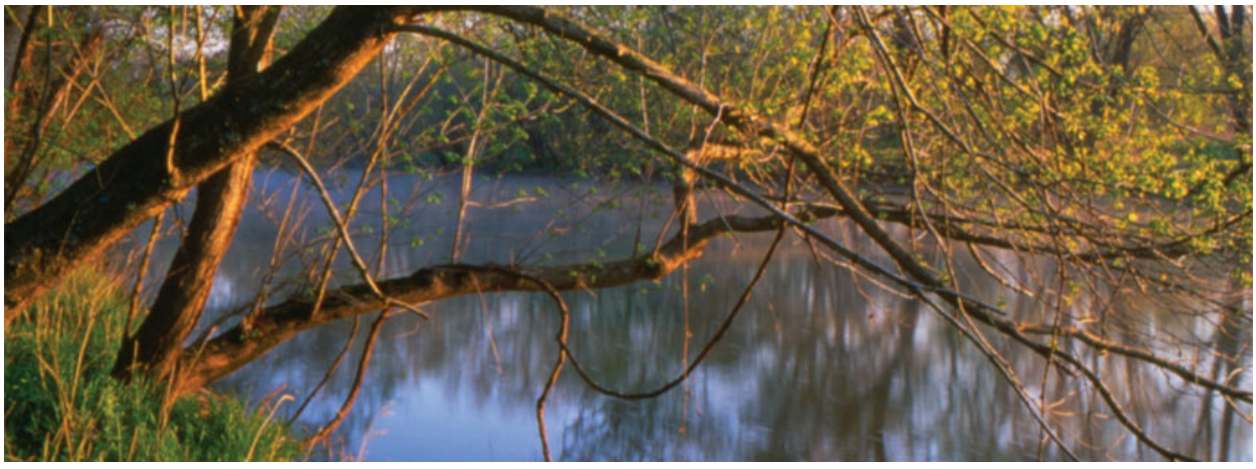
The Plan builds upon previous planning efforts and studies including, but not limited to, the External Advisory Group (related to the Environmentally Sensitive Development Area), the Ohio EPA Total Maximum Daily Load (TMDL) Report for the Big Darby Watershed, and the Hellbranch Watershed Forum. It is the goal of the Accord that each jurisdiction work towards adoption and implementation of the Plan and its provisions.

A Mission Statement and Plan Principles have guided this planning effort and will continue to lead Accord jurisdictions through plan implementation.

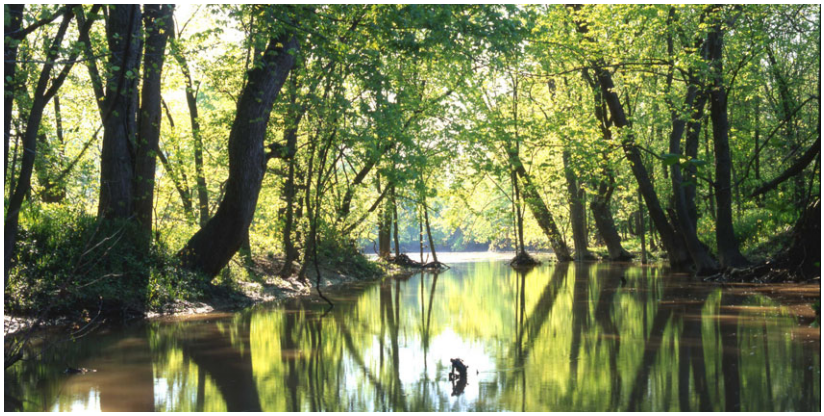
Mission Statement

The Big Darby Accord consists of local governments within the Franklin County area of the Big Darby Creek Watershed. The mission of the Big Darby Accord is to cooperatively develop a multi-jurisdictional plan and accompanying preservation and growth strategies, capable of implementation, oversight, and enforcement, which are designed to:

- **Preserve, protect and improve, when possible, the Big Darby Watershed's unique ecosystem by utilizing the best available science, engineering and land use planning practices;**
- **Promote responsible growth by taking measures to provide for adequate public services and facilities and promote a full spectrum of housing choice, as well as adequate educational, recreational, and civic opportunities, for citizens of each jurisdiction and for Central Ohio;**
- **Create a partnership that recognizes the identity, aspirations, rights, and duties of all jurisdictions and that develops methods of cooperation among the partners through means which include the cooperative utilization of public services and facilities; and**
- **Capitalize on the results of other efforts by considering local comprehensive plans, as well as the work of the Environmentally Sensitive Development Area External Advisory Group, the Hellbranch Watershed Forum, the 21st Century Growth Policy Team, and other local planning and zoning efforts, in the development of the plan.**



Big Darby Creek *Source: Metro Parks/Jim Murtha*



Big Darby Creek *Source: The Nature Conservancy*

Conservation Category	Acres
Protected	4,310
Existing	6,131
Tier 1	5,790
Tier 2	1,885
Tier 3	7,150
Total	25,266

Acreages of Conservation Categories

Plan Framework

Review and analysis of available information resulted in the identification of "plan drivers" which affect the amount, location and type of development recommended in the Plan.

Plan drivers include the level of development that is currently permitted in the planning area (referred to as by-right); accessibility and capacity of centralized sewer and roadway systems; environmental conditions related to sensitive natural resources; and water quality and aquatic habitat conditions related to current and proposed land uses.

The Plan drivers led to the creation of a general land use plan that promotes a sustainable land use pattern and locates the highest amount of development in areas that are less sensitive and within close proximity of centralized sewer and regional transportation networks. A conservation strategy based on natural resource features and a desire to create a connected green infrastructure network balances development with the goal of conserving almost 25,000 acres of land. To achieve the Mission, both elements - development and conservation - need to be pursued simultaneously.

Accord Plan Principles

- **Protection of environmentally sensitive areas**
- **A general land use plan that balances environmental protection and responsible growth**
- **A general land use plan that recognizes existing sewer and waste water treatment capacities, while taking into account the rights accorded watershed landowners under current zoning**
- **Growth will be served by adequate public facilities, particularly central sewer**
- **A development policy that provides for mechanisms to acquire environmentally sensitive areas**
- **A memorandum of understanding among Accord members to implement the agreed upon plan**
- **Development without the condition of annexation**
- **Mechanisms for cooperative revenue sharing among Accord members**
- **Water quality, biological integrity, and adaptive management**

Conservation Strategy

A system of Tiers identifies land areas of protection based on unique environmental resources that were identified during the environmental sensitivity analysis. A majority of the sensitive features are associated with areas of high potential for groundwater and surface water flow exchange, areas of high groundwater pollution potential, floodplains, wetlands, and stream corridor zones. The Tiers also encompass existing parks and easements totaling over 7,000 acres as well as areas that are already protected under current regulations like floodplains and the calculated stream protection zone. The goal of the Accord is to protect the Tiers through development policies and regulations, and proposed voluntary programs and incentives for conservation.

Tier 1 includes land within the 100-year floodplain, wetlands, and critical groundwater recharge and pollution potential zones. Tier 2 includes areas with highly erodable soils and wooded areas of greater than 3 acres in size. Tier 3 is considered important for protection because these areas allow for the creation of linkages among all the components of the land conservation strategy - as well as suitable areas for parkland.

Development Strategy

The general land use plan, which is based on a development level that is currently permitted by local zoning codes, identifies an additional 20,000 dwelling units of development. When combined with the estimated existing population, the long-term (30 years) build out for the planning area is about 100,000 residents. Figure 1.0, located at the end of this executive summary, identifies the proposed general land use plan for the Big Darby Accord planning area. To manage this growth in a manner that protects water quality and aquatic habitat, the proposed plan is guided by several key concepts:

- Higher density development in a new town center between Interstate 70 and US Route 40 (West Broad Street) that would be served by centralized sewer.
- Additional areas of higher density adjacent to Hilliard and the City of Columbus along the eastern edge of the study area that would be served by centralized sewer.
- Areas of conservation development within Brown, Prairie and Pleasant Townships that cluster development which are served by alternative community-based sewage treatment.
- Site and regional-level application of stormwater best management practices (BMP'S) to control stormwater quantity and quality so that it does not adversely affect the health of the watershed and meets Ohio EPA requirements for pollutant loadings for Total Suspended Solids, Nitrogen and Phosphorus.

Proposed Generalized Land Use Categories	Acres	Percent
Agricultural Use	3,356	6%
Commercial	196	0%
Industrial	50	0%
Public / Semi Public	1,053	2%
Mixed Use	357	1%
Res Conservation Devp 50% Open Rural densities	9,406	17%
Res Conservation Devp 50% Open 1 du/ac	1,189	2%
Rural Residential	1,026	2%
Rural Estate	4,805	9%
Suburban Low Density 0.5-3 du/ac	149	0%
Suburban Medium Density 3-5 du/ac	4,073	7%
Urban Medium Density 5-8 du/ac	130	0%
Urban High Density 8+ du/ac	447	1%
Special Residential LEED	328	1%
Town Center*	1,825	3%
Golf Course**	729	1%
Existing Park**	6,266	11%
EC Protected	4,334	8%
Tier1	5,600	10%
Tier2	1,850	3%
Tier3	7,160	13%
Roads & Transportation***	1,701	3%
	56,029	**100%**

Proposed Land Use Categories
**Excludes identified Conservation areas in Town Center (about 675 acres)*
***Excludes Conservation protected area*
****Calculation considers only major* roads.

The general land use plan proposes a variety of new land use categories for the planning area. In addition to conservation areas, principle land use categories include conservation development and a new mixed-use Town Center.

Conservation Development

Conservation development, also sometimes referred to as cluster development, is recommended as the preferred land use pattern to protect the area's environmental features through open space set asides and to protect the rural character of the area. The Plan identifies two conservation development land use categories; both require that 50% of a development site be placed in a perpetual easement that is managed in a natural state. In the Hilliard expansion area, which will receive centralized sewer, conservation development at 1 dwelling unit per acre is recommended providing for up to 2,000 dwelling units. In Brown, Prairie and Pleasant Townships, conservation development at permitted rural densities is recommended. New standards and regulations pertaining to siting and design criteria, operator and monitoring requirements, and efficiencies of alternative community-based sewage treatment systems will guide rural conservation developments. Incentives to encourage stream restoration and additional open space set asides are recommended.

Conservation developments should reinforce the rural character of the watershed. Housing types should be varied within developments and encourage creativity to meet the needs of mixed incomes.
The location of open space in conservation developments should

be dictated by the location of environmentally sensitive features, and contiguity and connectivity of existing open space features to help achieve a green infrastructure network. The design of conservation developments should be flexible to reserve the best available soils on the site for community-based sewage treatment.

For larger lot developments that occur outside of conservation developments, local jurisdictions should encourage at least 50% of the site be placed in a conservation easement to ensure proper care and native vegetative features.

Town Center

The intention of the Town Center zone is to create a sustainable and highly desirable mixed-use area that includes a full range of residential, retail, office and public uses including parks and open space within a 2,500 acre zone. The Town Center is envisioned as a walkable village that includes retail uses facing key streets to create a lively and visually appealing community.

The Town Center core should be a safe, attractive, efficient, walkable area with convenient connections to residential neighborhoods and nearby transit. The Town Center's outer edges should be designed in a manner that allows for a transition to surrounding uses. The Town Center should evoke special characteristics that set it apart from its surroundings and contribute to its individuality.

The City of Columbus has identified an initial sewer capacity for the Town Center of 5,000 equivalent dwelling units. The total amount of development may increase depending on sewer service availability. Development within the Town Center should follow design standards and guidelines that are developed in a more detailed planning effort. A minimum base density should be established to allow for 8 to 15 dwelling units per acre.

Water Quality

The water quality modeling analysis was successful in duplicating the results from the TMDL study, in particular for the Hellbranch Run watershed. Water quality modeling of the proposed Big Darby Accord general land use plan shows there will be a reduction in the level of specified pollutants that are contained in stormwater runoff and discharged to the Hellbranch Run or directly to the Big Darby Creek main stem. The Ohio EPA TMDL sets specific targets for reductions in loadings of Total Suspended Solids and Phosphorus at 95% and 81% respectively. The general land use plan achieves a significant improvement in the direction of reaching Ohio EPA targets attributed to conservation strategy and land use pattern.

To achieve the goals of the TMDL, the Plan identifies appropriate and innovative best management practices (BMPs) for site development in the form of a BMP toolkit. A BMP planning process is also proposed to provide guidance in determining the appropriate application for site development. The use of Low Impact Development (LID) design techniques is recommended to reduce the amount of impervious cover on a site and allow for more natural areas and infiltration.

Policies

The Plan identifies supporting policies that each jurisdiction should adopt to ensure the watershed is protected. These policies are more fully explained in the Big Darby Accord Plan. Major policy recommendations associated with environmental components, conservation development, the Town Center, open space, water quality, best management practices and sewer service are summarized below.

Environmental Resources

The main goals of the Big Darby Accord planning effort are to preserve and protect areas that contribute the most to water quality and to improve the overall aquatic habitat within the Franklin County portion of the Big Darby watershed. These areas, associated with Tiers 1, 2 and 3, in some cases already have protective status related to state or federal regulations. The Plan recognizes these requirements and provides additional guidance. Key Plan provisions include the protection of riparian corridors through the application of a stream corridor protection zone (SCPZ) and reinforcing the protection of existing wetlands. The SCPZ precludes certain activities from occurring within a certain distance of all stream channels. In addition, the Plan recommends preserving existing wetlands to the extent possible. Any mitigation required in meeting the needs of environmentally sensitive resources should create stream and wetland restoration opportunities, or other similar benefits.

Conservation Areas

The Plan recommends requiring permanent easements for areas that are intended for conservation, including stream corridor

protection zones and land that is set aside as part of conservation development requirements. Easements can provide economic benefits to property owners. All easements should be held jointly by home owners associations, governmental entities or conservation groups to ensure that they are properly maintained and managed over the long term. Consistent guidelines for the maintenance and care for privately held open space lands or land held within easements will need to be developed to ensure the areas are planted with native vegetation. Developers should be required to work with Franklin Soil and Water Conservation District and the local jurisdiction to develop a planting plan for any open space easement, plant the initial cover and ensure a successful outcome for a specified number of years.

Development

Policies related to development are aimed at creating a more sustainable land use pattern that can be served by infrastructure, protects sensitive resources, and create places that increase the quality of life for residents and visitors. The Plan discourages conventional subdivisions, which are inconsistent with the goals of the Plan, and proposes development patterns that cluster housing in conservation developments or in a new mixed-use Town Center. The Plan encourages the application of Leadership in Energy and Environmental Design (LEED™) building principles, particularly LEED™ Neighborhood Design (ND) principles which are under development.

Development proposals will need to include an evaluation of environmental site conditions, required best management practices to meet water quality goals, environmental policies, and the availability of utilities. The Plan recognizes that flexibility may be needed to meet all requirements and suggests incentive opportunities to help reach the overall goals of the Plan.

Stormwater

Development in the Accord planning area will need to meet a new standard in order to meet water quality goals of the Ohio EPA and of this Plan. Stormwater management policies for the Big Darby Accord Plan are tied to maintaining and improving water quality and aquatic life use attainment within planning area watercourses. The Plan recommends a regional approach to stormwater management in the Town Center to provide sufficient treatment and pollutant removal.

Best management practices are structural or non-structural practices, management practices, or a combination of these techniques, that minimize the impacts of agricultural or urbanized land uses on water quality by removing or reducing pollutants. BMPs capture and treat pollutants found in runoff and manage the frequency, volume and energy of the runoff so that water resources are not degraded.

The Plan summarizes information on design criteria, benefits and limitations, pollution removal efficiency, site design factors, depth to the water table, and the scale at which each BMP is most effective.

Planning for stormwater management BMPs within a development begins with the collection of data on the local receiving waters and information regarding pollutants of concern within the downstream watershed area. The Plan outlines an eight step BMP planning process to select appropriate BMPs that address both the proposed development and the pollutants of concern listed in the TMDL. Practices such as green roofs, pervious pavement, rain water harvesting, filtration devices, hydrodynamic devices, bioretention, grass channels, dry swales, wet swales, infiltration basins, infiltration trenches, dry wells, and underground detention are discussed. It is important to review stormwater policies as science, technologies, industry, and design will likely evolve.

Utilities

Centralized sewer will be provided to the Town Center and the identified development corridor within the Hilliard expansion area. Current capacity constraints limit development in the proposed Town Center to 5,000 equivalent dwelling units and 2,000 dwelling units in the Hilliard expansion area. Centralized sewer service will also be provided to the LEED area east of Alton and Darby Creek Road. Capacity exists for approximately 1,400 equivalent dwelling units in this area. Central sewer service may also be provided in a manner consistent with the Accord general land use plan to some sites closer to the existing system that were previously annexed or are zoned for development.

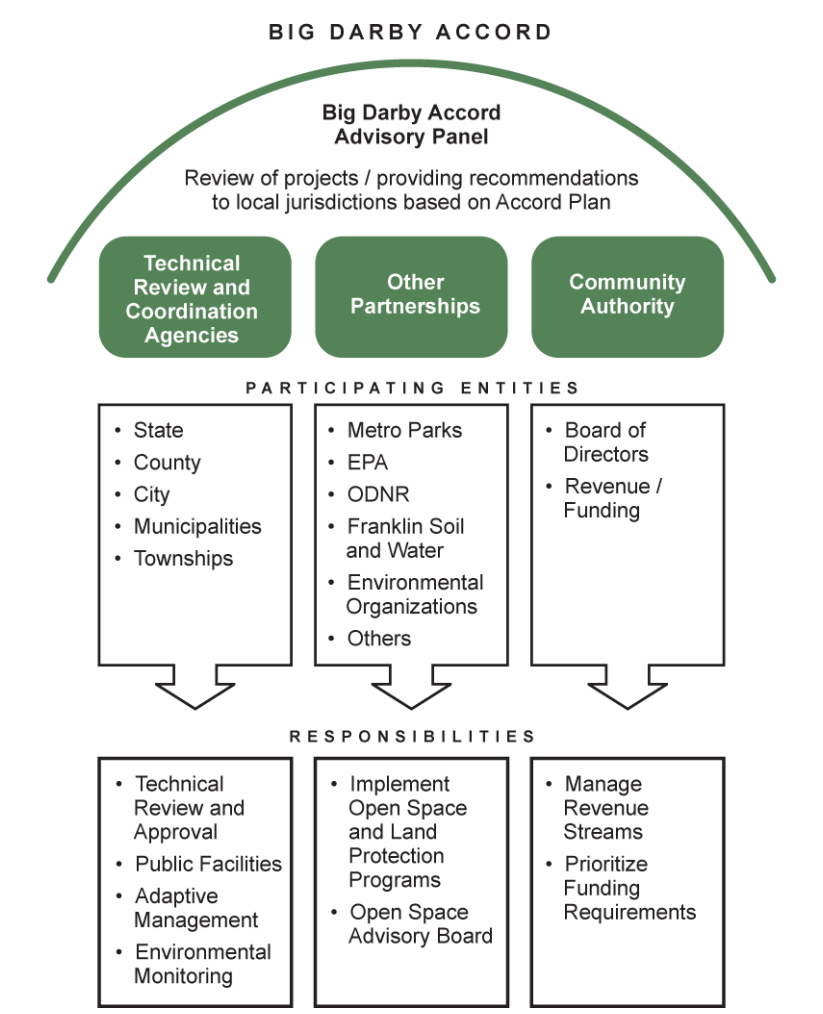
To avoid a proliferation of household sewage treatment systems (HSTS), other areas would utilize alternative community-based sewage systems such as drip or spray irrigation. Management, operation, design, maintenance and other requirements for community-based systems are being evaluated.

Implementation

Implementation of the Big Darby Accord will require coordinated effort among a number of key stakeholders, including local governments, state agencies, landowners, conservation organizations, and developers. A Memorandum of Understanding between the jurisdictions is being pursued to solidify the commitment to work together to implement the Plan. To help jump start efforts, the Accord jurisdictions should consider appointing or jointly hiring staff to coordinate efforts.

Development Review and Coordination

Adoption of the Plan will require updates to local comprehensive plans, zoning and subdivision regulations, and related policies. These efforts should be coordinated whenever possible to promote efficiency. Future zoning and site development review processes must be consistent and apply evenly to all areas of the planning area. The Plan recommends the formation of a Big Darby Accord Advisory Panel to fulfill an oversight function to the review process and create a mechanism for collaboration. The recommended structure is similar to the Rocky Fork-Blacklick Accord Panel. Development and rezoning proposals will proceed through review at the local jurisdiction level aided by the use of a development review checklist that identifies requirements for Accord Plan consistency. The Big Darby Accord Advisory Panel will review completed development and zoning proposals prior to local jurisdiction technical review. Following the technical review and review of staff reports, the Big Darby Accord Advisory Panel will provide a non-binding recommendation regarding the proposal to the local jurisdiction. Final approval resides with the local jurisdiction.



Various Roles and Responsibilities for Plan Implementation

Funding

Funding the Plan will require several existing and new mechanisms including a new community authority, tax increment financing (non-school) program, and a $2,500 per unit developer contribution. Based on a number of assumptions, these mechanisms could collectively generate upwards of $430 million (present value) dollars over time. Revenues will also be leveraged with other available resources to fund plan improvements related to infrastructure and utilities, land acquisition and conservation, stream restoration, community facilities, stormwater management, and water quality monitoring. Accord jurisdictions should allow flexibility in meeting plan requirements, particularly if opportunities arise for regional solutions such as large scale stream restoration, regional stormwater facilities, and alternative community based sewage systems.

Town Center Master Plan

A recommendation of the Big Darby Accord Plan is to prepare a detailed master plan for the Town Center area as identified within the Plan. A master plan would help

establish a more specific vision for the development of the Town Center and would provide a detailed set of recommendations including level of development, infrastructure requirements, design guidelines, and phasing. The master plan should address public and private properties within the Town Center and incorporate the adjacent areas as part of the analysis to ensure the Town Center complements and is compatible with the surrounding areas.

There are a number of steps required in the preparation of the master plan. At a minimum Brown and Prairie Townships should lead the master plan effort, in coordination with other members of the Accord.

Programs

The Plan identifies a variety of new programs for reaching the goals of the general land use plan and creating a conservation network of 25,000 acres. Priorities for conservation efforts should be linked to the Tiers with acquisition efforts focused on Tiers 1 and 2. The Accord should work closely with organizations like Metro Parks, the Nature Conservancy (TNC), Darby Creek Association, Ohio Department of Natural Resources (ODNR), Franklin Soil and Water Conservation District, Natural Resources Conservation Service (NRCS) and The Ohio State University (OSU) to provide increased visibility to conservation efforts and to pursue and leverage funding sources. In addition, the Accord should establish an Open Space Advisory Council to guide and coordinate conservation efforts. Programs should be established to allow for land acquisition, density transfers, nutrient reduction on farmland, backyard conservation, and outreach to landowners.

To allow for ongoing study and to adapt to changes over time, the Plan recommends establishing a comprehensive water quality monitoring program at both the watershed level and the development site level. The primary purpose of the watershed level monitoring is to ensure that the aquatic life use designations for all reaches of a stream are being met. The purpose of the development site level monitoring is to ensure development sites are not exceeding determined allowable release rates for the pollutants of concern as defined by the Ohio EPA in the TMDL. To establish the protocols, process and details of the monitoring program (and to help establish goals, consistency and coordination for stream restoration efforts), an Environmental Monitoring Group (EMG) should be established with representatives from The Ohio State University, Ohio EPA, Ohio Department of Natural Resources, Franklin Soil and Water Conservation District, and one outside conservation group representative. The EMG should prepare a State of the Darby" report every two to five years to report on water quality trends within the watershed compared to the TMDL and Plan goals. This report should state concerns and identify any recommended action for mitigating impacts.

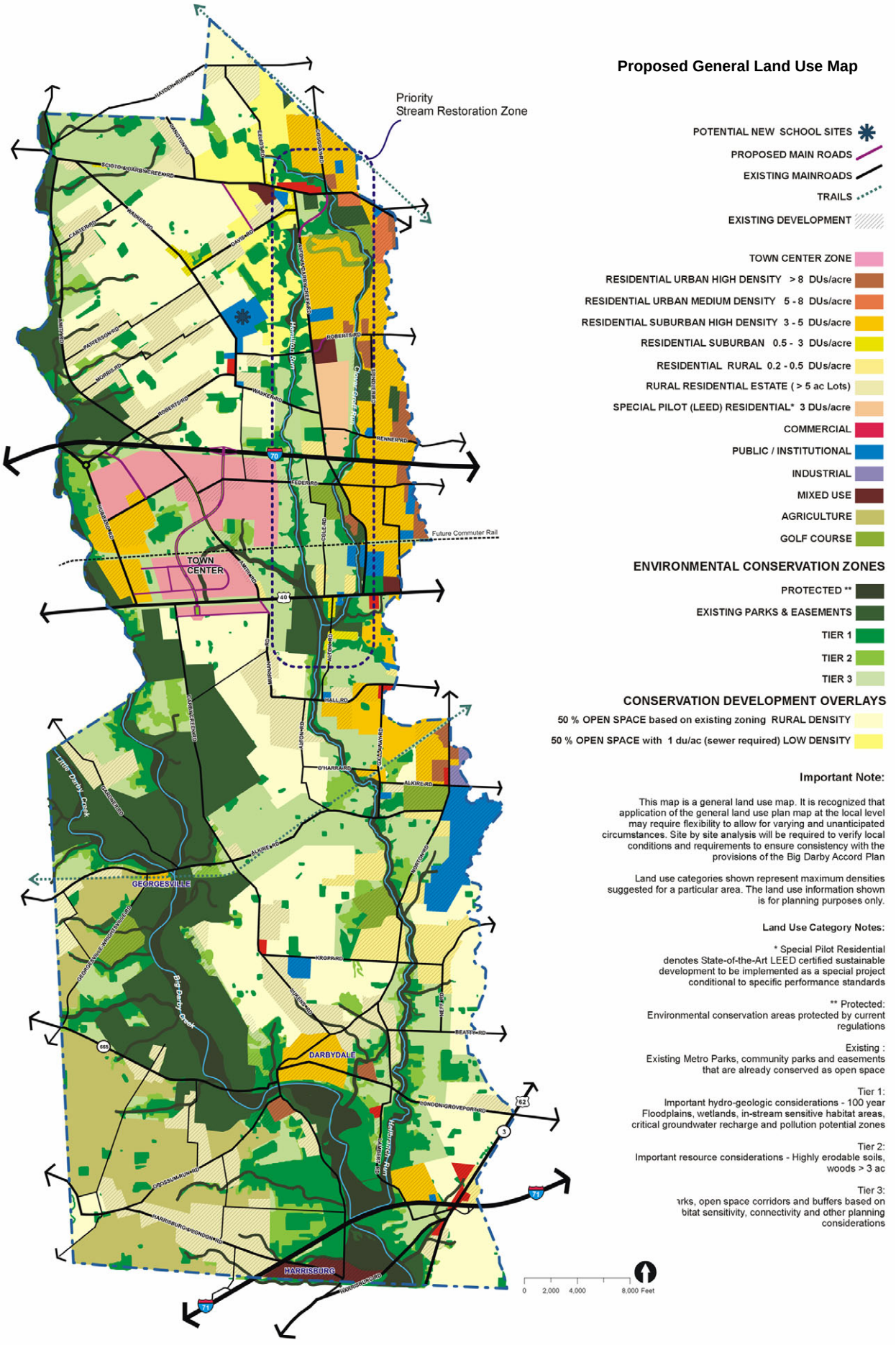
Early Actions

The Accord Plan is a living document that, over time, will need to be updated. Several of the programs recommended in the Plan are intended to provide feedback that will be used to adapt policies, programs, and standards to ensure that actions today and in the future are still meeting the Mission of the Accord. New technologies related to best management practices, new tools and open space programs may arise. Several early actions are identified for the Accord jurisdictions to move the planning process into action. These actions are further refined in an emerging Memorandum of Understanding among the jurisdictions:

- Adopt the Plan (1-4 months)
- Complete and Adopt a Memorandum of Understanding (1-4 months)
- Update local regulations (2-6 months)
- Establish a Darby Accord Advisory Panel (4-6 months)
- Identify staff resources to facilitate implementation of plan elements (6-9 months)
- Perform facilities planning for services (6-12 months)
- Initiate Town Center Master Plan process (6-12 months)
- Set up Community Authority and non-school TIF (6-18 months)
- Begin an environmental monitoring program (6-18 months)
- Continue public education and outreach (ongoing)

The Big Darby Accord Plan has brought together ten jurisdictions and created a Plan that serves as a model for regional planning throughout the entire Big Darby Watershed and the State of Ohio. Working together has increased benefits for all communities in the watershed. The jurisdictions of the Accord and their partners have raised the bar in a spirited commitment to protect the Big Darby Watershed for generations to come.

Proposed General Land Use Map



POTENTIAL NEW SCHOOL SITES
PROPOSED MAIN ROADS
EXISTING MAINROADS
TRAILS
EXISTING DEVELOPMENT

TOWN CENTER ZONE
RESIDENTIAL URBAN HIGH DENSITY > 8 DUs/acre
RESIDENTIAL URBAN MEDIUM DENSITY 5 - 8 DUs/acre
RESIDENTIAL SUBURBAN HIGH DENSITY 3 - 5 DUs/acre
RESIDENTIAL SUBURBAN 0.5 - 3 DUs/acre
RESIDENTIAL RURAL 0.2 - 0.5 DUs/acre
RURAL RESIDENTIAL ESTATE (> 5 ac Lots)
SPECIAL PILOT (LEED) RESIDENTIAL* 3 DUs/acre
COMMERCIAL
PUBLIC / INSTITUTIONAL
INDUSTRIAL
MIXED USE
AGRICULTURE
GOLF COURSE

ENVIRONMENTAL CONSERVATION ZONES

PROTECTED **
EXISTING PARKS & EASEMENTS
TIER 1
TIER 2
TIER 3

CONSERVATION DEVELOPMENT OVERLAYS

50 % OPEN SPACE based on existing zoning RURAL DENSITY
50 % OPEN SPACE with 1 du/ac (sewer required) LOW DENSITY

Important Note:

This map is a general land use map. It is recognized that application of the general land use plan map at the local level may require flexibility to allow for varying and unanticipated circumstances. Site by site analysis will be required to verify local conditions and requirements to ensure consistency with the provisions of the Big Darby Accord Plan

Land use categories shown represent maximum densities suggested for a particular area. The land use information shown is for planning purposes only.

Land Use Category Notes:

* Special Pilot Residential
denotes State-of-the-Art LEED certified sustainable development to be implemented as a special project conditional to specific performance standards

** Protected:
Environmental conservation areas protected by current regulations

Existing :
Existing Metro Parks, community parks and easements that are already conserved as open space

Tier 1:
Important hydro-geologic considerations - 100 year Floodplains, wetlands, in-stream sensitive habitat areas, critical groundwater recharge and pollution potential zones

Tier 2:
Important resource considerations - Highly erodable soils, woods > 3 ac

Tier 3:
arks, open space corridors and buffers based on bitat sensitivity, connectivity and other planning considerations

1.0 Introduction

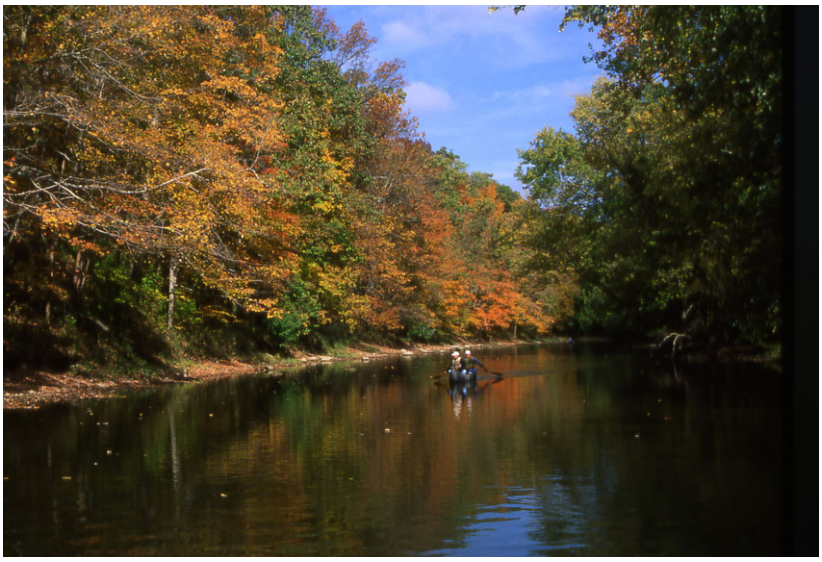
1.1 Formation of the Accord

It has been well documented that the Big Darby Watershed is one of the most biologically diverse aquatic systems in the Midwest and is among the top warm freshwater habitats in the nation. The Big Darby Watershed is home to 38 state and federally listed aquatic species. The sustainability of the Big and Little Darby Creeks is of critical importance so that they continue to be healthy, biologically diverse, and a recreational treasure for current and future generations.

The Big Darby Watershed also represents the largest undeveloped area in Franklin County. With the continued growth of Central Ohio, the watershed has experienced increased development pressures in recent years. Due to the unique nature of the Big and Little Darby Creeks, any development within their watersheds must be carefully planned and managed.

In July 2004, elected officials from jurisdictions that comprise the Big Darby Watershed in Franklin County gathered to discuss the importance of protecting the watershed and the need for a common vision for future development. Jurisdictions involved included Brown, Prairie, Pleasant, Norwich and Washington Townships; the Cities of Columbus Hilliard, and Grove City; the Village of Harrisburg; and Franklin County.

The historic meeting of Big Darby jurisdictions followed years of studies and planning activities by each jurisdiction and various other organizations. These efforts have contributed to a common understanding of the importance of the watershed, the quality of the waterways and the vision of each jurisdiction, and have served as a foundation of the Big Darby Accord planning effort.



Big Darby Creek
Source: The Nature Conservancy/Anthony Sasson

In addition to the comprehensive planning activities, two recent initiatives have brought together representatives of multiple jurisdictions and interests to address watershed issues: the ESDA External Advisory Group and the Hellbranch Watershed Forum. The Big Darby Accord Plan is the culmination of these efforts.

ESDA External Advisory Group
The EPA-approved *Columbus Metropolitan Facilities Plan Update* (November 3, 2000) establishes a goal "to protect critical water resources, especially in the Darby Watershed." This plan designates an Environmentally Sensitive Development Area (ESDA) that includes most of the Big Darby Watershed in Franklin County. The plan recognizes that while "the City of Columbus will ultimately provide centralized service within a portion of it, no service whatsoever shall be provided within the ESDA until the following conditions are met for the area to be served:

- Riparian buffer restrictions are in place;
- Comprehensive stormwater management planning has occurred;
- Conservation development restrictions are in place which involve the concept of clustering development to preserve tracts of open space, including farmland; and
- Adequate public facilities, including roadways, exist or are planned to support any proposed development."

Section Outline

The Hellbranch Watershed Forum

The Hellbranch Watershed Forum was created by a cooperative agreement signed May 22, 2002 by elected officials of Franklin County; the cities of Columbus, Hilliard, and Grove City; and Brown, Norwich, Pleasant, and Prairie townships. The Forum was organized to collaboratively develop consistent stormwater policies and regulations, develop a pilot restoration project, and cooperate in and support a watershed plan for responsible development and stewardship of the Hellbranch Watershed. Work completed as part of the Hellbranch Watershed Forum effort has been incorporated into the Big Darby Accord effort.

Planning Area

The Big Darby Watershed covers 555 square miles of central Ohio just west of the Columbus metropolitan area (see Figure 1.1). Big Darby Creek originates in Logan County and flows more than 80 miles before joining the Scioto River near Circleville, Ohio. Land use is predominately row crop agricultural, except for the watershed's suburbanizing eastern edge along the border of Madison and Franklin Counties, and in Union County.

The Big Darby Accord planning area (shown in Figure 1.3) is 84 square miles in size, or about 56,000 acres, and represents about 15% of the total watershed. Major stream corridors within the planning area include Big Darby Creek, Little Darby Creek, Hellbranch Run, Clover Groff and Hamilton Ditches (herein referred to as Runs).

The Big Darby Accord planning area encompasses the portion of the Big Darby watershed within Franklin County and includes the area associated with the City of Columbus' adopted Hellbranch Run Watershed Protection Overlay and the established Environmentally Sensitive Development Area (ESDA). The limits of the planning area are primarily defined by the US Geological Survey hydrologic unit code boundary for the Big Darby Creek Watershed in Franklin County. Those limits have been refined and extended by using the 2-foot contour interval mapping published by the Franklin County Auditor. It is recognized that some sites located at the eastern edge of the planning area may not actually be part of the Big Darby watershed. It is not the intent of the Accord that the plan's provisions apply to sites outside of natural drainage area of the Big Darby Watershed. This will require consideration on a site-by-site basis during the implementation process.

Aside from the County which includes all jurisdictions, the largest jurisdiction by land area within the planning area is Pleasant Township with 24,000 acres, or 45% of the planning area. Grove City, although part of the Accord, does not have any land within the actual planning area boundary. Figure 1.2 shows the acreage for each jurisdiction based on GIS mapping.

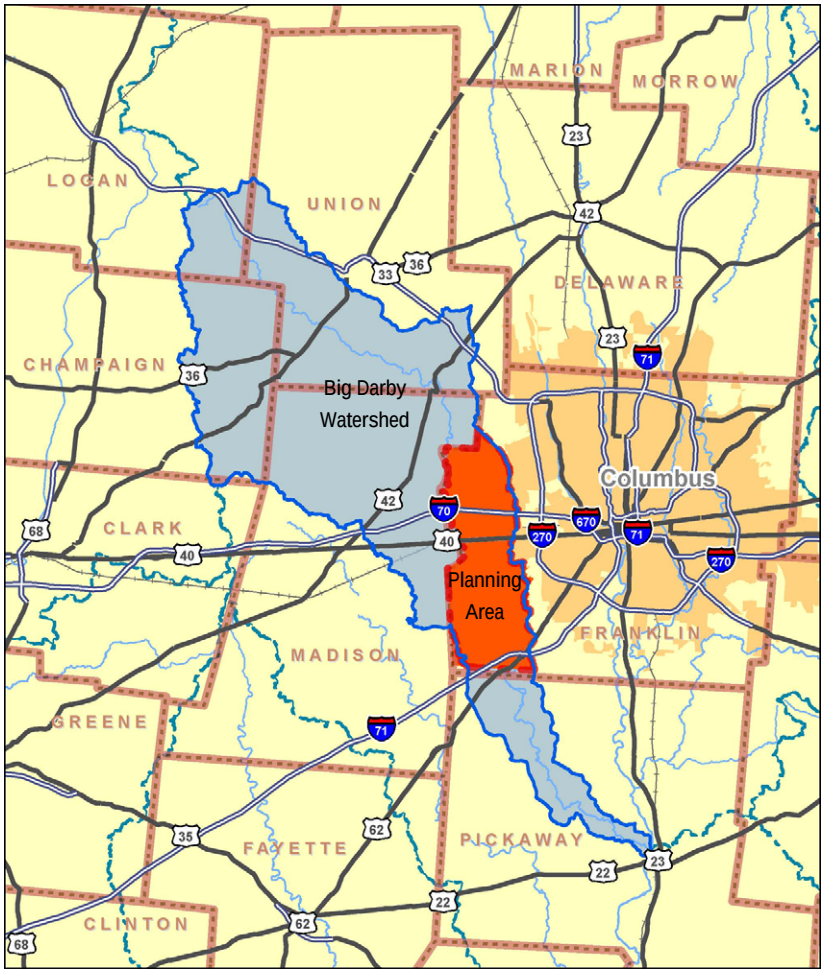
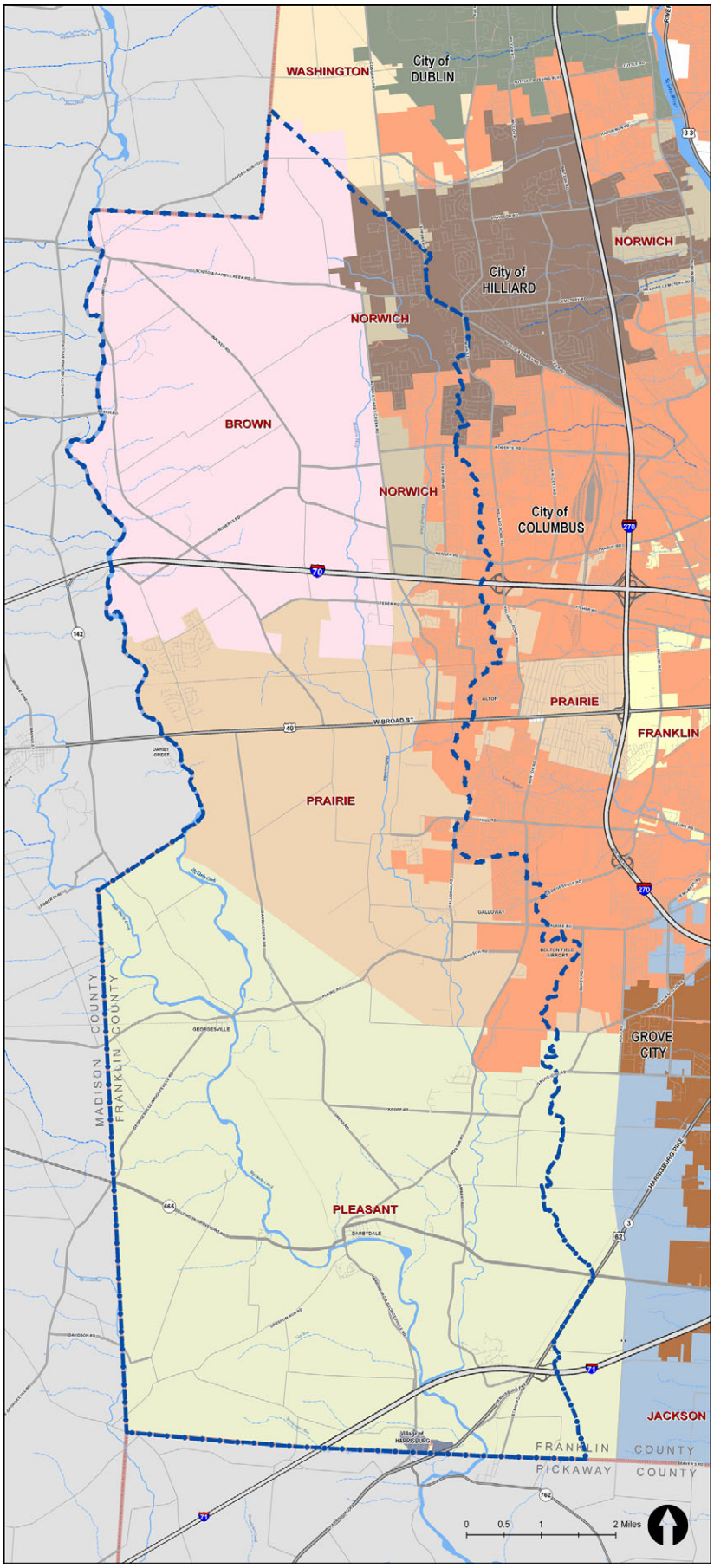


Figure 1.1 Planning Area (orange) within Big Darby Creek Watershed (blue)
Source: EDAW



Jurisdiction	Acres	% of Planning Area
Brown	13,840	25.67
Norwich	1,025	1.90
Prairie	10,530	19.53
Pleasant	24,018	44.54
Washington	8.7	0.02
Columbus	3,102	5.75
Hilliard	1,209	2.24
Harrisburg	82	0.15

Figure 1.2 Acres Per Jurisdiction within Planning Area
Note: Acreages are estimates.

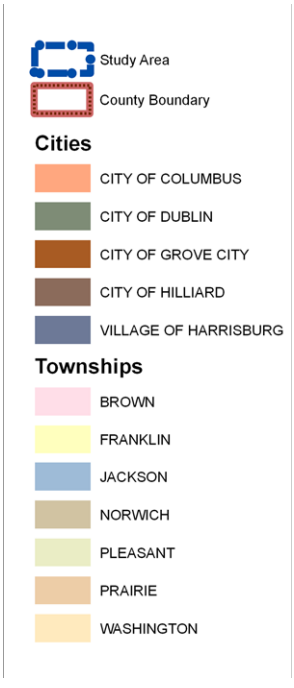


Figure 1.3 Accord Jurisdictions and Planning Area

Mission Statement

The Big Darby Accord consists of local governments within the Franklin County area of the Big Darby Creek Watershed. The mission of the Big Darby Accord is to cooperatively develop a multi-jurisdictional plan and accompanying preservation and growth strategies, capable of implementation, oversight, and enforcement, which are designed to:

- **Preserve, protect and improve, when possible, the Big Darby Watershed's unique ecosystem by utilizing the best available science, engineering and land use planning practices;**
- **Promote responsible growth by taking measures to provide for adequate public services and facilities and promote a full spectrum of housing choice, as well as adequate educational, recreational, and civic opportunities, for citizens of each jurisdiction and for Central Ohio;**
- **Create a partnership that recognizes the identity, aspirations, rights, and duties of all jurisdictions and that develops methods of cooperation among the partners through means which include the cooperative utilization of public services and facilities; and**
- **Capitalize on the results of other efforts by considering local comprehensive plans, as well as the work of the Environmentally Sensitive Development Area External Advisory Group, the Hellbranch Watershed Forum, the 21st Century Growth Policy Team, and other local planning and zoning efforts, in the development of the plan.**

1.2 Big Darby Accord Plan Principles

The Accord has developed a set of Plan Principles that has guided the development of the Plan. The principles have been instrumental in achieving consensus among the Accord jurisdictions and have directly shaped the land use map and planning process. As the Accord moves forward to implement the Plan, the Plan Principles will provide direction for decision making to local officials and to the public to ensure that actions, both individually and collectively, are achieving the Mission of the Accord.

Protection of environmentally sensitive areas

The general land use plan protects environmentally sensitive areas in a green infrastructure of approximately 20,000 acres. The green infrastructure includes floodplains, wetlands, groundwater and surface flow exchange areas, special habitat areas, wooded areas, and areas with groundwater pollution potential. These elements contribute to the Darby's unique ecosystem and should be protected and preserved according to the mission statement, Accord recommendations, and regulatory requirements, such as Ohio EPA's (OEPA) 208 plan.

A general land use plan that balances environmental protection and responsible growth

Development is managed and focused in a sustainable town center and a range of conservation-style development patterns, which will create opportunities for open space preservation. The land use pattern offers a mix of uses, maximizes access to infrastructure, and guides development to less sensitive areas. This approach promotes a responsible growth pattern as recommended in the mission statement.

A general land use plan that recognizes existing sewer and wastewater treatment capacities, while taking into account the rights accorded watershed landowners under current zoning

The plan will work within the limits of existing sewage conveyance system and treatment capacities. At the same time, the plan will recognize zoning and development rights that are currently in place. The plan will identify practical and equitable mechanisms of preserving these rights while striving to protect water quality by focusing density in key locations. Through this approach, the plan will seek a balance on both a regional and project-specific basis where appropriate.

Growth areas will be served by adequate public facilities, particularly central sewer

Central sewer service is planned for identified growth areas including the town center and existing contract service areas pending available capacity. Central sewer service is not planned, or anticipated for, a majority of the planning area, including areas associated with lower density conservation development. Non-centralized services would be subject to standards and inspection programs to ensure the systems are functioning properly. Such a program should be consistent with Accord recommendations and regulatory requirements, such as Ohio EPA's 208 plan.

A development policy that provides for mechanisms to acquire environmentally sensitive areas

Development of policies and procedures that link new development to the provision of green space within the environmentally sensitive areas of the land use plan, both regionally and within the same site, is encouraged. These green spaces would provide permanent protection of the environmentally sensitive resources.

A memorandum of understanding (MOU) among Accord members to implement the agreed upon plan

The MOU represents a commitment to continue to implement the plan and work together to leverage resources. The MOU encourages consistency and compliance across political boundaries. As a primary step in a long-term implementation process, the MOU underscores the importance of adaptive management techniques to monitor plan implementation.

Development without the condition of annexation

The City of Columbus is offering the limited extension of water and sewer services without the condition of annexation. As part of the Accord process, the City of Columbus is identifying conditions that must be met to qualify for utility extensions into unincorporated areas. This will require consideration of existing utility contracts, design and cost implications, capacity, provision of a full range of housing options, revenue sharing and compliance with Accord provisions.

Mechanisms for cooperative revenue sharing among Accord members

Through the creation of joint economic development districts (JEDD), cooperative economic development agreements (CEDA), and/or community authorities, Accord members can structure specific agreements to allow revenue sharing across political boundaries as development comes on line. Cooperative agreements and new revenues can be established to help provide community resources and amenities and to initiate joint projects in the planning area, including open space. The general criteria may include, among other things, establishing an amount of millage to be collected by a Community Authority and the manner in which the proceeds would be used.

Water quality, biological integrity, and adaptive management

This plan relies on the principle of adaptive management, an ongoing process. This includes prediction, monitoring, inspection, enforcement, and ongoing planning to continue to maintain and pursue aggressive Ohio EPA water quality goals that will improve the water quality and biological integrity of the Big Darby Watershed. Pursuit of this objective is balanced with the understanding that, while Accord provisions can apply to the entire watershed, they can only address the Franklin County portion of the overall watershed.

Source: EDAW

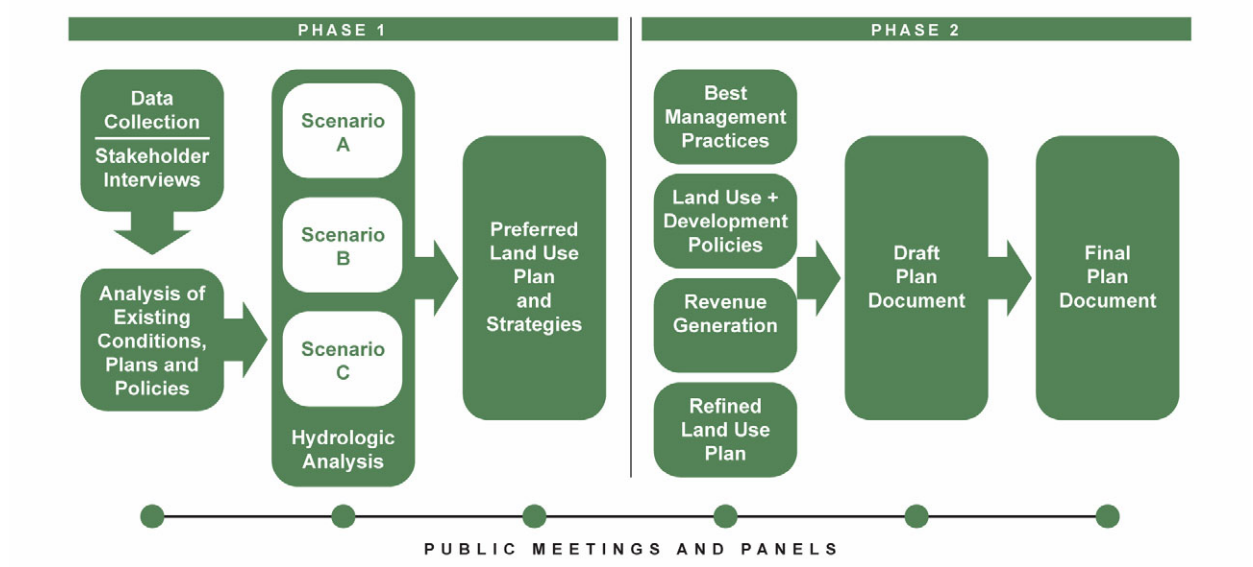


Figure 1.4 Big Darby Accord Planning Process Diagram

1.3 Planning Process

The Big Darby Accord planning process was initiated in April 2005. The ten jurisdictions that form the Accord have guided the planning process with the help of a subcommittee, referred to as the Group of Four (G4). The G4 representatives were ambassadors of the process, guiding the consultant team, communicating with the public, and conveying feedback from all ten jurisdictions into the process.

Figure 1.4 represents the overall planning process from initiation to plan completion.

Phase 1

- Data collection, outreach and stakeholder interviews
- Inventory and analysis of existing conditions, plans, and policies
- Land use scenario development and hydrological model application
- Development of preliminary land use plan map

Phase 2

- Best management practices analyses
- Tools and programs for conservation and development
- Revenue generation and agreements
- Draft Plan development
- Final Plan

The planning process has included a variety of opportunities for public feedback including stakeholder interviews, small focus groups, four public meetings, a project website (http://www.franklincountyohio.gov/BigDarbyAccord), email notifications, press releases, a hotline number, and mailings. In addition, events such as panel discussions have been sponsored by individual jurisdictions and other organizations to provide education and outreach to interested citizens on planning topics that relate to the future of the watershed. Interest in the Accord process has been strong with good attendance at public events.

In addition, a stakeholder group comprised of representatives from various agencies met consistently over the course of the planning effort to provide guidance to the planning team and Accord jurisdictions. Members included representatives from the Ohio Department of Natural Resources; Ohio Environmental Protection Agency, Metro Parks, Darby Creek Association; The Nature Conservancy; Franklin Soil and Water Conservation District; Columbus and Franklin County Housing Trust Corporation; Building Industry Association of Central Ohio; and United Way of Central Ohio.

Combined, these efforts have reached residents and interested citizens and generated healthy dialogue around key plan issues. This input has directly shaped the

June 2005 Accord Public Meeting
Source: EDAW

Big Darby Creek Tributary
Source: The Nature Conservancy/Anthony Sasson

plan and guided policies and standards that are described in the following sections of this plan. The Accord process is an example of a successful regional collaborative planning process that should be considered throughout the Darby Watershed.

The Big Darby Accord Plan is intended to serve as a multi-jurisdictional guide for development and conservation.

It is the goal of the Accord that each jurisdiction work towards adoption and implementation of the plan and its provisions. It is recognized that application of the Plan at the local level will require flexibility to allow for varying and unanticipated circumstances. Plan implementation will also require monitoring and periodic updates to ensure currency.

Adoption of this Plan at the local level will require a process that meets each jurisdiction's requirements for policy adoption. It is anticipated that adoption will include additional public meetings, and input and endorsement by the locally elected officials. Following the adoption of the Big Darby Accord Plan, each jurisdiction will then need to review their zoning code to determine how to implement the land use plan. This too will involve a process of public discussion and endorsement by the locally elected officials.

The Big Darby Accord Plan will be implemented over the next twenty to thirty years; therefore, the plan has built-in flexibility to adapt to changing community needs and new technologies.

Implementation efforts among the Accord jurisdictions, partner agencies and organizations, and property owners are already underway. The success of this planning effort will lie in the ability of the Accord and others to work together in the pursuit of the Mission. Over time this plan will need to be updated to adapt to new technologies and changing land uses to ensure water quality goals are being met and programs and policies are relevant. This planning effort should serve as a model for cooperative planning in the watershed.

1.4 Report Format

This document is set up in five sections and an appendix, briefly described as follows:

Section 1: Introduction – provides an overview of how the planning process was initiated, describes the Accord Mission and Principles and the plan process.

Section 2: Plan Framework – describes the factors instrumental to the development of the land use plan including natural resources, available infrastructure and current policies.

Section 3: Land Use – identifies the conservation and development strategy for the planning area.

Section 4: Policies – sets forth policies that will be needed in order to meet the Mission and implement the plan related to open space, development, water quality, and coordination.

Section 5: Implementation – identifies a series of programs and revenue sources for plan implementation.

Appendix: The appendix is structured to provide background information that supports the plan recommendations. Appendices A through F provide additional information related to water quality, funding, planning data sources, development review, considerations for a stormwater utility and draft recommendations related to alternative community wastewater systems.

2.0 Plan Framework

The Big Darby Accord Plan has been developed to provide a proactive approach to managing development and ensuring the protection and improvement of water quality and aquatic habitat in the Big Darby Creek watershed. The Plan provides guidance for how and which land should be developed, preserved, and protected. The Plan, similar to a comprehensive plan, provides land use and policy guidance for changes in land use over time.

As discussed in the Darby Accord Mission Statement, the Big Darby Accord Plan seeks to balance development with protection of the Big Darby Watershed. In developing the general land use plan, a significant amount of existing conditions data was reviewed and additional analyses were completed. Information reviewed included:

- Natural resources including streams, soils, floodplain, wetlands, vegetation, hydrology and other sensitive resources
- Current policies and plans including land use, zoning, and comprehensive plans
- Water quality trends and impacts associated with existing and proposed land use changes
- Physical conditions such as existing and planned infrastructure (e.g., roads, central sewer systems)
- Current local and state regulations

Review and analysis of available information resulted in the identification of "plan drivers," or significant factors that affect the amount of development that the area could achieve and still provide protection for the Big Darby Watershed. These drivers have influenced land use and policy recommendations and represent both opportunities and constraints. The drivers have largely shaped the Plan and will continue to be factors as plan implementation is initiated.

The drivers, described further in the following sections, provide a solid framework for the formation of a conservation strategy, the general land use plan and implementation strategies. Drivers include:

1. *By-Right Zoning – the allowable level of development established by current zoning*
2. *Infrastructure*
3. *Environmental Sensitivity Analysis*
4. *Water Quality and Biology*

2.1 By-Right Zoning

Zoning codes and regulations dictate permitted land uses and the maximum amount of development that can occur within a given area. As a result, zoning has one of the largest impacts on existing land use patterns. Zoning regulations within the planning area vary by jurisdiction and are therefore difficult to summarize in a comparative way. For example, low density residential development means one thing to the City of Columbus and something else to an unincorporated area of Franklin County. Today, the Cities of Hilliard, Columbus, and Grove City as well as Prairie and Washington Townships administer their own zoning regulations. The remaining jurisdictions, Brown, Norwich, Pleasant, and the Village of Harrisburg, follow the Franklin County Zoning Resolution (though Harrisburg is in the process of creating their own code).

Population Growth

It is worth emphasizing that the current land use and zoning policies allow for a significant amount of future development to occur within the planning area. Additional households will bring an increase in population. A comparison among several reports about population growth reveals a consistent belief that the central Ohio region will continue to grow over the next twenty to thirty years. The exact rate of growth is difficult to determine and often varies among agencies and experts because population growth is dependent on many factors. However, it is reasonable to expect that a certain amount of growth is inevitable. The economies of the central Ohio area continue to expand by attracting more jobs and people to fill those positions. This trend results in an increased demand for housing and services including transportation, schools, community facilities, and other basic services.

The most widely referenced source for population information is the US Census that occurs every ten years. Many other studies use US Census data as a baseline to

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formulate population projections. Ohio County Indicators and Ohio County Profiles, prepared by the Office of Strategic Research, Ohio Department of Development, project population for each county in Ohio through 2030. Population forecasts by the Office of Strategic Research are based on 2000 Census data and are provided in five year increments. Projections are based on assumptions about trends in fertility, mortality, and net migration.

According to the Office of Strategic Research, Franklin County is projected to continue to grow to a total population of 1,326,180 in the year 2030 (Figure 2.1). This represents a 20% increase over year 2000 population levels. Some of the projected growth will occur within the planning area and local zoning and comprehensive plans in the planning area have policies in place to allow for development.

Year	Office of Strategic Research Projected Population	% Change from 2000
2000	1,068,978	0%
2005	1,112,880	0.0%
2010	1,155,910	4.1%
2015	1,195,310	8.1%
2020	1,238,250	11.8%
2025	1,281,760	15.8%
2030	1,326,180	19.9%

Figure 2.1 Franklin County Population Projections

Sources: Ohio Office of Strategic Research, 2003.

Jurisdiction	Median Year Structure Built	* Owner Occupied Housing Median Value 1990	2000	% Change	Housing Units 1990	2000	% Change
Brown	1977	$116,600	$193,900	66.3%	620	709	14.4%
Norwich	1987	$88,800	$158,000	77.9%	1,598	1,450	-9.3%
Prairie	1966	$63,400	$91,800	44.8%	6,629	6,954	4.9%
Pleasant	1974	$92,600	$135,900	46.8%	2,222	2,507	12.8%
Washington	1981	$162,700	$109,200	-32.9%	736	464	-37.0%
Grove City	1977	$74,900	$119,800	59.9%	7,675	10,712	39.6%
Hilliard	1991	$72,600	$157,600	117.1%	4,556	8,957	96.6%
Harrisburg	1940	$62,000	$92,000	48.4%	137	140	2.2%
Columbus	1970	$65,300	$101,400	55.3%	277,744	323,236	16.4%
Franklin County	-	$73,300	$116,200	58.5%	405,418	471,016	16.2%
Ohio	-	$62,900	$103,700	64.9%	4,371,945	4,783,051	9.4%

Figure 2.2 Housing Characteristics

Sources: US Census, 1990 and 2000. **These numbers reflect entire jurisdictions and not just the planning**

Housing

Within Ohio, an increasing trend shows that land in active agricultural use is declining and the amount of agricultural land that is non-cultivated is increasing. Recent development patterns within the planning area reinforce this trend as agricultural lands are being converted to other uses, primarily low-density housing (Growth and Change at the Rural-Urban Interface, 2003). The trend for large-lot residential developments is occurring throughout the planning area as subdivision practices produce 5 to 20 acre lots along rural roads. Existing zoning regulations have helped define the existing landscape and promoted a rural pattern of development that is highly consumptive of land.

According to the US Census, Franklin County is growing faster than the state in housing units. Both Franklin County and the City of Columbus experienced a 16% increase in housing units from 1990 to 2000, well above the 9.4% at the state level. Annexation policies have contributed to increases in housing units for incorporated areas and a loss of housing in unincorporated areas. Housing units in the City of Hilliard almost doubled from 1990 to 2000, marking an explosive growth period for the City and increased demand for services to meet the influx of residents. Recent initiatives in Hilliard have dramatically curtailed the residential growth rate. Jurisdictions marking decreases in the number of housing units, most likely due to loss of land through annexation, include Washington and Norwich Townships.

Housing units are rising in value and continue to exceed the owner-occupied median value of homes around the state (Figure 2.2). With the exception of Washington Township, all jurisdictions experienced an increase of housing values between 46 and 117%. Housing values show that homes located in the northern part of the planning area, specifically the City of Hilliard, Brown, and Norwich Townships, maintain the highest owner occupied median home values within the planning area. Homes in this area experienced the most increase in value between 1990 and 2000.

Future Level of Development

As future land uses were considered, it became increasingly important to identify an overall level of growth that would be appropriate for the Franklin County portion of the Big Darby Watershed. Residents expressed a desire to retain the rural character of the area and to encourage a higher standard of development that would protect water quality.

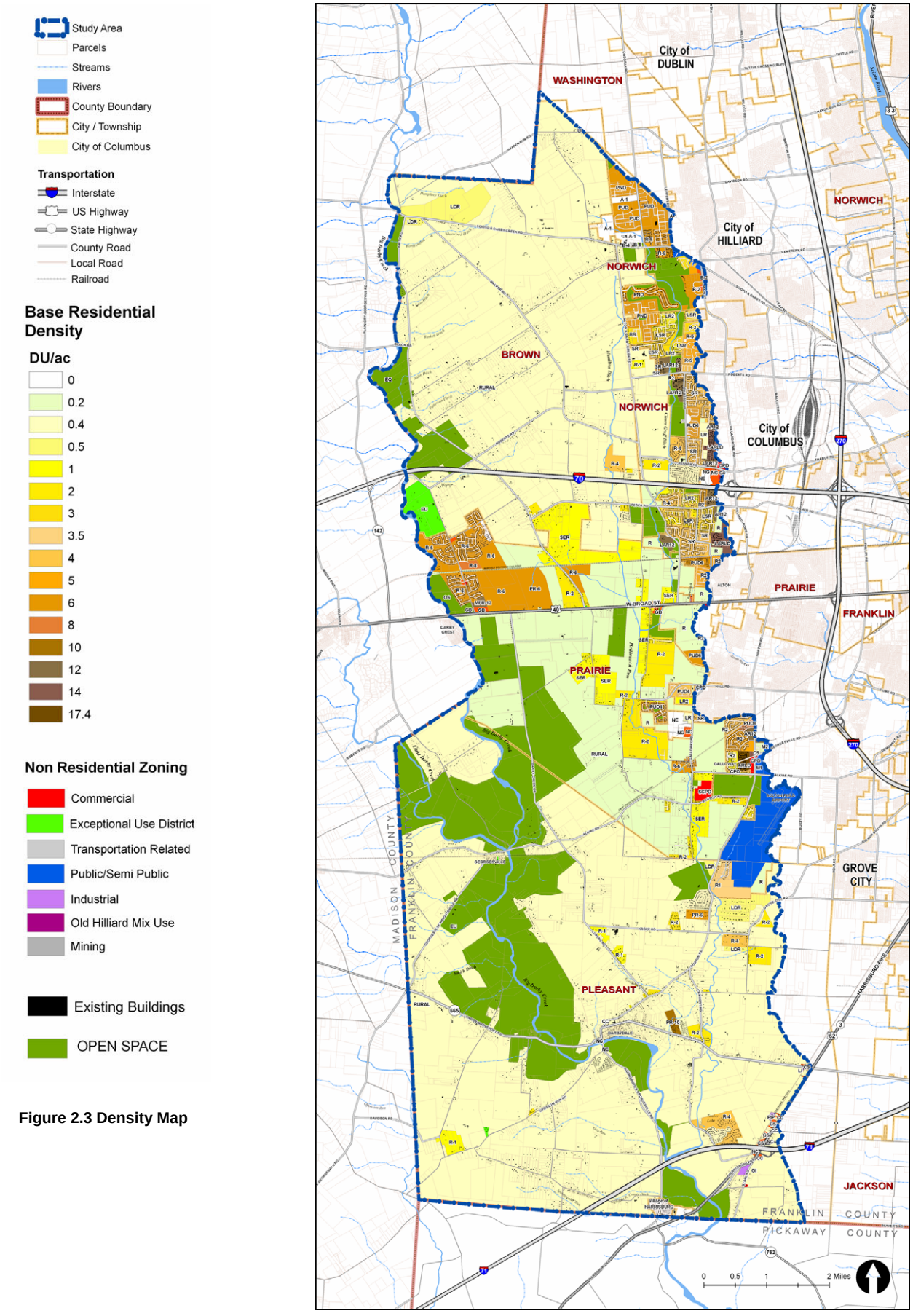


Figure 2.3 Density Map

Accord jurisdictions have endorsed the concept of allowing for a similar level of overall development within the planning area that is currently allowed under the existing zoning. Referred to as "By-Right Zoning," this concept recognizes the zoning densities that are in place today as a baseline for overall future development. Current zoning policies related to density, shown in Figure 2.3, favor a low density development pattern distributed across the planning area. Pockets of higher density are located along the eastern edge and along West Broad Street. Further analysis reveals that if the current policies were carried, approximately 20,000 dwelling units could be developed within the planning area in a dispersed pattern; the Accord Plan proposes a similar level of development, but in a pattern that is more manageable, sustainable, and environmentally sensitive.

The proposed plan, described in Section 3.0, focuses density in a areas along the eastern edge of the planning area adjacent to the Cities of Hilliard and Columbus and suggests a higher density "Town Center" between I-70 and US 40 (West Broad Street). The Town Center location is based on the availability of central sewer service, existing road infrastructure, and reduced concentrations of environmentally sensitive resources.

Based on analysis, it is estimated there are 19,000 existing housing units within the planning area today. Based on a conservative assumption of 2.58 people per household, this equates to an existing population of approximately 49,000. As stated above, current policies allow for additional growth of approximately 20,000 dwelling units, or 51,000 additional people. Overall, when combined, the long-term build based on the by-right concept is approximately 100,000 people. Development potential will be constrained by environmental and infrastructure considerations, including the ability to properly permit and regulate non-centralized sewer systems. New standards, policies, and programs identified elsewhere in this plan will be needed to properly manage new development in a way that enhances quality of life for people and the environment.

2.2 Infrastructure Considerations

Access to adequate facilities is an essential ingredient in identifying appropriate growth areas. Two major factors have surfaced as primary infrastructure considerations: sewer capacity and service area, and existing and planned roadway infrastructure.

Sewer Service

The Accord planning area lies within the City of Columbus' Regional Facility Planning Area (RFPA), as designated by the Ohio EPA's (OEPA) 208 Plan, which also identifies the City as the Designated Management Agency (DMA) responsible for providing sewer service within this area. All sewages collected by the City of Columbus within this area would be conveyed to and treated at the Southerly and Jackson Pike wastewater treatment plants, which discharge directly to the Scioto River. As a separate incorporated area, the City of Hilliard has a sewer service contract with the City of Columbus. Under the terms of that contract, Hilliard owns and maintains sewer lines within their municipal boundary but relies on Columbus for wastewater treatment.

Within the Accord planning area, the 208 Plan also identifies an area surrounding Lake Darby Estates, immediately west of and overlapping with a portion of the town center, as a sub-Regional Facilities Planning Area and designates Ohio American Water as the DMA for that area. Ohio American Water operates a wastewater treatment plant that is exclusive to the designated sub-regional area and that discharges directly to Big Darby Creek.

Another DMA within the Accord planning area is the Franklin County Sanitary Engineer's Department, which operates several smaller wastewater treatment facilities scattered throughout the planning area, including a new 0.3 Million Gallon per Day (MGD) Wastewater Treatment Plant near the unincorporated Village of Darbydale. The facility became operational in the summer of July 2005 and serves the unincorporated Village of Darbydale, the Oak Hills Mobile Home Park (MHP), the Community Gardens MHP, the Pleasant Acres MHP, and the Darbydale Elementary School. In addition, the Franklin County Sanitary Engineer will serve the Timberlake subdivision through the Darbydale WWTP, thereby allowing the previously operating Timberlake WWTP to be eliminated. The service area for the Darbydale WWTP is set forth in the Ohio EPA Director's Final Findings and Orders (DFFO), which was issued to the County Commissioners for sewage treatment problems in the Darbydale area. Only those specific properties enumerated within the Orders will be served, expanded to include the Timberlake subdivision.

The Village of Harrisburg has approached Franklin County regarding the possibility of sewage service through the Darbydale WWTP. The County Sanitary Engineer has noted that the WWTP has sufficient capacity to serve the existing village but, in doing so, would reduce the capacity of the plant to service other areas. It is anticipated that the County will agree to provide service to the Village and would coordinate with the Ohio EPA to ensure conformance with the provisions of the 208 Plan regarding the expanded service area.

Under the 208 Plan, neither Ohio American Water nor the County Sanitary Engineer is permitted to provide sewer service beyond their presently designated service area without the appropriate authorization. Figure 2.4 shows the sewer service areas for the planning area.

In addition to the authorities responsible for providing central sewer service within the Accord planning area, the Franklin County Board of Health is responsible for the permitting and oversight of on-lot septic systems, also referred to as household sewage treatment systems (HSTS) or household sewage disposal systems. HSTS applications are predominantly leach field or home aerator type systems. In either case, there is often a physical connection between that system and stormwater drainage, such a roadside ditch or field tile.

Sewage Treatment Alternatives

Development within the Accord planning area can be serviced through various means of sewage treatment. Despite the current zoning, the location of a development site, physical limitations of soil types and groundwater depth, and the type and density of the development all have an impact on the form of sewage treatment that is appropriate and possible.

Connection to an Existing Central Sewer System

The City of Columbus owns and maintains the Big Run sanitary trunk sewer, which is located along Broad Street and terminates near the eastern boundary of the Accord planning area. The City also owns the Roberts-Millikin sanitary sub-trunk sewer located along Roberts Road which also terminates near the eastern boundary of the planning area. Both of these sewers are shown on Figure 2.4.

The current capacity of each of these sewer lines is a limiting factor in the amount of development that can occur in these areas. If any additional capacity in those systems becomes available in the future it will also affect the timeframe of when development occurs.

An initial capacity analysis of each of these sewer systems was conducted to determine the extent to which additional development within the planning area could be accommodated within the constraints of those systems. The City of Columbus has determined that the capacity of the Big Run sanitary trunk sewer would currently allow for receiving 5,000 additional equivalent dwelling units from the Town Center portion of the planning area. The Columbus sewer system may also have additional capacity for some areas closer to the existing system, currently annexed or zoned for development, in a manner consistent with the Accord general land use plan. Central sewer service would also be provided in a manner consistent with the general land use plan to the Hilliard Growth area and LEED area. Analysis performed for the Roberts Millikin sanitary sub-trunk sewer shows an ability to provide sewer service 2,000 equivalent dwelling units in the Hilliard growth area. This system could also provide capacity for approximately 1,400 equivalent dwelling units in what has been referred to as the LEED area east of Alton and Darby Creek Road and south of Roberts.

Development of Community-based Alternative Sewage Treatment Systems

For areas beyond that which would be served by a central sewer system, a separate option for treatment is necessary. To avoid the future proliferation of HSTS within the planning area, efforts are underway to identify community-based applications that would offer a regional approach to providing sewer service. The intent of these applications would be to collect sewage from a regional area for transport to a location that is viable for lagoon and land application types of sewage treatment, avoiding a direct discharge to any watercourse. Presently, separate technical and regulatory committees formed of local officials and experts in alternative treatment systems are convening to consider the details of the standards and regulatory requirements related to these types of systems. The goal is to identify a community-based authority to own and operate these systems, using an existing DMA from the 208 Plan as that authority. Appendix F includes draft recommendations put forth by the Alternative Wastewater Treatment Technical Committee.

Application of on-lot systems
Inevitably, there will continue to be some form of development within the Accord planning area that includes individual on-lot systems. The committees referenced above are also looking at this issue and considering standards and regulations governing on-lot systems. Presently, these systems are under the authority of the Franklin County Board of Health and would remain under that authority.

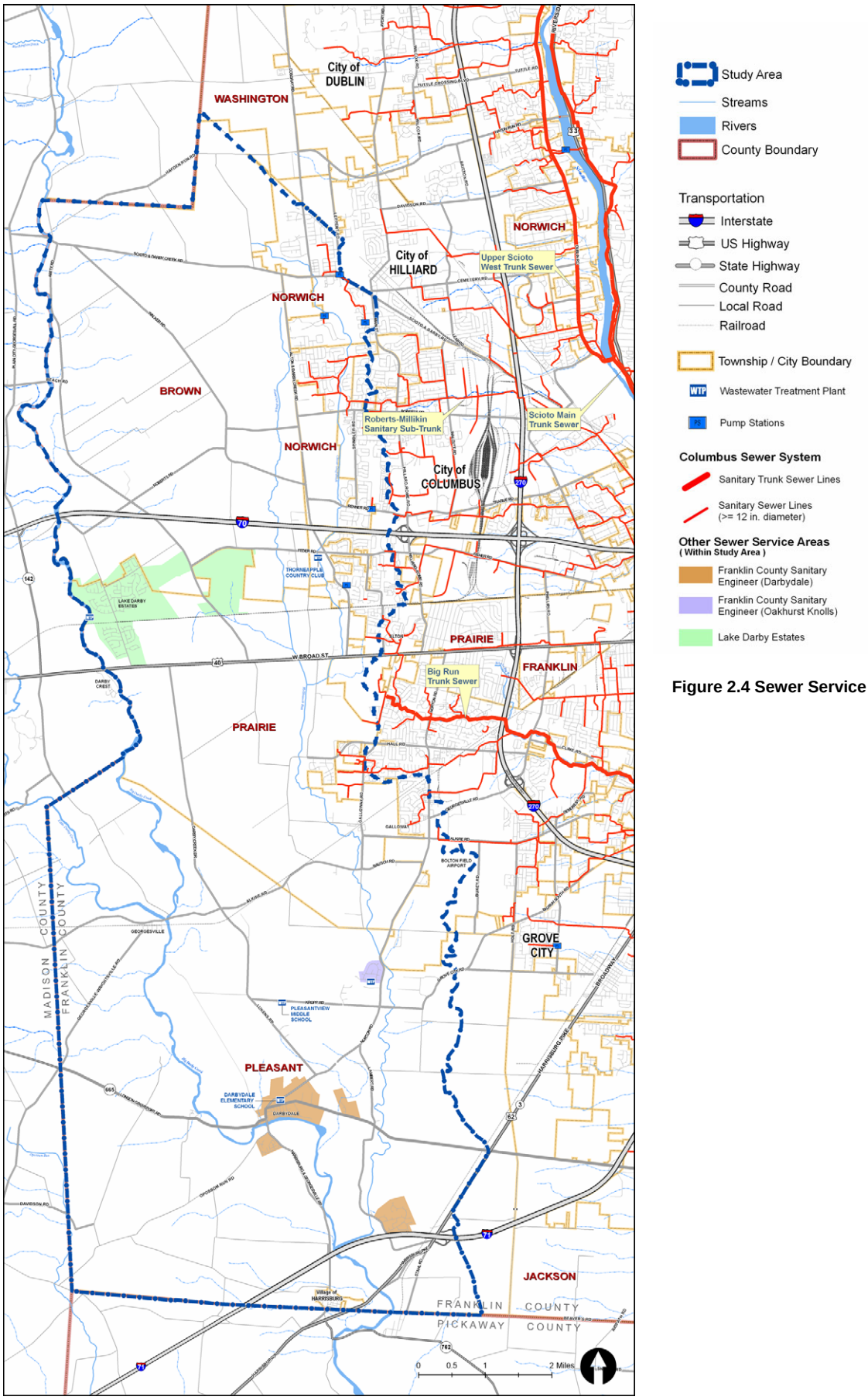


Figure 2.4 Sewer Service Areas Map

Transportation
This plan does not include a detailed transportation analysis or modeling of traffic impacts. However, a review of planned transportation projects is helpful in understanding future impacts related to new development.

The roadway system within the Accord planning area is primarily composed of two-lane rural roads. This is particularly the case for the roadway systems west of the Cosgray Road/Alton & Darby Creek Road corridors. As annexations and developments have progressed westward and reached the Cosgray Road/Alton & Darby Creek corridor, roadway widening and intersection improvements have begun to take place along Cosgray Road and Alton & Darby Creek Road – and along north-south and east-west roadways east of this corridor.

A common approach to transportation planning applies a "planning level" assessment when relating 24-hour traffic volumes to the ability of a roadway to properly accommodate the traffic demands. This assessment relates traffic demands to level-of-service. Level-of-service (LOS) is based on a grading system which ranges from "A", or perfect operation, to "F", failing. An LOS "E" indicates that a facility is operating basically at capacity and the addition of more traffic will cause the facility to fail. When improvements are considered for the transportation system, the goal is to achieve an LOS "C" or "D" in the peak design hour through the 20-year life of the facility.

For planning level assessments, the 24-hour average daily traffic (ADT) relates to a service level as shown in Figure 2.6.

Based on analysis of data, none of the current ADTs on the two-lane roadways approach the 10,000 vehicle threshold. Therefore, the two-lane roadway system in the planning area is basically operating at a "C" level of service or better overall. This is not to say that there aren't some capacity problems at individual intersections. As intersection capacity problems begin to occur, the responsible public agencies have been adding turn lanes at intersections and installing traffic signals in some instances. A number of transportation improvement plans are identified on Figure 2.5 that were noted in the Franklin County Thoroughfare Plan, the 2006-2009 Transportation Improvement Plan (TIP), and the 2030 Transportation Plan.

The 2006-2009 TIP includes only two projects relative to the planning area that relate to minor widening and safety improvements to Scioto Darby Creek Road – along with improvements at the intersection of Scioto Darby Creek Road with Alton & Darby Creek Road.

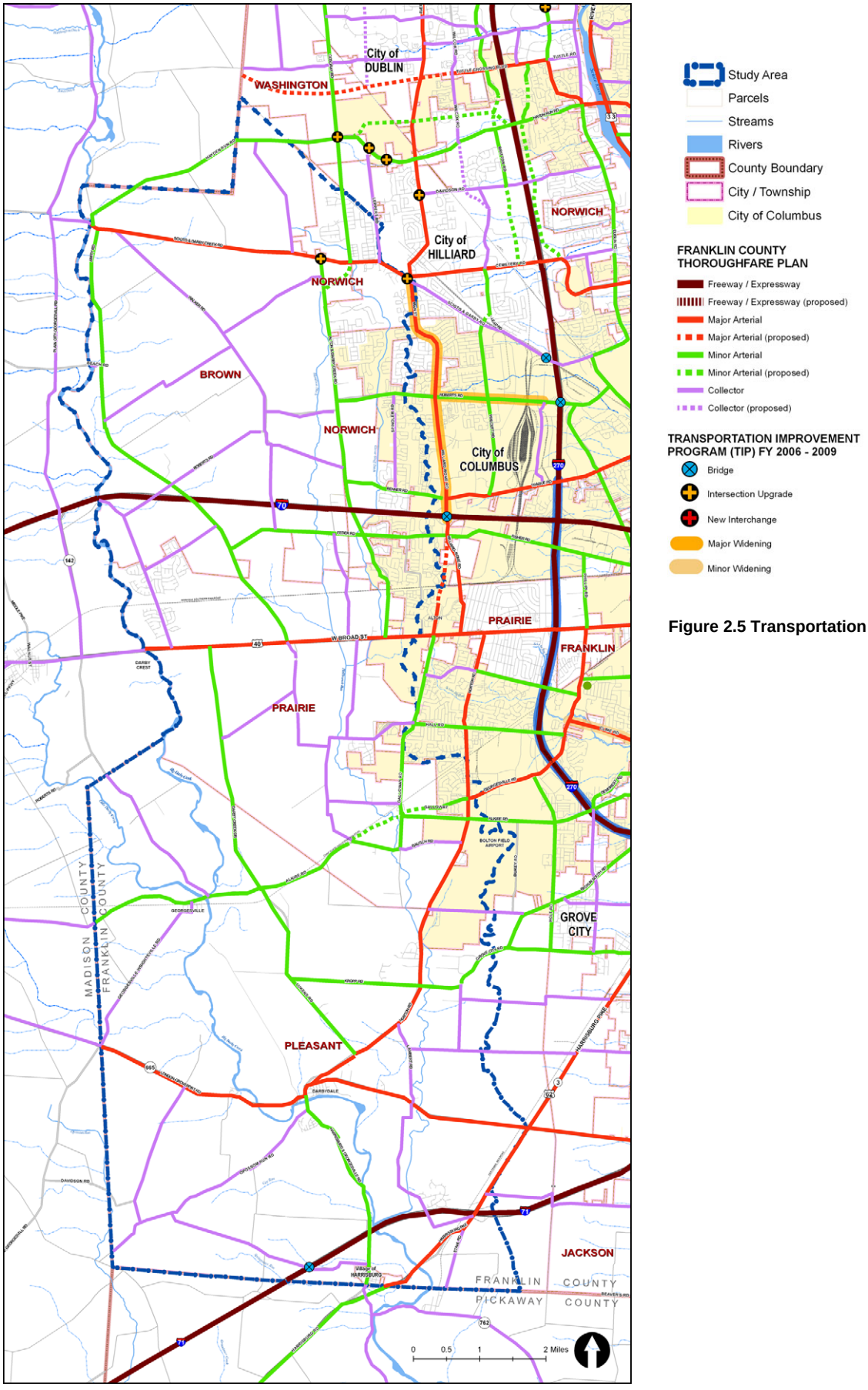


Figure 2.5 Transportation Map

Type of Facility	Max ADT @ LOS "C"	Max ADT @ LOS "D"	Max ADT @ LOS "E"
2-lane Roadway[2]	10,000	10,000 to 15,000[4]	15,000
4-lane Roadway[3]	20,000	25,000 to 35,000[4]	33,000 to 41,000 [4]
6-lane Roadway[3]	30,000	35,000 to 45,000[4]	50,000+[4]

Figure 2.6 General Planning Level Average Daily Traffic LOS Thresholds

*Assumes peak hour traffic is approximately 9% of daily traffic with approximately a 60/40 directional split.

[2]The threshold varies depending on the presence of a left turn lane at intersections or other access points.

[3] Assumes necessary turn lanes at intersections.

[4]The threshold varies depending on the volume of cross-road traffic needing to access the facility.

There are numerous projects listed in the 2030 Transportation Plan. Most of these projects relate to the Cosgray Road/Alton & Darby Creek Road corridor and areas to the east. Of significance are the proposed extensions of Alton & Darby Creek Road north and south, the connection of Alton & Darby Creek Road with Cosgray Road, and a couple of new roads related to the southern extension of Elliott Road. Improvements are called for at the intersections of Walker Road with Roberts and Amity Roads, and safety improvements are called for along Alkire Road and Norton Road.

It should be noted that interchange upgrades are called for on I-270 at Cemetery Road, Roberts Road, and Georgesville Road, and on I-70 at Hilliard-Rome Road. These interchanges are already over capacity and severe congestion occurs. Of particular significance to the Accord planning area, the Hilliard-Rome Road interchange on I-70 realizes excessive traffic demands since it is the only interchange between Big Darby Creek and I-270. Significant additional developments west of the Alton & Darby Creek Road corridor will increase traffic demands on the east-west feeder roads (e.g. Feder and Renner Roads) and on already overloaded Hilliard-Rome Road.

A more detailed discussion of infrastructure policy considerations is included in Sections 4.0 and 5.0.

Hydro-geologic	Hydrologic	Ecologic
Groundwater and Surface Flow Exchange	Wetlands	Threatened and Endangered Species
Soils	Floodplains	Land Cover (Woodlands)
Groundwater Pollution Potential		Stream Attainment Levels

Figure 2.7 Environmental Sensitivity Analysis Resources

2.3 Sensitivity Analysis

The process for developing an evaluation system to identify environmentally sensitive areas in the planning area was a necessary first step in creating a land use plan. Existing landscape features, both natural and man-made provided a starting point to formulating future land use scenarios and were considered as the foundation for the land use alternatives developed during the planning process. Because of their complex qualities and their valued function in the watershed, environmentally sensitive areas are considered suitable candidates for open space, parks, or other preserved lands. The Big Darby Watershed is valued for its habitat systems, water quality, and ecology. Protecting these systems and ensuring their sustainability and improvement is a baseline consideration for the environmental sensitivity analysis and an overall goal of the Big Darby Accord Plan.

The environmental sensitivity evaluation process consulted a number of resources collected from multiple sources including an extensive amount of geographic information system (GIS) data. A list of the base GIS data that has been compiled as part of this planning effort is provided in the Appendix. To simplify and organize an evaluation system, the key resources shown in Figure 2.7 were considered as part of the environmental sensitivity analysis.

Environmentally sensitive areas were identified using the following three step resource-based evaluation method:
Step 1: GIS Data Layer Analysis
Step 2: Qualitative Assignment
Step 3: Merge and Join

Step 1: GIS Data Layer Analysis

Hydro-geologic, hydrologic, and ecologic resources were evaluated and in some cases further analyzed for specific information. Identifying areas that exhibit high and moderate degrees of ground and surface water flow exchange and groundwater pollution potential required a closer analysis of DRASTIC data from the Ohio Department of Natural Resources (ODNR). DRASTIC uses a numerical rating and weighting system that is combined with the seven factors to calculate a ground water pollution potential index or relative measure of vulnerability to contamination. DRASTIC factors include:

D – depth to water
R – depth to recharge
A – aquifer media
S – soil media
T – Topography (% slope)
I – Impact to Vadose zone media
C – Conductivity to the aquifer

Other analyses were conducted to extract highly erodible soils and soils with hydric components. Land cover, particularly wooded areas greater than three acres were identified as key areas for habitat and potential linkages in a green network that would contribute to overall ecosystems in place.

In isolation wooded areas may appear unimportant; however, this analysis is oriented toward creating future land use scenarios of which wooded areas and tree cover are considered valued components. Additional analyses were conducted to identify water quality factors that relate to environmental sensitivity. It is important to note that not all habitat and water quality factors translate to identifiable features on the landscape such as a wetland or floodplain. For example, aquatic life use attainment ratings for the Big Darby, Little Darby, Clover Groff, Hamilton and Hellbranch are identified and recognized, but are not specifically listed as factors because they are qualitative. However, the environmental sensitivity process does recognize the importance of protecting the aquatic environment through multiple avenues including the identification of floodplains and riparian setback zones and through the policy recommendations.

FEMA published floodplains are present along major stream corridors including Big Darby Creek, Little Darby Creek, Hellbranch Run, Clover Groff and the Hamilton Ditches (herein after referred to as Clover Groff and Hamilton Runs). To address stream corridors without FEMA floodplains, a calculated beltwidth has been applied to provide an offset from the centerline of the stream.

	High	Medium	Low
	Category 1	Category 2	Category 3
Hydrogeologic			
High Degree of Flow Exchange	H		
Moderate Degree of Flow Exchange		M	
High Groundwater Pollution Potential	H		
Highly Erodible Soils	H		
Areas with Hydric Soils			L
Hydrologic			
Wetlands	H		
FEMA 100 Year floodplain Boundary	H		
Beltwidth Calculated Buffer Zone	H		
FEMA 500 Year floodplain Boundary			L
Ecologic			
Federal, State Endangered	H		
State Threatened	H		
Species of Special Concern	H		
Wooded Areas 3 Acres or Greater		M	
Wooded Areas 0.5 to 2.99 Acres			L

Figure 2.8 Environmental Sensitivity Analysis Components and Categorization

Step 2: Qualitative Assignment

The key resource data layers were assigned a qualitative value of high, medium, or low, shown in Figure 2.8. A qualitative assignment was necessary to prioritize the environmentally sensitive areas in the planning area for their value in maintaining a healthy watershed and to begin to recognize degrees of sensitivity as they relate to proposed future land uses.

A highly sensitive value is associated with resources that relate to protecting water quality, both surface and groundwater, or critical habitat areas (threatened, endangered, or species of concern) for plant and wildlife habitat recognized by Federal or State agencies. Areas that exhibit a high degree of flow exchange or a high groundwater pollution potential due to hydro-geologic characteristics were ranked high. Linear features such as floodplains or beltwidths are also assigned a high value for their recognized value in maintaining healthy waterways, providing habitat areas in streams and along water ways, and minimizing flood damage and personal property loss.

Areas with a moderate degree of flow exchange between ground and surface water were assigned a medium sensitivity. In addition, wooded areas of three or more acres were assigned a medium value to emphasize their importance in providing habitat areas and creating a network of green corridors.

Those features assigned a low environmentally sensitive value relate to Hydric soils, land within the 500 year floodplain (beyond the 100 year floodplain boundary), and wooded areas between one half and three acres. Hydric soils compose a significant amount of land within the planning area and are a limiting factor for certain types of development. Soil type becomes of particular importance when dealing with alternative sewage treatment or on-lot septic systems and, therefore, should be addressed through the site development review and approval process. Hydric soils are not well-suited for septic systems because they encumber the treatment process and limit filtration of effluent. This process has identified hydric soils to understand how they relate to other environmentally sensitive areas. Development policies and regulations for best management practices and non-central sewer systems further address hydric soils.

All high, medium, and low environmentally sensitive areas should be considered as having important values worthy of preservation. The presence of environmental factors also correlates to potential problematic impacts for development.

Step 3: Merge and Join

The final step in the environmental sensitivity analysis created a composite map identifying all high, medium and low areas shown in Figure 2.9. Due to the existing predominantly low density development pattern, it was decided that existing development patterns should not be excluded from the environmental sensitivity process. Areas that are already developed may be suitable for mitigation techniques or other preservation efforts to enhance or protect identified sensitive resources.

Overall, 32,351 acres of environmentally sensitive areas were identified, covering 60% of the planning area. Of those resources identified through this process, about half are highly sensitive. The majority of those features in the high category are associated with high potential for groundwater and surface water flow exchange and high groundwater pollution potential. When combined, the high and medium sensitive areas account for about 19,000 acres within the planning area, or 35% of the planning area. The majority of resources within the low category are attributed to areas with hydric soils.

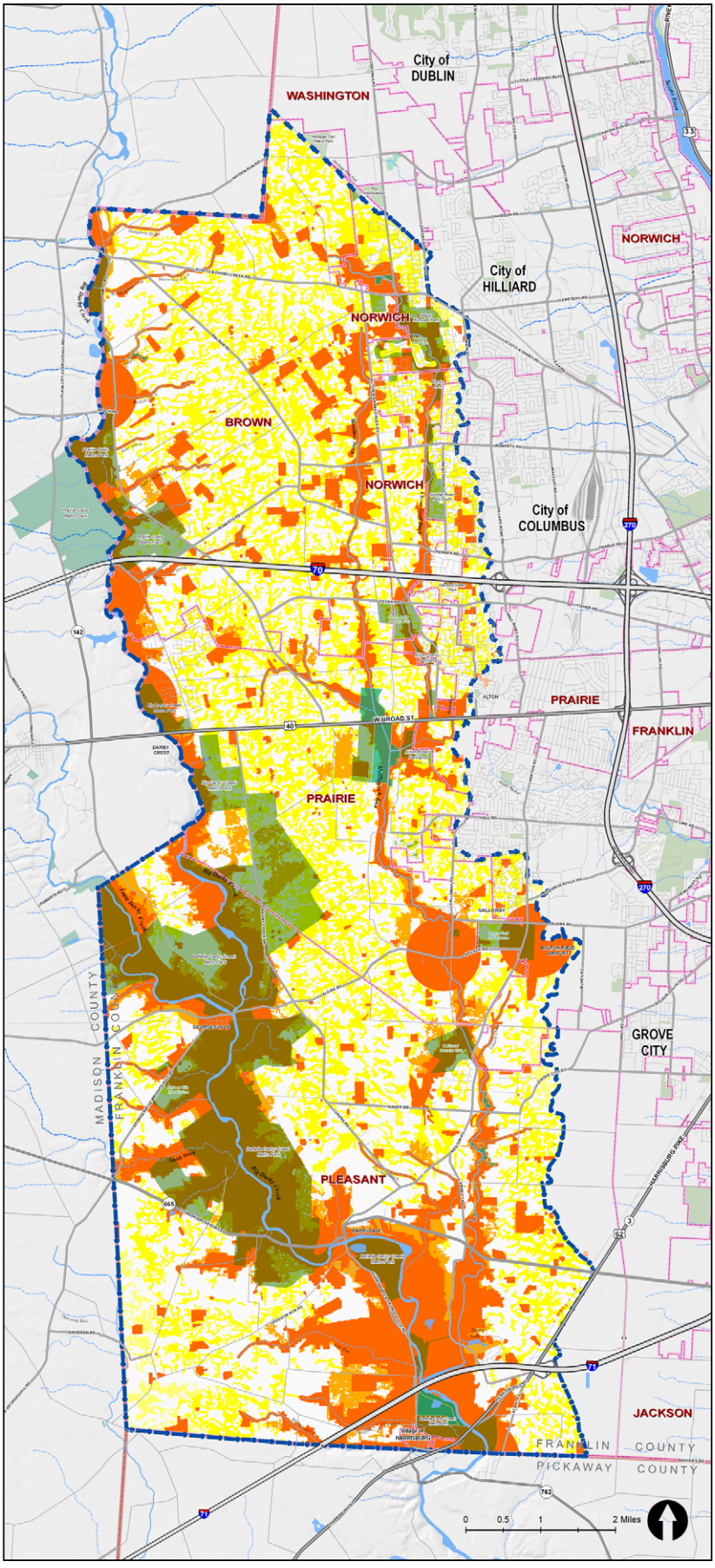


Figure 2.9 Environmental Sensitivity Map

A significant amount of land within the planning area, 7,399 acres, is already protected in a system of parks and easements, primarily Metro Parks along Big Darby Creek. Easements account for 145 acres held through Franklin Soil and Water Conservation District. Existing parks and protected lands provide an initial green network for the planning area and help provide protection to sensitive natural resources. For the purpose of this analysis, existing protected lands or open spaces includes park lands, easements, golf courses, and cemeteries.

Almost 22% or 7,000 acres, of the identified high, medium, and low sensitive areas are located within existing open space lands. This overlap is most apparent in the high category where over 5,000 acres of land is protected. Although this is commendable, more than 25,000 acres of sensitive areas remain unprotected, some of which have already been developed.

2.4 Water Quality and Biology

Generally speaking, Ohio measures the health of its streams by examining the number and types of fish and macroinvertebrates living within the water environment and sets specific standards for ensuring streams are meeting the requirements to sustain these life forms. The biological condition of streams is a direct indicator of the impact of surrounding landscape influences. This section discusses goals and programs tied to the improvement of water quality and aquatic life use attainment within the various watercourses in the planning area. Watercourses, including subwatershed boundaries and other hydrological resources are shown in Figure 2.10.

The term 'healthy stream' is used to describe a watercourse that meets a certain level of aquatic life use attainment and includes a diversity of qualifications. The concept of stream health can be generally distilled into four basic parameters: chemical water quality, morphology, habitat quality, and riparian and watershed quality. These parameters are interrelated and their combined effect influences the quality and diversity of the biotic communities (fish and macroinvertebrates) within the stream. In addition, the overall health of a stream is a determining factor in the amount of pollution the stream can assimilate without becoming a toxic environment for the biota within.

When addressing the issue of healthy streams within the Accord planning area, evidence shows a decline in the biological diversity of the aquatic ecosystem of Big Darby Creek and non-attainment of several key water quality parameters within the Hellbranch Run Watershed, which comprises a significant portion of the planning area.

Prior investigations into the biological diversity of the Big Darby Watershed have considered several indicators of stream health, including specific fish species, mussel communities, and macroinvertebrates. The composition of each of these communities is an indicator of the health of a stream, and declining populations and diversity of each can provide an indication of declining water quality. The trends in aquatic habitat are captured in the compiled scores for the Index of Biological Integrity (IBI) for fish, and the Invertebrate Community Index (ICI) for macroinvertebrates, throughout the watershed. Another method of assessing stream quality is the Qualitative Habitat Evaluation Index (QHEI), which is utilized to determine the relative quality of the physical habitat provided by the stream. This assessment evaluates the geomorphological condition of the stream by looking at channel substrate, morphology, and riffle structure, as well as assessing the associated riparian corridor and adjacent floodplain.

Long-ear Sunfish
Source: Metro Parks/Mac Albin

The Ohio EPA has performed extensive investigations and studies related to the water quality conditions to the Big Darby Watershed. These efforts culminated in the publication of the Total Maximum Daily Load (TMDL) report for the watershed (OEPA, 2006). The TMDL focuses on specific pollutant conditions and loadings in identifying the extent to which impairment existed throughout the watershed. The Hellbranch Run Watershed, which comprises approximately 46% of the Accord planning area, was identified within the TMDL as a significant source of Total Suspended Solids (TSS) and nutrient pollutants to Big Darby Creek.

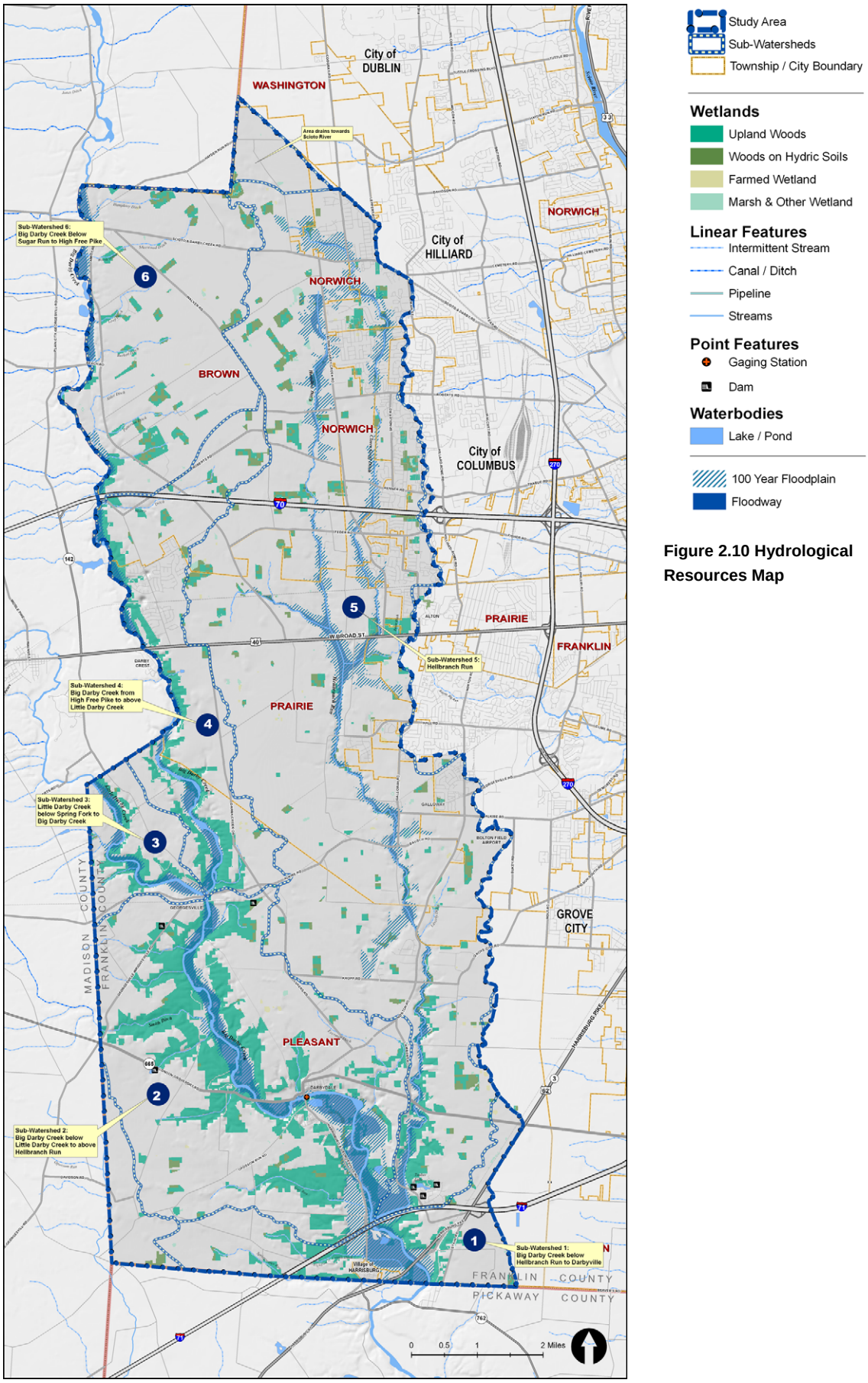


Figure 2.10 Hydrological Resources Map

Description of Watercourse Impairment

The Hellbranch Run Watershed has been identified as being impaired and fails to meet certain water quality criteria. The Hellbranch Run Watershed is comprised of two main tributary streams: Clover Groff Run and Hamilton Run. These tributary streams are in close proximity to the expanding suburban areas of western Columbus; however, there is still a significant presence of agricultural land use within these watershed areas. Both watercourses have been hydrologically modified in the past, attributed to a 'ditching' process that is commonly associated with agricultural land use within the State of Ohio. The ditching process includes a straightening, widening, and deepening of the stream channel to increase flow capacity and facilitate the use of field tile to drain the adjoining farm fields. In addition, the wooded riparian corridor along these tributary streams is degraded by land use activities that encroach upon the channels. Physical degradation of Clover Groff and Hamilton Runs is reflected in the generally low QHEI scores assessed by the Ohio EPA for the greater portion of these streams, especially within the headwater areas.

One consequence of the ditching process is a channel loses the functional components that contribute to aquatic habitat. Furthermore, a channel that is capable of conveying larger storm events is also subject to degradation through channel bank erosion and 'downcutting', a process that only advances the ditching process by lowering the channel gradient and expanding the width of the channel. Conversely, an over-wide channel can be subject to aggradation as sediments conveyed in stormwater runoff are deposited within the channel bottom due to a lack of velocity and energy to carry that material. The processes associated with channel degradation are a primary source of sediment loading in a stream system, as confirmed by findings of the Ohio EPA's TMDL related to the Hellbranch Run Watershed.

Degradation of the physical habitat and riparian areas along streams within the Hellbranch Run Watershed, coupled with sediment and nutrient runoff from agricultural and urban land use practices within the watershed, has an observable negative effect on fish and macroinvertebrate communities. This effect is apparent in the generally lower ICI and IBI scores assessed by the Ohio EPA within Clover Groff Run, Hamilton Run, and the upper Hellbranch. The scores show a general trend of improvement as the watercourses move downstream towards the confluence with Hellbranch Run and Big Darby Creek, where there is a wider, more intact riparian buffer and less channel modification.

ICI and IBI scores calculated for the portion of Big Darby Creek within the planning area indicated that the majority of the stream is meeting a category of Exceptional Warmwater Habitat (EWH). There is information suggesting a downward trend in QHEI scores for portions of the middle Big Darby Creek and that the diversity and overall population of mussel species is declining (Darby Creek Watershed Inventory, 2005). Findings associated with the declining mussel communities suggest that this decline is possibly attributed to a decline in fish population and increasing water turbidity and smothering of the channel bottom due to sedimentation within the channel (Discussions with Dr. Tom Watters, OSU).

Clover Groff (ditching) at Roberts Road
Source: The Nature Conservancy / Anthony Sasson

Aquatic Life Use Attainment

Based upon the findings of the *Biological and Water Quality Study of the Big Darby Creek Watershed, 2001/2002* (OEPA, 2004), the Ohio EPA has placed aquatic life use designations upon various watercourses within the Accord planning area. Furthermore, through the TMDL process, the Ohio EPA has identified portions of those watercourses that are in attainment, partial attainment, or non-attainment of that use designation. Each category of use attainment that pertains to watercourses within the planning area is described below (TMDL, 2006). Figure 2.11 illustrates water quality issues in the planning area.

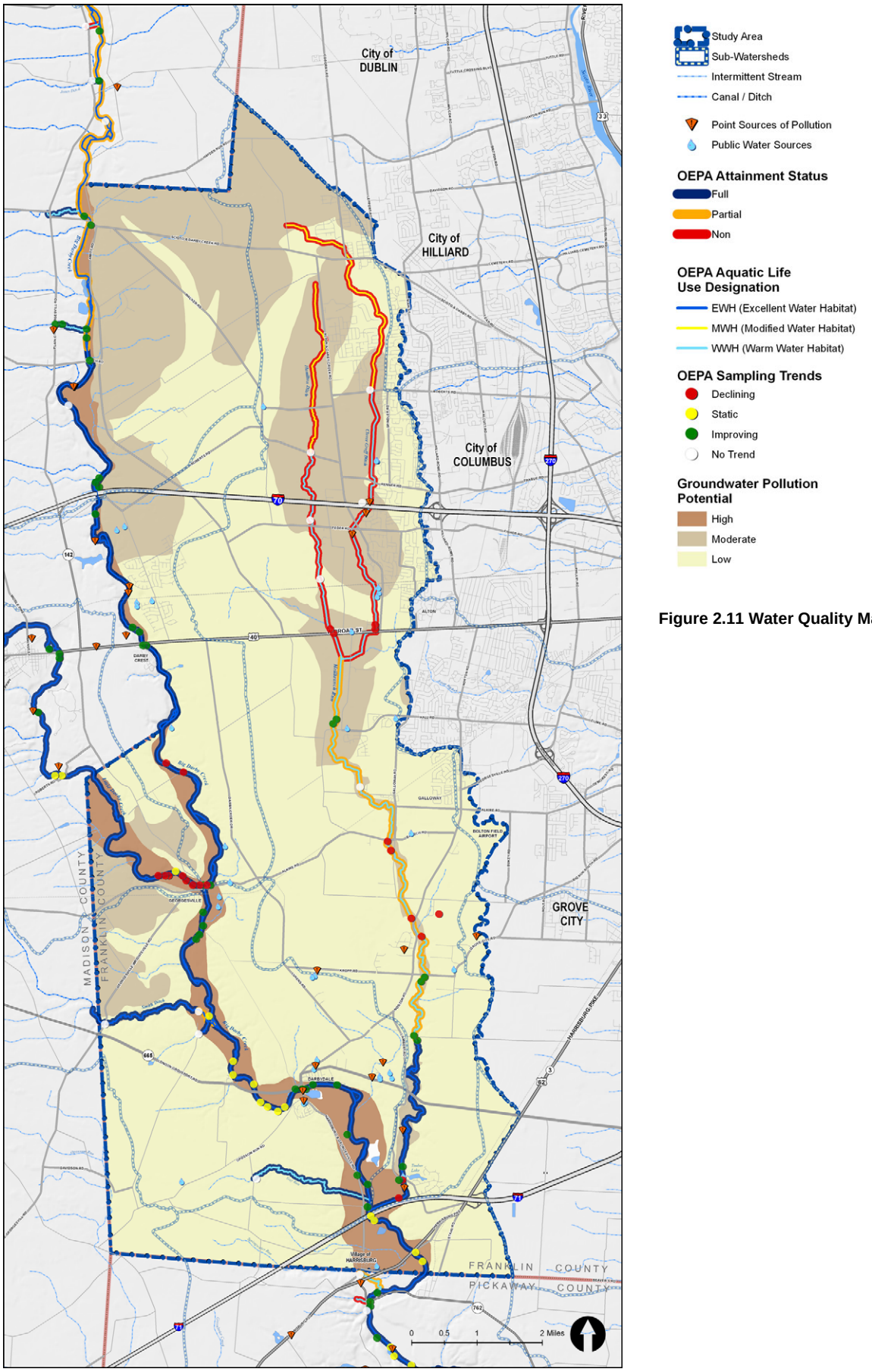


Figure 2.11 Water Quality Map

Stream Name	Aquatic Like Use Designation	Level of Use Attainment		
		Full	Partial	Non
Hellbranch Run Watershed				
Clover Groff Run	MWH – upstream of Roberts Road			X
	WWH – downstream of Roberts Road to the confluence			X
Hamilton Run	MWH – upstream of Widener Road			X
	WWH – downstream of Widener Road to the confluence			X
Hellbranch Run	WWH – upstream of Beatty Road		X	
	EWH – downstream of Beatty Road to the confluence	X		
Big Darby Creek Watershed[1]				
Main Stem[2]	EWH		**Upstream of Fitzgerald Run (RM 45.0)**	
		Downstream of RM 45.0		
Smith Run	EWH	X		

Figure 2.12 Summary of Aquatic Life Use Designation and Attainment

[1] Watercourses within the Big Darby Accord that are directly tributary to Big Darby Creek

[2] Only the portion that discharges though Franklin County

Source: OEPA TMDL, 2006; Big Darby Watershed Inventory, 2005

Warmwater Habitat (WWH): An aquatic life use designation that is characterized by the "typical" warmwater assemblage of aquatic organisms for Ohio's rivers and streams. This use represents the principal restoration target for the majority of water resource management efforts in Ohio.

Modified Warmwater Habitat (MWH): An aquatic life use designation that applies to rivers and streams that have been subjected to extensive, maintained, and essentially permanent hydromodification such that the biocriteria for the WWH use is non-attainable, and where the activities have been sanctioned and permitted by State or Federal law. In these watercourse, the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor habitat quality.

Exceptional Warmwater Habitat (EWH): An aquatic life use designation that is reserved for waters that support "unusual and exceptional" assemblages of aquatic organisms that are characterized by a high diversity of species, particularly those that highly intolerant and/or rare, threatened endangered or special status (e.g., declining species). This designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.

Figure 2.12 provides a list of the various major watercourses studied within the planning area, the designated life use attainment for each, and the finding pertaining to attainment (Big Darby Watershed Inventory, 2005/TMDL, 2006).

There are several small tributary streams within the planning area that are directly tributary to Big Darby Creek. The Ohio EPA, in their assessment of the Big Darby Watershed has not provided an aquatic life use designation for those watercourses, except for Smith Run, and no attempt is made here to provide an assessment of the habitat conditions associated with those channels. Each has only a small watershed area in comparison to those that are identified in Figure 2.12. Furthermore, Little Darby Creek is not separately included in this assessment due to the fact that only a small portion of that watershed is within the Accord planning area.

Impairment Summary

The aquatic life use designations and the extent to which they are attained play a significant role in determining where changing land uses and restoration opportunities can have the most significant positive impact on water quality. Significant impairment has been documented in the upper portion of the Hellbranch Run Watershed, associated with both the Hamilton and Clover Groff Runs.

Conservation-related land uses can have the most beneficial impact on impaired streams. Examples of these practices and their practical benefits to water quality are described below.

1. Preserving existing agricultural lands in perpetual conservation areas or easements for conversion to native grass and woodlands can reduce the amount of sediments and nutrients commonly associated with stormwater runoff from that land use.
2. Preservation and enhancement of riparian stream corridors provides an enriched habitat environment and introducing vegetative cover would provide stream stability characteristics.
3. Conservation development practices that include open space set asides and stormwater Best Management Practices (BMP), promoting groundwater recharge, and providing structural measures for capturing pollutants will help promote water quality improvements.
4. Implementing agriculture BMP's can mitigate the impacts of agricultural drainage (field tiles), sediments, and nutrients commonly associated with agricultural lands.

A key driver of the Accord Plan is to achieve the aquatic life use designation for each watercourse, upgrading streams designated as MWH to WWH where practicable. To achieve that, it is believed that stream restoration activities within the Hellbranch Run Watershed, particularly along Clover Groff Run and Hamilton Run will be needed. Sustainment of the EWH designation for the main stem of the Big Darby Creek is also a goal of water quality initiatives within the planning area. For this reason, attention must be paid to the smaller watercourses that are directly tributary to Big Darby Creek in the western portion of the planning area.

Water Quality Goals

Establishing and maintaining healthy streams required the identification of a land use scenario that over time would help address issues of non-attainment of aquatic life use designations within the Hellbranch Run Watershed and preservation of areas of attainment throughout the planning area.

The first step in this process, the environmental sensitivity analysis identified areas that were to be protected from urbanization, which constitute preferred areas for conservation and possible restoration. Primary influences that determined the resulting general land use plan related to water quality include:

1. *Protecting floodplains and stream corridor protection zones throughout the planning area and preserving them as naturalized riparian corridors.*
2. *Avoiding areas of high groundwater/stream baseflow interaction and pollution potential zones, as defined by the Ohio Department of Natural Resources (ODNR) DRASTIC mapping.*
3. *Protecting larger contiguous forested areas.*
4. *Implementing conservation development with a 50% open space requirement.*

Next, hydrological modeling provided a detailed analysis of the impact of land use scenarios on the pollutants identified by the TMDL as being factors in water quality impairments within the planning area. The purpose of the analysis was to determine how urbanizing land uses affect the pollutant loadings to the receiving streams and to better understand the benefits of conservation land use practices. Efforts related to the hydrological modeling process are described in the Appendix.

The last step to establishing and achieving healthy streams involved investigating the use of stormwater BMPs related to land use conditions and established water quality targets within the TMDL. Each BMP has unique benefits and drawbacks related to sustainment and function.

The planning area is comprised of two distinct watersheds: 1) the entire Hellbranch Run Watershed; and 2) the remaining areas to the west and within Franklin County that are directly tributary to Big Darby Creek. Within the TMDL document, the western areas are distributed amongst three separate subwatershed areas, identified as BDC 4, BDC 5, and BDC 6.

Figure 2.13 identifies the pollutant parameters and reductions that are stipulated in the TMDL report for the Hellbranch Run Watershed. Due to the fact that this watershed is a significant component of the Accord planning area and that only

Pollutant	Calculated Loadings (kilograms/year)[1]		
	Existing	Target	% Reduction to Meet Target
Total Suspended Solids (TSS)	3,051,200	152,560	95
Total Phosphorus (TP)	15,266	2,805	82

Figure 2.13 Summary of Target Pollutant Load Reductions – Hellbranch Run Watershed

[1] All values are average annual values over the duration of the planning period, published in the TMDL; non-point source loadings only.

portions of the other TMDL-identified sub-watersheds are within the planning area boundary, only the information for Hellbranch Run is presented with the understanding that the water quality initiative within Accord will be influenced by those values.

Discussion of Current Water Quality Initiatives

There are several existing policies, regulations, and on-going environmental protection initiatives that affect the level of development that can occur in the watershed. Each of these resources has at least one of the three essential components of environmental protection related to water quality: riparian corridor protection (stream setbacks); stormwater and floodplain management, and; conservation development. The resources listed have influenced policy recommendations in this plan.

Hellbranch Overlay (Columbus)

In 2002, the City of Columbus adopted the 'Hellbranch Overlay' (Columbus Code 3372.7), a codified standard for stormwater management that applied to all land development within the city limits and within the Hellbranch Run Watershed. The provisions of the overlay remain in effect even with the City's implementation of the revised Stormwater Drainage Manual, which applies city-wide. Based on discussions with the City of Columbus, they would apply the more stringent criteria to any future development within the overlay area.

External Advisory Group (OEPA)

In late 2003, the Ohio EPA engaged in an initiative to develop water quality criteria for an area identified as the Environmentally Sensitive Development Area (ESDA). The initiative is a component of an on-going update to the 208 Water Quality Management Plan for the central Scioto River basin, which includes Franklin County and the Big Darby Watershed, which is described below. The ESDA is a portion of the Big Darby Watershed and is located within the western limits of Franklin County. The Ohio EPA required that these initiatives be developed and enacted prior to the extension of centralized sewer services into this area.

The initiative required Columbus, who would ultimately provide the central sewer service, to convene an External Advisory Group (EAG) that would consider recommended criteria for riparian buffers, stormwater management, conservation development and adequate public facilities. The EAG was comprised of representatives from the municipal jurisdictions within the ESDA, along with other stakeholders, such as The Nature Conservancy, Darby Creek Association, The Ohio State University and the Building Industry Association (BIA). The result of the EAG process was a November 2004 report that outlined consensus and non-consensus recommendations related to these issues. [Note: the EAG was unable to address the issue of adequate public facilities in the timeframe that they were allotted].

Stormwater Drainage Manual (Columbus)

The City of Columbus recently released and is enforcing the provisions of their revised Stormwater Drainage Manual, dated March 2006. The drainage manual contains policies pertaining to stream corridor protection, floodplain preservation, and stormwater management. With regard to stormwater management, the manual has detailed provisions for stormwater controls related to both the quantity and quality of stormwater runoff released from a development site. The manual provides design criteria for the structural components of a stormwater system, such as curb inlets and storm sewer pipes, as well criteria for features related to post-construction water quality, such as extended detention basins and bioretention facilities.

NPDES Phase II (Franklin County)

Phase II of the National Pollutant Discharge Elimination System (NPDES) program is being implemented by Franklin County to include unincorporated areas within the County, including the various townships within the Accord planning area. The Cities of Hilliard and Grove City are also participating Phase II communities, and the City of Columbus is a Phase I community.

The NPDES initiative within Franklin County is being conducted in cooperation between the County engineer's office and the Franklin Soil and Water Conservation District (FSWCD). This initiative is intended to develop stormwater management standards including water quality considerations consistent with those mandated by the Ohio EPA through their statewide general permit for stormwater discharge. Furthermore, through the NPDES program, the County is investigating the regulation of certain on-lot home septic systems as 'illicit discharges' when those systems fail to function as intended.

The NPDES program and the State of Ohio's general permit for stormwater discharge address requirements related to both construction-phase and post-construction water quality. The portion of the general permit that addresses construction-phase activities includes a requirement for a Stormwater Pollution Prevention Plan (SWPPP) containing provisions for erosion and sediment control for areas denuded during construction. The post-construction requirements identify the necessary components of a permanent on-site stormwater management facility that provide for long-term water quality.

Fundamentally, the post-construction standards require the implementation of some sort of structural BMP for all development sites larger than one acre. For larger development sites, greater than five acres, the standards are more specific and require a BMP facility with a prescribed water quality volume and residence (drawdown) time for the intercepted stormwater runoff. Presently, the Ohio EPA is in the process of updating the NPDES permitting process for areas within the Big Darby Watershed.

208 Plan (OEPA)

The Ohio EPA is currently engaged in an update to the 208 Water Quality Management Plan for the central Scioto River basin. The 208 Plan is comprised of criteria and standards related to providers of central sewer service. The plan establishes the municipal jurisdictions and other entities responsible for providing sewer service and the service areas they are responsible for. As mentioned above, the plan update included the EAG process that established recommendations for water quality initiatives that would need to be implemented by the recognized service providers prior to extending service into the ESDA. The draft revised 208 Plan contains an Appendix (9-3) that outlines specific water quality provisions for Big Darby Creek. Furthermore, that appendix has even more specific water quality criteria related to the portion of the watershed within Franklin County, reflecting the consensus recommendations of the EAG process.

Stormwater Permit (OEPA)

The 208 Plan itself is not a regulatory tool for implementing water quality standards. As such, the Ohio EPA has created a draft revised stormwater general permit that is specific to the Big Darby Watershed and makes reference to the water quality criteria from the 208 Plan and is also based on the water quality goals established by the TMDL report. The Ohio EPA is authorized to regulate stormwater discharges under the statewide NPDES program permit. The conditions of the permit apply when land disturbing activities occur in excess of one acre, at which time the applicant must submit a Notice of Intent (NOI) to the Ohio EPA along with technical information demonstrating compliance with both construction phase and post-construction water quality standards, described previously. Currently, the revised stormwater permit is in draft form and the Ohio EPA is considering comments submitted during the public comment period.

Hellbranch Watershed Forum

The Hellbranch Watershed Forum (HWF) is an on-going initiative that involves a local stakeholder group that is similar to the one identified within the EAG and is being partially funded by the US Army Corps of Engineers. The FSWCD is serving as the local sponsor for the project and is leading the local stakeholder group. The HWF has been developing policy recommendations related to riparian buffer protection, and stormwater and floodplain management. These recommendations have been provided to the Accord for consideration and are summarized in the Hellbranch Watershed Action Plan document. The recommendations have been developed in cooperation with the engineering consultant to the HWF, Fuller, Mossbarger, Scott & May Engineering, Inc. (FMSM) and represent a consensus process among the local stakeholder group that makes up the HWF.

TMDL Report (OEPA)

The TMDL (Total Maximum Daily Load) Report for Big Darby Creek Watershed represents a significant water quality initiative. The information presented previously regarding the Hellbranch Run Watershed is the basis for the water quality modeling performed as part of the Accord planning effort. The specific pollutants and stipulated reduction goals in the TMDL are the foundation for stormwater BMPs that are recommended within the Accord planning area.

Adaptive Management

The overall goal to improve and maintain water quality within the Accord planning area is a long-term process that will require the use of adaptive management techniques. Currently, the Ohio EPA TMDL, Section 208 water quality planning, permits for wastewater and stormwater discharge, and various environmental policies are used to guide development. With the implementation of the Accord Plan, development will be guided by new standards intended to help reach the goals of TMDL. Despite these various measures of oversight and enforcement, a broader program related to the evaluation and monitoring of the watershed and specific stormwater management features that may be implemented is needed to realize an adaptive management approach.

Big Darby Creek
Source: Metro Parks/Mac Albin

3.0 Land Use Plan

The land use plan is based on sound planning and environmental principles critical to balancing growth while protecting water quality. These principles include several key strategies identified by the US Environmental Protection Agency. The EPA has developed a report on protecting water resources while allowing for development that indicates three key goals to protecting water quality:

- Preserve large, continuous areas of open space;
- Preserve critical ecological areas, such as wetlands, floodplains, and riparian corridors; and
- Minimize overall land disturbance and direct connection of impervious surfaces associated with development.

To achieve these goals, the general land use plan includes a strong land conservation strategy, described in Section 3.1. This strategy is based on the environmental sensitivity analysis and incorporates a range of tools and techniques to help conserve critical resources and improve water quality.

Second, the plan focuses a portion of the development within a higher density Town Center located between West Broad Street and I-70. This Town Center encourages higher density development within a limited area, an approach supported by the US EPA in a publication called "Protecting Water Resources with Higher-Density Development." This reports compares analysis of several scenarios of development within a watershed, and indicates that the same amount of development equally distributed across the

Key Recommendations

- **Protect Tiers 1, 2 and 3 within the Land Conservation Strategy to create a network of green infrastructure.**
- **Focus land acquisition efforts to Tier 1 and 2 areas where resources are most sensitive.**
- **Support local organizations and agencies that are actively involved in land conservation efforts.**
- **Promote regional recreational trail development.**
- **Adopt conservation development land use and zoning with 50% open space for rural areas that are not served by central sewer in Prairie, Brown and Pleasant Townships**
- **Adopt conservation development land use and zoning at 1 unit per acre with 50% open space in the Hilliard growth area, which will be served by central sewer.**
- **Create a new destination with a high density mixed use town center between West Broad Street and Interstate70, which will be served by central sewer.**
- **Adopt new Town Center zoning with base minimum densities, locating the highest density in the core area of the Town Center with transition to surrounding uses.**
- **Provide supporting institutional uses in the town center and where appropriate.**
- **Provide areas for mixed land to support residential development.**
- **Continue agricultural uses in southwest portion of the planning area.**
- **Improve and enhance US Route 40.**
- **Complete an Interchange Justification Study.**
- **Incorporate Leadership in Energy and Environmental Design (LEED) principles of design, particularly Neighborhood Design (ND) into site design.**
- **Apply low impact development (LID) techniques into site design and revise regulations to allow implementation of LID.**
- **Support the 22 development principals from Darby Creek Watershed Stormwater Management Strategies and Standards for New Development.**
- **Support principals from EPA National Management Measure to control non-point source pollution from Urban Areas.**
- **Achieve the water quality goals set forth by OEPA TMDL, for TSS, N and P through changing land uses and application of best management practices.**
- **Encourage the application of best management practices on agricultural lands.**
- **Enhance stream morphology through restoration efforts in the priority stream restoration zone along Clover Groff and Hamilton Runs and the upper portions of the Hellbranch Run.**
- **Promote regional stream restoration that allows connectivity to other watercourses.**

Section Outline

watershed creates a higher amount of impervious cover and a higher amount of runoff than the same amount of development clustered into a smaller area. Therefore, the general land use plan illustrates a pattern of more concentrated development as part of the Town Center.

The general land use plan is the sum of two interrelated parts: a land conservation strategy and a land use plan. To achieve the Mission of the Accord, both the land conservation strategy and the land use plan will need to be pursued simultaneously with new policies and standards of development that are more fully described in Section 4.0.

The Big Darby Accord Plan recognizes the property rights of landowners in the watershed and has developed polices to provide several options for landowners. Property owners retain the right to develop their land under the governing policies and regulations, subject to all environmental standards and requirements set forth by regulating agencies such as the Ohio EPA as well as new standards set forth in this plan. Landowners retain the ability to sell their land or participate in new programs recommended in Section 5.0. Some of these programs include tax benefits for landowners.

3.1 Conservation Strategy

The Darby watershed is home to several State and federally listed endangered species and is truly a jewel of Ohio and the Midwest. To further protect this valued watershed, an increased level of protection is needed to protect water quality and preserve the natural resources and unique character of the area.

This planning effort represents a significant opportunity to proactively protect resources which directly and indirectly contribute to biodiversity, improved water quality, habitat areas, and ecological processes of the Darby watershed planning area. Increased protection in the form of land conservation and stewardship can only improve conditions of water quality and will contribute positively to retaining the unique character of the area.

A grand opportunity deserves a bold direction. Through land conservation and stewardship efforts, the Big Darby Accord Plan sets forth a goal of protecting about 25,000 acres of land within a comprehensive green infrastructure network consisting of environmental conservation zones (Tiers) that include existing parks and easements, riparian corridors, easements, open spaces, greenways and trails. This network will be achieved by working together with local jurisdictions, developers, landowners, and conservationists using a variety of existing and new programs, careful planning and development, and spirited cooperation.

Purpose

The land conservation strategy is formulated on the environmental sensitivity analysis described in Section 2.3 and is presented in a system of environmental conservation zones identified as Tiers. It is the goal of this Plan to encourage the protection and conservation of all land within the Tiers. Since green infrastructure elements provide communities with an ecological framework, it is essential to identify and protect these areas prior to development. In addition, restoring natural systems throughout the watershed is far more expensive than protecting undeveloped land, and man-made wetlands and other restoration projects often fail to function as well as their natural counterparts over the long run (Benedict, McMahon, 2002).

Responsible land conservation and open space protection includes deciding where development should and should not occur. In areas where development has already occurred it is still important to assess where restoration could occur to restore habitat areas and improve the overall environmental conditions. Over time, the Land Conservation Strategy should guide the location of development and provide a blueprint for regional open space programs and acquisition efforts, which are more fully explained in Section 5.0.

Green infrastructure is our nation's natural life support system – an interconnected network of waterways, wetlands, woodlands, wildlife habitats and other natural areas; greenways, parks and other conservation lands; working farms, ranches and forests; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life for America's communities and people."

Definition of Green Infrastructure, as noted in Renewable Resource Journal, Autumn 2002 in an article entitled Green Infrastructure: Smart Conservation for the 21st Century, by Mark Benedict and Edward T. McMahon.

Benefits of Open Space

A green infrastructure is based on connecting people to green spaces and parks and linking together natural areas to benefit biodiversity and minimize habitat fragmentation (Benedict, McMahon, 2002). Integrated systems of open space promote the movement of species and the preservation of ecological processes critical to a healthy ecosystem. In fact, in 1999 the President's Council on Sustainable Development identified green infrastructure as a key component in comprehensive approaches to sustainable community development (The President's Council on Sustainable Development, Towards a Sustainable America, 1999).

Conservation is sound investment. Development that destroys or degrades natural features and resources is environmentally and economically wasteful. Protection of natural features provides a public benefit to all.

While open space generates less property tax revenue per acre than developed land, major findings show that open space actually produces an overall tax revenue surplus which subsidizes other land uses, and open space provides public and environmental benefits that more than compensate for preferential tax costs (Economic Benefits of Open Space, Miller, 1992). Development often costs more in services (health and safety services, traffic, community facilities, utilities) than it pays in taxes resulting in a net increase in the local tax rate for the public. Residential development expenditures often exceed revenues while farmland and open space revenues (as well as commercial and industrial) exceed expenditures.

Numerous studies highlight specific open space attributes that can be used to establish economic value. Measurable attributes of open space include things like biological diversity, wildlife habitat, soil conservation, rural character, flood control, quality of life, cost efficient development, climate control, fishery protection, scenic views, scientific opportunity, forestry, public access and many more (Miller, 1992). Assigning monetary values to these attributes can depict significant economic value to open space. One direct benefit of open space is the increase in adjacent property values.

3.1.1 Conservation Strategy Components

The land Conservation Strategy is comprised of a system of elements including areas already protected under existing regulations, existing parks and easements, and proposed tiers. The Tiers are based on a number of factors and include features that were part of the sensitivity analysis described in Section 2.3. Specific policies related to the regulation of elements within the conservation strategy, i.e. riparian corridors, floodplains, etc., are further discussed in Section 4.0.

The goal of this plan is to protect all lands within the land Conservation Strategy. Property owners holding land within the Tiers will be encouraged to participate in voluntary conservation programs while the Accord jurisdictions will work collectively to implement regional open space programs with key partners. Existing development and any newly proposed development in the Tiers will need to occur in accordance with applicable base zoning regulations and other standards for development including best management practices. Policies related to the types of appropriate activities, land management approaches and other considerations for the Tiers are described in Section 4.0.

Overall, the land Conservation Strategy shown in Figure 3.2 identifies approximately 25,000 acres of land in five categories outlined in Figure 3.1.

Conservation Category	Acres
Protected	4,310
Existing	6,131
Tier 1	5,790
Tier 2	1,885
Tier 3	7,150
Total	25,266

Figure 3.1 Conservation Categories Acreages
Note: About 1,300 acres within Metro Parks is classified in the Protected Category.

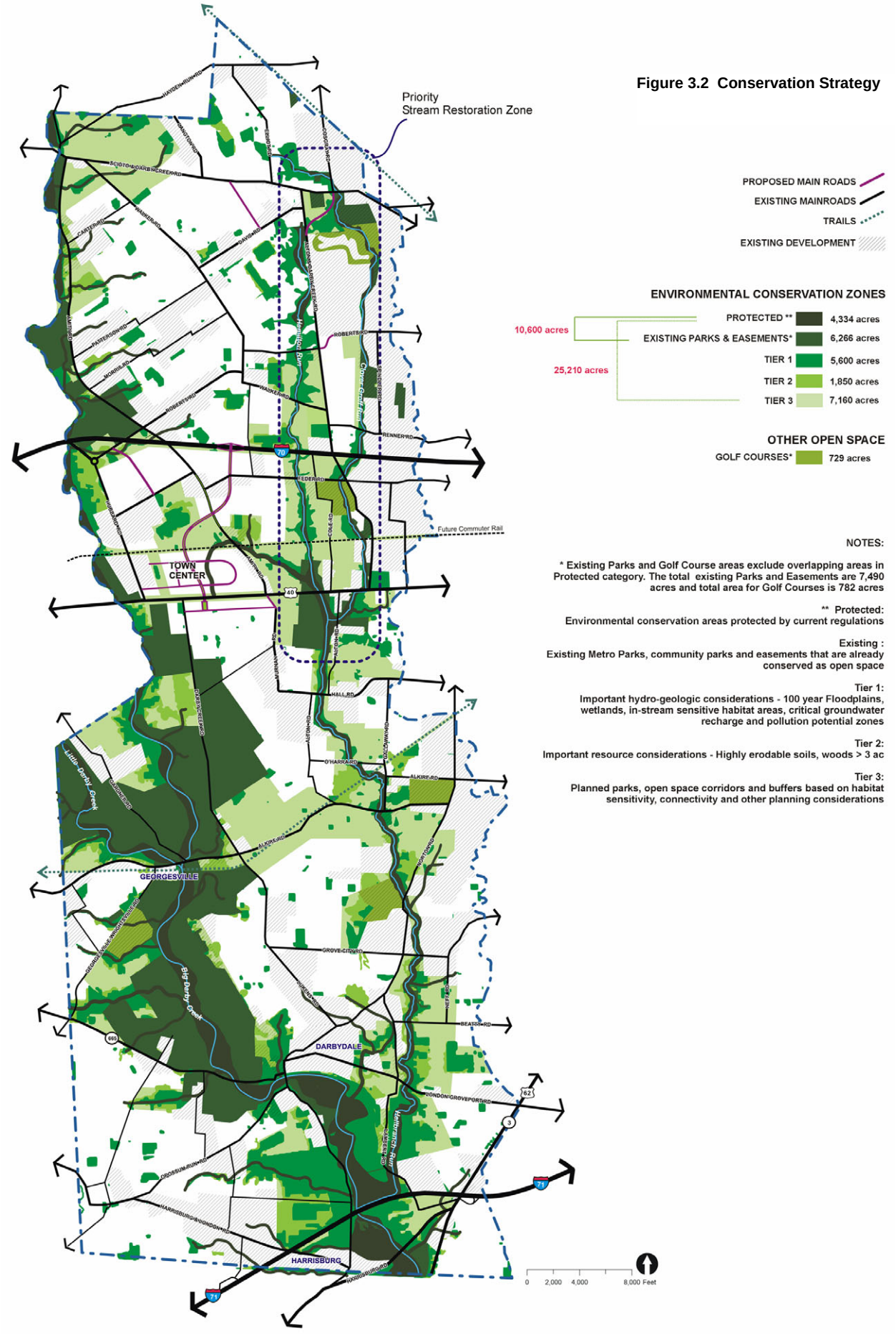
Existing Parks and Easements

The Battelle Darby and Prairie Oaks Metro Parks encompass and protect almost 7,000 acres within the planning area. These parks, located along the banks of the Big and Little Darby Creeks, include significant riparian zones, forests and open space, and together, represent the single largest contiguous tract of land currently in conservation within the planning area and in Franklin County. The mission of Metro Parks is compatible with the creation of a land conservation strategy for the Accord planning area and Metro Parks is a formidable partner in implementing the Accord Plan. The Metro Parks Strategic Plan, 2005 identifies habitat restoration areas, community restoration areas, community open space and a greenway trails system. The Accord Plan fully supports the efforts of Metro Parks.

Franklin Soil and Water Conservation District (FSWCD) currently has easements on 145 acres of land within the planning area. The FSWCD mission is to "promote responsible land use decisions for the conservation, protection and improvement of soil and water resources by providing assistance through effective partnering and technical guidance in Franklin County". Their services include education, public information, construction and post construction review and inspection, backyard conservation, conservation implementation on private lands, county drainage mapping layer, and conservation easements.

Other municipal parks are located throughout the planning area. Increased development westward into the planning area as well as planned future development areas identified in this plan will require additional park land and facilities, including active recreation fields for soccer and other organized sports. Development of this plan does not include a needs assessment to determine the number of fields, type of facilities, or other specific detail; however, this plan has identified general areas for future facilities based on the general land use plan. Generally, the location of facilities should maximize access and be centrally located to neighborhood centers.

Figure 3.2 Conservation Strategy



Protected Zone
Today, current regulations provide for the protection of about 4,300 acres of land that is encompassed by the FEMA designated floodway or calculated beltwidth. Because these elements are already protected by regulations or ordinances, they have been categorized separately and will retain their protected status in this plan. This plan will maintain the current level of protection and recommends local jurisdictions put in place policies to protect further Tier 1, 2 and 3 areas. Until those policies are developed and adopted, development in Tiers 1, 2, and 3 could occur at the current permitted level, subject to all other regulations.

Tier 1
Land within Tier 1 is considered the primary priority for protection through land acquisition and other programs. Encompassing about 5,800 acres, resources within Tier 1 are significant in maintaining the overall health of the watershed. Resources in Tier 1 include the 100 year floodplain, wetlands, critical groundwater recharge and pollution potential zones. The protection of these elements provides a buffer for sensitive in-stream habitats. Stream corridor protection zones and floodplain protection policies are described in Section 4.0 and have been recommended as guidelines for the minimum standard of protection.

Floodplains
Floodplains are defined along the banks of rivers, streams, or creeks as areas that may be inundated with water following heavy rainstorms. During high water events, floodplains absorb water and help prevent rivers, streams and creeks from overflowing. Water expands into the floodplain areas and infiltrates into the ground, slowing water flow and allowing groundwater recharge. Floodplains in their natural state are beneficial for a number of reasons:

- Reducing the number and severity of floods
- Minimizing non-point source water pollution
- Filtering storm water
- Providing habitat for plants and animals
- Aesthetic beauty and outdoor recreation benefits.

Floodplains are home to many types of plants and animals and may also have forests and wetlands on or adjacent to them. These river edges provide habitat for insects, birds, reptiles, amphibians, and mammals. The vegetation helps filter contaminants out of the water flowing into the river. Additionally, vegetated floodplains provide shade for the adjacent rivers and streams, increasing dissolved oxygen levels and consequently improving habitat for aquatic plants and animals (Center for Earth and Environmental Science, Indiana University- Purdue University).

The effectiveness of a stream's floodplain to convey and store flood water can be adversely affected by human activity. Development practices within and along floodplains affects the land's ability to absorb rain and floodwaters and can contribute to flood events that are larger and more frequent leading to increases in property damage and life threatening situations.

Riparian Corridors
Riparian corridors include grass, trees, shrubs or a combination of natural features along the banks of streams that serve to filter pollutants, provide stream bank stability, protect stream species, improve water quality, slow run-off, and provide a transition between other open space, developed land, and the streams. Riparian corridors at a minimum include the 100 year floodplain or Beltwidth, which ever is greater. For the purposes of this plan, policies related to the riparian corridor are addressed in the Stream Corridor Protection zone in Section 4.0. In some cases, particularly along the Big Darby Creek main stem the riparian corridor is vast due to floodplain and other natural resources found within the zone.

Riparian zones typically comprise a small percentage of the landscape, often less than 1 percent, yet they frequently harbor a disproportionately high number of wildlife species and perform a disparate number of ecological functions compared to most upland habitats. Riparian zones have been widely recognized as functionally unique and dynamic ecosystems only within the past 25 years (US Army Engineer Research and Development Center, Environmental Laboratory, April 2000).

Wetlands
For the purpose of a land conservation strategy, wetlands are included and categorized under the umbrella of open space. Wetlands are a natural feature within the landscape that offer multiple benefits to water quality and habitat and therefore should be preserved and protected. National or state wetland inventory data is a starting point to identify wetlands; however, due to differences in scale and changing environmental factors it is important to evaluate the presence of wetlands on a site by site basis through the development review process.

This type of analysis ensures all wetlands are properly identified and delineated allowing for increased protection.

Groundwater Recharge and Pollution Potential Zones
Groundwater and surface water are fundamentally interconnected and are integral components of the hydrologic cycle. Because the quality and quantity of surface waters can be dramatically affected by groundwater contributions, preservation of the water resources in the Darby Creek planning area requires considerations for the protection of groundwater quality and recharge capacity. Groundwater entering surface waters most frequently comes from unconfined (water table), shallow aquifers. These aquifers interact closely with streams, sometimes discharging water into a stream or lake and sometimes receiving water from the stream or lake. An unconfined aquifer that feeds streams provides the stream's base flow, and the stream is called a "gaining" stream. Because of this base flow support, groundwater is often responsible for maintaining the hydrologic balance of surface streams, springs, lakes, wetlands and marshes. Therefore, to fully understand the source of the stream baseflow and its contribution to the stream system habitat, knowledge of the unconfined aquifers adjacent to streams is essential.

The source of recharge to the groundwater regime is infiltration of precipitation through the soil or percolation of surface water through the substrata of streams, lakes, wetlands and marshes. Recharge to shallow, unconfined aquifers can be locally restricted through the creation of impervious areas (buildings, roads, parking lots, etc.), lined or armored stream channels, and artificial subsurface drainage systems, resulting in a decrease in the amount of groundwater returned to the surface elsewhere.

Tier 2
Land within Tier 2 is considered a secondary priority for protection through land acquisition and other programs. Encompassing approximately 1,885 acres, resources within Tier 2 include highly erodible soils, and contiguous wooded areas that are greater than three acres in size.

Highly Erodible Soils
Highly erodible soils are those that have a high potential to erode based on their physical and chemical properties when combined with particular climatic conditions. Within the planning area, nineteen (19) soils are categorized by the NRCS as highly erodible, four (4) as potentially highly erodible, and two (2) as not highly erodible. These designations are important for federal agriculture programs.

Wooded Areas
While wide, intact, wooded riparian corridors are a crucial factor in the overall aquatic and terrestrial species diversity and richness within the Big Darby Creek watershed, wooded parcels (and wetlands) removed from the riparian corridor also have significant, but lesser benefits to the overall habitat condition. Wooded parcels greater than three acres have been included in Tier 2. Connectivity between wooded parcels is beneficial for wildlife movement and expansive areas of woodland offer excellent opportunities for reducing stormwater runoff and erosion and increasing surface water infiltration and groundwater recharge.

Tier 3
Land within Tier 3 is considered a tertiary priority for protection through land acquisition. These areas should be conserved through permanent conservation easements, within conservation development subdivisions and other suitable mechanisms. Tier 3 is envisioned as providing an integral piece of the open space network by creating linkages among all other components of the Land Conservation Strategy. Passive recreation and certain types of sensitively designed active recreation should be considered suitable for Tier 3 areas.

The overall goal of creating a network will only be possible through careful planning and efforts to link existing and future conservation lands. Corridors of conservation promote habitat movement and diversity and can lead to increased recreational opportunities while preserving rural character. Land within Tier 3 provides buffers and linkages around areas that have been associated with unique habitat, including enhancing the riparian corridors along some stream corridors. Approximately 7,150 acres are identified as Tier 3.

Habitat Connectivity and Buffer Areas
Due to the unique aquatic environment within the Big Darby Creek Watershed and particularly along the main stem of Big Darby Creek, a significant number of threatened and endangered species are present. Protection of these important habitats is accomplished through the Endangered Species Act (ESA), enacted by the U.S. Government in 1973. In addition to the Federal protected species list, Ohio has its own list of State threatened and endangered species that require protection.

The Natural Heritage Database is a compendium of records of rare plants and animals, high quality plant communities, special animal assemblages or colonies, and other natural features within Ohio. The database search revealed the presence of two (2) Federal Endangered species, one (1) Federal Candidate species, eleven (11) State Endangered species, seven (7) State Threatened Species, four (4) State Potentially Threatened species, and six (6) State Species of Concern. Records of mollusk beds and glacial erratics (rocks or boulders deposited by glacial movement) were also noted.

As expected, the highest concentration of rare species is located within the Big Darby Creek main stem and within the downstream portion of Little Darby Creek near the confluence. Essential to support sensitive species, these areas provide the best quality habitat (evidenced by OEPA QHEI scores) and have the greatest amount of wooded riparian buffer within the watershed.

A number of the species listed in the planning area are static species or communities, as indicated on Figure 2.8. *Static* species are generally unable to move around, or to move great distances, under their own power. Mussels and plants fall into this category. Static species are more susceptible to habitat destruction and point source pollution than motile species, which can move upstream or downstream relatively quickly in response to an impact. For this reason, static species should receive special consideration when planning disturbances within the watershed. As a general rule, however, all threatened or endangered species are subject to a number of forms of habitat degradation as the landscape changes form, and their long-term viability must be considered in the planning process.

Trails

Trails within the watershed offer residents and visitors an opportunity to explore nature, take part in a healthy activity by walking, biking or hiking, and can contribute to a better understanding of the dynamic nature of the watershed. Trails already exist within the Metro Park system and efforts are underway to expand the Metro Park trail system to include a more comprehensive network of trails throughout the watershed. This plan supports the efforts of MetroParks in their pursuit of a regional trail network, including efforts to connect with regional trail systems that extend to Cincinnati and Cleveland.

Trail systems should be considered an integral part of community development; serving as a link between neighborhoods, activity centers, employment areas, schools and public facilities and other destinations. From a regional perspective, trails attract visitors supporting the local tourism and travel industry; however, their primary emphasis in the Darby watershed planning area is to encourage a healthy lifestyle and elevate the quality of life for existing and future residents. Developers should coordinate with Metro Parks and local jurisdictions to connect neighborhood trails with regional trail systems, creating a web of off-road connections that improves safety and creates recreational value. Trails should be considered during roadway improvement projects; funding for trail projects could be allocated when funding is pursued for transportation-related infrastructure.

3.2 Existing Land Use

Existing land uses are described below, followed by a description of the proposed general land use plan. Acreages have been determined using GIS and should be considered estimates for master planning purposes only.

Figures 3.3 and 3.4 depict the **existing** land use within the Big Darby Planning area. This information is based on a combination of sources including data from the Mid Ohio Regional Planning Commission (MORPC), information from the local jurisdictions such as comprehensive plans, and aerial photography obtained through the Franklin County Auditor, 2002. The existing development pattern shows a higher concentration of residential uses along the eastern boundary of the planning area, along the edges of Hilliard and Columbus and generally east of Alton Darby Creek Road. The remainder of the planning area is mostly agriculture with pockets of rural residential developments. The subdivision of lots has created rows of very deep 5 acre lots or larger along rural roadways while the interior portion of the tract remains active agriculture.

Open prairie lands
Source: EDAW

Large-lot development
Source: EDAW

Suburban-style development
Source: EDAW

Based on a GIS analysis, about 26% of the planning area is developed, accounting for almost 14,000 acres, not including existing parks. For the purposes of calculation, large lot parcels with only one home that may have additional development capacity were assumed to be fully developed. It is estimated that about 19,000 residential units already exist within the planning area as well as existing commercial, public, park and other uses.

Existing residential land uses, including some small urban, suburban and rural development account for about 22% (12,000 acres) of the planning area.

Existing Land Use	Acres	Percent
Agriculture	31,536	56%
Commercial	218	<1%
Industrial	29	<1%
Public / Institutional	1,355	2%
Residential	12,083	22%
Rural Estate	*4,805*	
Rural	*3,132*	
Suburban	*1,890*	
Suburban High Density	*1,396*	
Urban Medium (5 - 8 du/ac)	*480*	
Urban High (> 8 du/ac)	*380*	
Parks & Open Space	7,490	13%
Golf	782	1%
Roads	2,536	5%
Total	**56,029**	**100.0%**

Figure 3.3 Existing Land Use Acreages

Of the 12,000 acres of residential development, about 4,800 acres is very low density rural development. Less than 1,000 acres is considered medium or high density (5 units per acre or greater). Figure 3.3 lists existing land uses and estimated acreages.

The existing development pattern reflects the continued growth of the urban and suburban development patterns to the west. A range of residential development densities occurs along the eastern edge of the planning area. Limited areas of commercial uses, golf courses, parks and other public/institutional uses also exist in the planning area.

Generally, west of the Hellbranch Run the development pattern is lower density with several pockets of higher density residential particularly along West Broad Street within Prairie Township and the City of Columbus. The remaining areas generally include agriculture uses and larger lot single family residential areas. Agriculture uses occupy approximately 56% of the planning area, or 31,000 acres. About 200 acres of commercial development is clustered near the intersection of Route 62 and I-70 and in the vicinity of Scioto and Darby Creek Road. Existing parks and open space, including Metro Parks, account for approximately 13% (7,443 acres).

Existing Land Use Categories

An effort was made to incorporate existing uses based on their own unique description and not try to assimilate the existing uses into new land use categories. Existing development is indicated by the use of a hatch pattern on the land use map. The following categories on the proposed land use map are related to existing development. Note that mixed use, commercial, public/institutional and agricultural uses relate to proposed land uses as well and are listed under both existing and new land use categories.

- **Rural Residential Estate:** Lots that are greater than 5 acres in size
- **Residential Rural**: 0.2 - 0.5 dwelling units per acre
- **Residential Suburban:** .5-3 dwelling units per acre
- **Residential Urban Medium Density:** 5-8 dwelling units per acre
- **Residential Urban High Density:** Greater than 8 dwelling units per acre
- **Industrial:** Light industrial uses such as warehousing, technology or business parks
- **Mixed Use**: A mix of residential and commercial/retail uses. Actual densities for existing mixed use areas were not determined but were assumed to be between 3-5 dwelling units per acre
- **Commercial:** Local or regionally serving commercial and office uses such as groceries, big box stores
- **Public/Institutional:** Schools, community facilities, government services, libraries
- **Agriculture**: Farmland

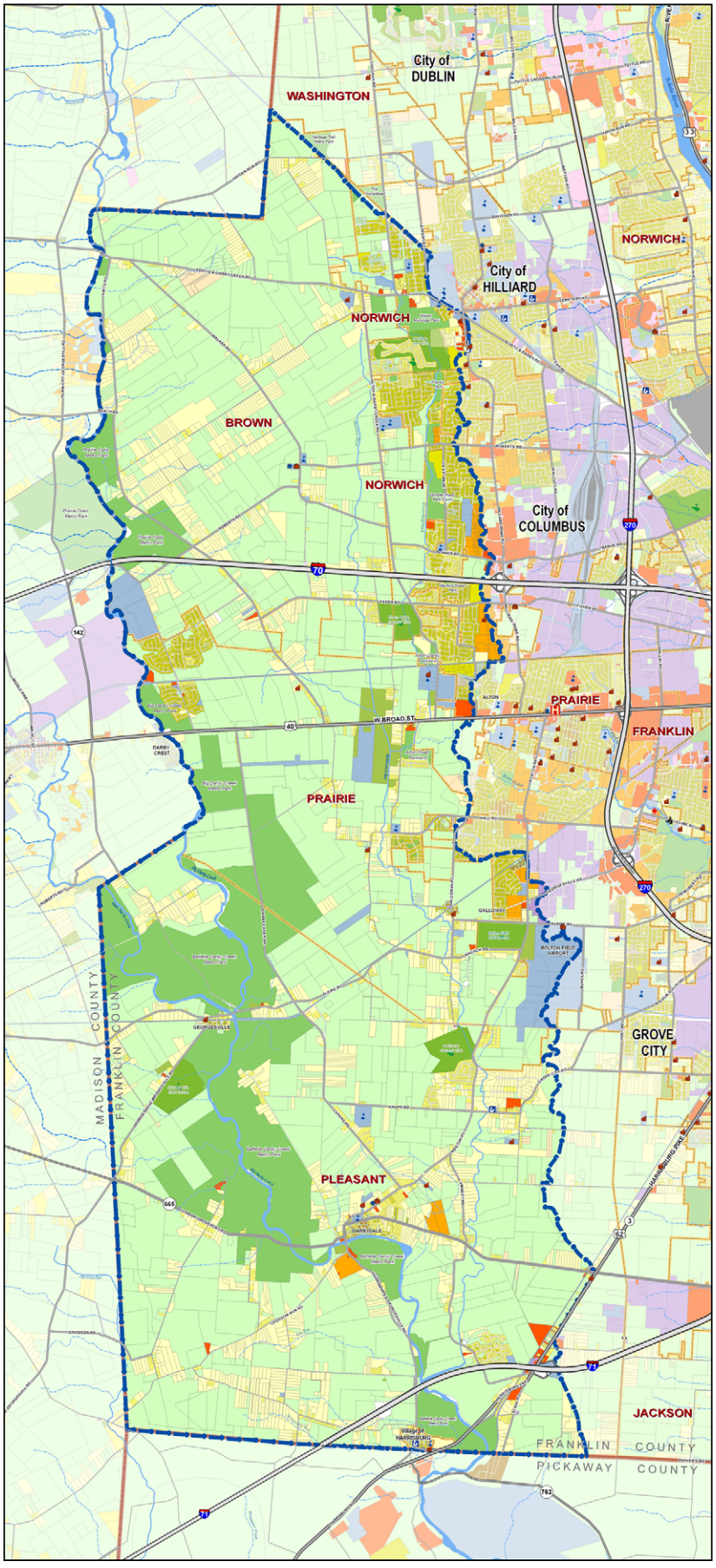


Figure 3.4 Existing Land Use Map

Parks and Trails	Acres	Description	Owner
Alton Road Parkland/Clean Ohio Parkland	103	Undeveloped and Conservation Stewardship	Columbus
Battelle Darby Creek Metro Park	6,251	Woodlands, Conservation	Metro Parks
Clover Groff Natural Area	25	Mitigated Wetland Area and Nature Preserve	Columbus
Franks Park	54	Neighborhood Park	Columbus
Hilliard Municipal Park (Includes Soccer Park, Latham Park)	133	Athletic Fields, Pool, Senior Center, Community Center, Bike Park, Tennis, Picnic Shelters, Amphitheater	Hilliard
Prairie Oaks Metro Park	715	Woodlands, Conservation	Metro Parks
Spindler Road Park	109	Soccer Complex and Stream Corridor Buffer	Columbus
Wexford Green Park	9.8	Playground, Woodlands	Columbus
Total	**7,399**		

Figure 3.5 Existing Parks

Sources: Columbus Park and Recreation Department, Hilliard Parks and Recreation Department, Metro Parks.
Note: Metro Parks acreages include only the area of the park that falls within the Accord planning area.

It is not the intention of the general land use plan to recommend that existing development should be removed or redeveloped to be consistent with Figure 3.6. Rather the land use plan is intended to illustrate how new development should complement the existing development patterns.

Existing Parks and Recreation

Based on existing land use data, about 7,399 acres of parkland currently exist within the planning area and is provided by many jurisdictions. The majority of parkland is concentrated in Metro Parks along Big Darby Creek. The largest park, Battelle Darby Creek Metro Park, is also the largest park within the Metro Park System. Prairie Oaks Metro Park provides an additional 715 acres of park land in the planning area. Heritage Park Metro Park, 58 acres, is located just outside the planning area long the Heritage Trail near Hilliard and offers a respite for trail users.

Metro Parks serve a regional area and provide Franklin County residents with direct access to natural resources through creative programming and education, events and land stewardship. Metro Parks estimates it receives about 5.5 million visitors per year. Their mission is to conserve open spaces, while providing places and opportunities that encourage people to discover and experience nature (Metro Parks Community Update, 2004). Metro Parks' land management practices include wetlands restoration, prairie restoration, wildlife management programs, farming, and species monitoring.

"Conservation and preservation of the best remaining natural areas is an important responsibility of Metro Parks"
Metro Parks Community Update, 2004

Metro Parks started acquiring land in the Darby watershed in 1948 with a purchase of 113 acres. Since then, the system has grown to over 23,000 acres, focusing on conserving significant natural features and resources. Metro Parks owns over 8,100 acres in the Darby watershed (about 7,000 acres in planning area), with about half of those acres acquired since 2000. Programs and initiatives are funded through a 0.65 mill property tax levy that extends to 2009 as well as other state and federal resources, private donations, and grants.

Metro Parks promotes partnerships with willing land owners and jurisdictions to acquire additional park lands. Future goals of Metro Parks are outlined in a 2005 Strategic Plan and include additional park lands and the creation of a greenway trail system linking Battelle Darby Creek Metro Park with Prairie Oaks Metro Park.

With the exception of Metro Parks, parks within the planning area vary in size and are generally located along the West Broad Street corridor or in the northern portion of the planning area, along Clover Groff Run. Hilliard Municipal Park at 133 acres is the third largest park in the planning area and offers a mix of activities including a swimming pool and athletic fields. Spindler Park and Alton Road Park are the next largest park facilities in the planning area at 109 and 103 acres respectively. Together these three parks offer about 300 acres of parkland to residents in the central and north part of the watershed. Other parkland accounts for less than 100 acres. Homestead Park in Washington Township is located along the planning area boundary and provides facilities. By contrast, the majority of parks in the southern portion of the planning

area are part of the Metro Parks system.

The Westland Area Commission is currently undertaking a recreation facilities study. The Department's recreation service delivery standards established in the 2003 Columbus Recreation and Parks Master Plan show a need for a recreation center in this area. Columbus is interested in establishing partnerships with other jurisdictions to deliver and maintain recreational services.

Trails and Greenways

Trail systems or greenways within the planning area are generally confined to existing park systems. Efforts to expand the greenway and trail system within the planning area and County are underway. The park agencies in Franklin County are partnering to deliver an interconnected multi-use trail system. The Heritage Rail Trail near Hilliard is a seven-mile multi-purpose trail from Old Hilliard to Plain City along the northeastern planning area boundary and provides a dedicated corridor for walking, jogging, bicycling, rollerblading and horse back riding. This effort is jointly managed and owned by Metro Parks and the City of Hilliard.

Metro Parks and Columbus Recreation and Parks are working to develop a greenway trail along right-of-way of the Camp Chase Rail corridor that when complete, will be an important regional linkage for central Ohio. The Camp Chase Rail Corridor could potentially connect into the Ohio-Erie trail systems of Cincinnati and Cleveland. Columbus is also planning a connecting trail along the Clover-Groff Run. Additional connections along Big Run Creek would link this corridor to the Scioto River Greenways Corridor.

Golf Courses

Golf courses within the planning area are generally evenly dispersed. However, most of the courses are privately operated and require membership for access. The five golf courses within the planning area include: Heritage Golf Club (private), Hickory Hills Golf Club (private), Mentel Memorial Golf Course at Bolton Field (public), Oakhurst Country Club (private), and Thorn Apple Country Club (semi-private).

3.3 Proposed Land Use

The proposed general land use plan, shown in Figure 3.7 is guided by several key concepts.

- Focus higher density development in a town center located between I-70 and US 40.
- Incorporate additional areas of higher density adjacent to the existing development of Hilliard and the City of Columbus along the eastern edge of the planning area where utility service can be provided.
- Provide for a Hilliard growth area that includes conservation development of 1 unit per acre.
- Provide several larger areas of conservation development in Brown, Prairie and Pleasant Townships – these are the areas that are unlikely to be served by sewer service.
- Incorporate the sensitive natural areas as part of a tier system that includes a protected zone as well as areas that should be targeted for protection in Tiers 1, 2 and 3.

The proposed general land use plan categorizes future land uses within the watershed into generalized land use categories. These categories were developed with consideration of current types of development in the watershed as well as standard categories that are typically found in community land use plans. The following paragraphs briefly describe all the land use categories, both conservation and development categories, that are part of the proposed general land use plan.

Proposed Generalized Land Use Categories	Acres	Percent
Agricultural Use	3,356	6%
Commercial	196	0%
Industrial	50	0%
Public / Semi Public	1,053	2%
Mixed Use	357	1%
Res Conservation Devp 50% Open Rural densities	9,406	17%
Res Conservation Devp 50% Open 1 du/ac	1,189	2%
Rural Residential	1,026	2%
Rural Estate	4,805	9%
Suburban Low Density 0.5-3 du/ac	149	0%
Suburban Medium Density 3-5 du/ac	4,073	7%
Urban Medium Density 5-8 du/ac	130	0%
Urban High Density 8+ du/ac	447	1%
Special Residential LEED	328	1%
Town Center*	1,825	3%
Golf Course**	729	1%
Existing Park**	6,266	11%
EC Protected	4,334	8%
Tier1	5,600	10%
Tier2	1,850	3%
Tier3	7,160	13%
Roads & Transportation***	1,701	3%
	56,029	**100%**

Figure 3.6 Proposed Land Use Categories
**Excludes identified Conservation areas in Town Center (about 675 acres)*
***Excludes Conservation protected area*
****Calculation considers only major* roads.

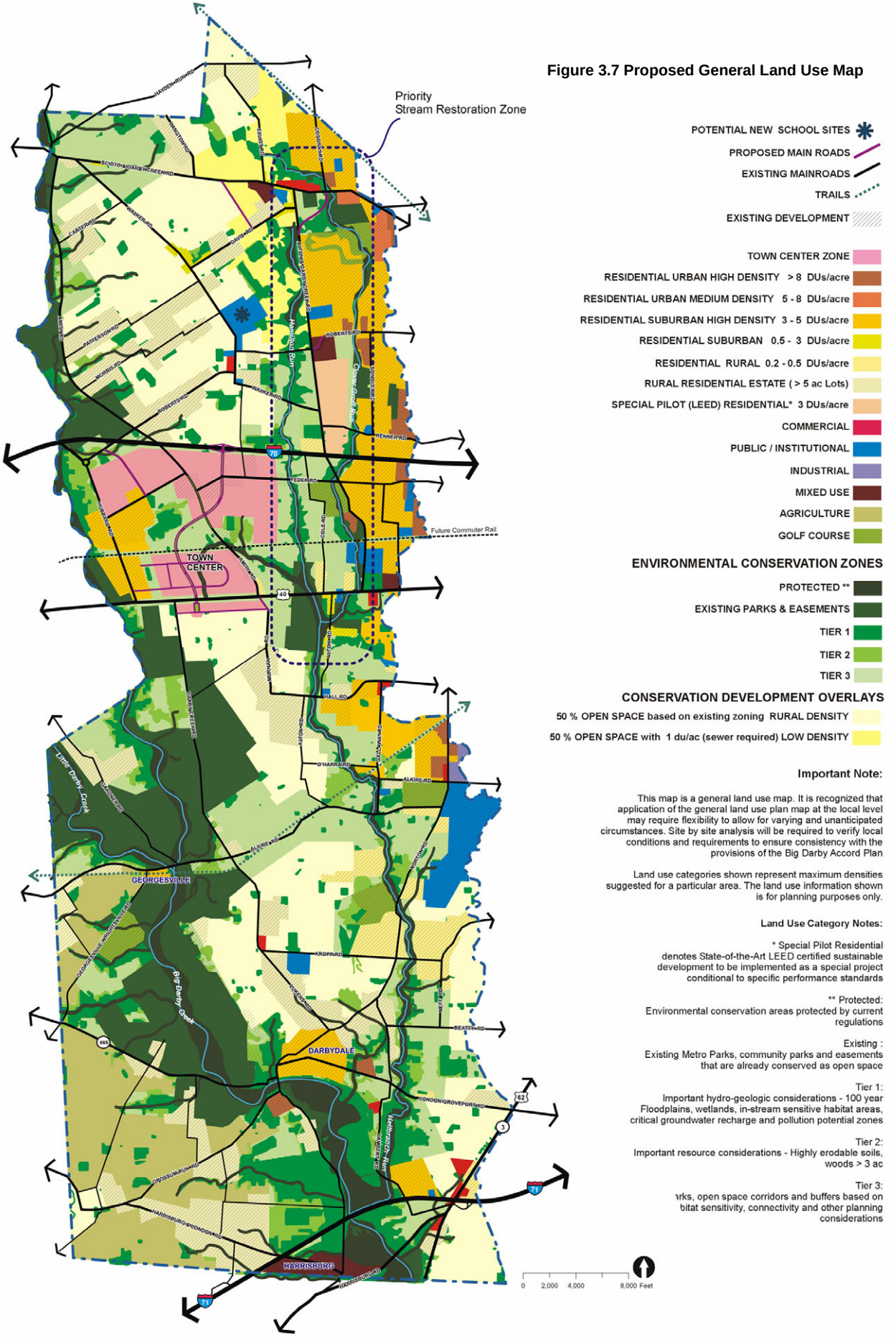
Conservation Land Use Categories
Land uses related to conservation, as described in Section 3.1, are an important part of the proposed land use plan and are referenced again below.

- **Protected Zone**: FEMA designated floodway or calculated beltwidth on all stream channels
- **Tier 1**: 100-year floodplains, wetlands, high potential groundwater pollution, high groundwater recharge areas
- **Tier 2**: Highly erodible soils, wooded areas greater than 3 acres
- **Tier 3**: Endangered habitat sensitive zones, proposed parks, corridors and connections, trails
- **Parks**: Existing parks
- **Golf Course**: Existing golf courses

Development Land Use Categories
Categories of land use have been developed to provide for future residential, commercial and institutional uses. These include the following

- **Conservation Development Low Density:** 50% open space at 1 dwelling unit (du) per acre; sewer service required
- **Conservation Development Rural Density**: 50% open space based on existing zoning; no central sewer provided
- **Special Pilot LEED ND Residential:** 3 dwelling units per acre and LEED ND certification suggested
- **Residential Suburban Density:** 3-5 dwelling units per acre
- **Agriculture**: Farmland
- **Town Center Zone:** Mixed use residential, retail and commercial center
- **Mixed Use**: 5-8 dwelling units per acre with limited neighborhood retail uses
- **Commercial:** local or regionally serving commercial and office uses
- **Public/Institutional:** Schools, community facilities, government services, libraries

Figure 3.7 Proposed General Land Use Map



3.3.1 Town Center

The Town Center concept is consistent with the goals of smart growth. Smart Growth encourages sustainable development that minimizes suburban and ex-urban sprawl and encourages higher density development in urban areas adjacent to transit or other exiting infrastructure systems. Principles of smart growth include:

- Mix Land Uses
- Encourage Compact Building Design
- Create a Range of Housing Opportunities and Choices
- Create Walkable Neighborhoods
- Foster Distinctive, Attractive Communities with a Strong Sense of Place
- Preserve Open Space
- Strengthen and Direct Development toward Existing Communities
- Provide a Variety of Transportation Choices
- Make Development Decisions Predictable, Fair, and Cost Effective
- Encourage Community and Stakeholder Collaboration in Development Decisions

The intention of the Town Center development is to create a highly desirable mixed-use area that includes a full range of residential, retail, office and public uses including parks and open space. Town Center is envisioned as a walkable village that includes retail uses facing key streets to create a lively and visually appealing community. The streets would have well proportioned sidewalks along small urban blocks along with parks and open space areas to help ensure a strong pedestrian ambiance. The Town Center core should be a safe, attractive, efficient, walkable area with convenient connections to residential neighborhoods and nearby transit. Although many people will still drive to the Town Center core, once there, they should be able to park once and walk to other destinations. The Town Center should create an environment that people will return to repeatedly for more than just shopping purposes. The Town Centers should satisfy everyday needs and provide enticements to linger and relax.

Multi-family housing
Source: EDAW

Single family housing
Source: EDAW

Mixed use development
Source: EDAW

Town center residential development
Source: EDAW

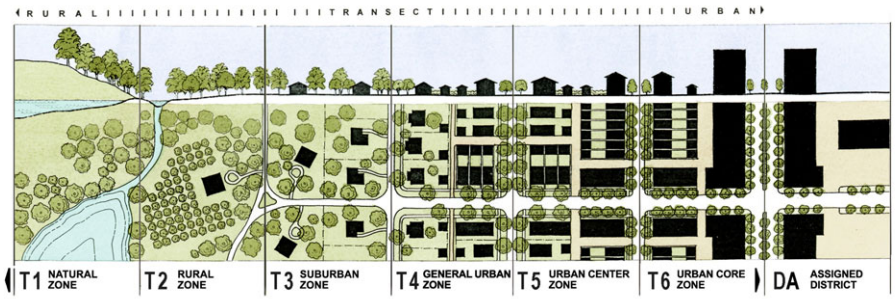
The Town Center should evoke special characteristics that set it apart from its surroundings and contribute to its individuality. The Town Center should strive to create community character with identifiable characteristics which can include:

- Preservation of environmentally sensitive areas
- Sustainable building practices and design
- Mixed uses both vertically and horizontally
- High density development in the core of the Town Center with transitions to surrounding lower density and existing development
- A broad range of housing types and price levels, bringing people of diverse ages, races, and incomes into daily interaction
- A variety of neighborhood to regional-serving commercial, office, and entertainment uses
- Well organized public spaces including parks, formal and informal spaces
- Incorporation of historic and cultural resources
- Regional stormwater facilities to protect water quality and enhance natural resources
- Community facilities and services
- Pedestrian orientated design
- Quality design and materials
- Access to existing and future transit opportunities

While the general land use plan illustrates a zone for the Town Center, it will likely include a mix of uses developed over time and through phases. The uses are envisioned to include residential, retail, commercial, office, institutional, park, and natural areas. Application of a concept termed 'transect' can help provide form for the town center and ensure the edges of the town center transition smoothly to less urbanized areas.

Planning Transect
"Transect" is a term and concept created by urban planner and architect Andres Duany to illustrate the effective transition from an urban core to a natural setting. This transition, which occurred organically and naturally in the past, now must be carefully considered since current zoning regulations have separated and segmented uses creating a disjointed landscape across urban, suburban and rural areas. Classified by zones, it is designed to allow for a seamless and orderly transition between urban and rural areas. By developing according to the transect model, single-use zoning is set aside, allowing for the appropriate mix of uses within each zone and encouraging a mix of design options. On the macro scale, the transect can be used to revise existing zoning codes and on the micro scale it can be used on large scale master plan developments.

The transect has six zones beginning with the Natural Zone that is conceived as permanently protected open space. This zone transitions into the Rural Zone which features large lot development on land that is environmentally sensitive and scenically valuable. The Suburban Zone consists largely of single family homes but can contain a mix of appropriate uses within walkable distances such as neighborhood retail, schools, and institutional uses. This mix of uses becomes richer as the transition continues into the General Urban Zone that features more residential density. The Urban Center and Urban Core Zones are the densest and most urban zones in the transect and have the largest mix of uses. The Urban Center Zone can be described as a neighborhood center or a town center, while the core is typically envisioned as a more regional center.



Transect Concept
Source: Smart Code Version 8.0

A transect concept should be applied to the Town Center to provide an acceptable transition from high density to surrounding rural developments. The urban core of the town center should gradually recede into more rural style development like conservation development and open space. Following a transect concept allows denser, concentrated development in the Town Center to coexist and seamlessly integrate with any existing development and environmentally sensitive areas.

To ensure a well planned and high quality town center is created, a more detailed Master Plan should be pursued as discussed in Section 5.0. Additional policies related to the mix of uses, design and character of the Town Center are described in Section 4.0

Density / Level of Development
The number of residential units anticipated to occur within the initial development of the Town Center is approximately 5,000 units, based on a sewer capacity analysis further discussed in Section 4.9. The total amount of development may increase depending on sewer service availability. Planning and design of the Town Center will be driven by the location of available utilities. Flexibility near the town center zone edges related to existing zoning, environmental features and the provision of services should be considered and addressed in the Master Plan process. Initial phasing should begin along West Broad Street.

To achieve a successful Town Center, a base level of density should be established within the core area of Town Center. This base level of density would allow for a mix of uses and encourage the creation of pedestrian friendly environment. Based on successful Town Centers both within central Ohio and from around the country, it is recommended that the core area be developed with a minimum of 8 units per acre to a maximum of 15 units per acre. Another approach to managing the density would be based on Floor Area Ratio (FAR). Floor Area Ratio is a method of calculating the building intensity allowed on a site. Floor Area Ratio is expressed as the gross floor area permitted on a site divided by the total net area of the site, expressed in decimals to one or two places. For example, on a site with 10,000 net sq. ft. of land area, a Floor Area Ratio of 1.0 will allow a maximum of 10,000 gross sq. ft. of building floor area to be built. On the same site, a FAR of 1.5 would allow 15,000 sq. ft. of floor area. To create a successful Town Center the FAR would likely be between 1.0 and 2.0.

These densities should be further explored and refined as part of the detailed Master Plan recommended for the Town Center.

3.3.2 Conservation Development

As Central Ohio has grown, people have migrated to what have become known as "subdivisions" located in more suburban or rural areas, including the Big Darby Accord planning area. Much of this type of development has followed a traditional design, which some have described as "checkerboard or cookie-cutter housing development." The residential zoning ordinances have encouraged such traditional designs by requiring minimum lot sizes, uniform road frontage and lot setbacks, specific road standards, and other standard requirements. In general, the only open space within such developments has been the yards between adjoining privately owned housing lots. In many cases, little planning went into preserving or improving the quality of the open-space areas or protecting natural features on the developed parcel.

Conservation development
Source: EDAW

Conservation development
Source: EDAW

This pattern of land use and land consumption has resulted in many people asking the question of whether we are creating a high quality of life in our communities. Conservation development, also sometimes referred to as cluster development, is an approach to development that allows residential development while still protecting the area's environmental features, allowing for more open space, and protecting the rural character of the area.

The rural character of western Franklin County is a contributing factor to the quality of life enjoyed by residents who live in the area. Rural character within the Big Darby Accord exists due to the predominance of open space, natural landscape, vegetation in the area and the emphasis on traditional land-based uses like agriculture. Other rural characteristics include significant park lands and equestrian activities. Several small communities exist, such as Darbydale and Georgesville, that provide concentrations of businesses and homes;

Highlight on Conservation Development

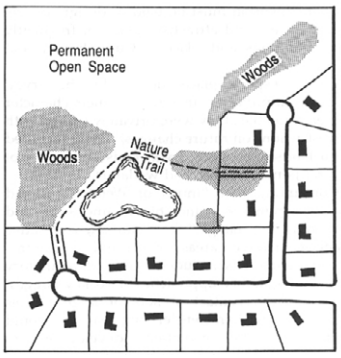
Well-designed conservation developments may benefit the whole community in terms of stormwater management. These developments usually have less impervious surface cover and provide more open space for water infiltration. These two factors combined can help reduce the amount of stormwater runoff leaving the property and thus decrease the chances that the new development will cause flooding problems. Although traditional subdivisions may be required to build stormwater detention areas, these structures usually only reduce the flow rate of water, not the increased volume. Natural areas, such as wetlands or native plantings that are a part of the conservation development's open space can help manage stormwater by reducing the volume of runoff and cleaning the stormwater during the infiltration process.

Another advantage of conservation developments is that they generally use less mass grading of the parcel's soil surface. Such grading can compact the soil and increase runoff even on areas where there is no construction. Road ditches in cluster designs are often grass swales instead of curb and gutter. These grassy areas allow for more water infiltration and are often less costly for developers and require less maintenance from the homeowners' association or community (http://www.urbanext.uiuc.edu/lcr/LGIEN2000-0010.html).

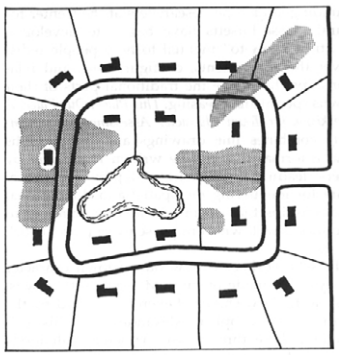
Conservation development is not a new concept to the Big Darby Accord planning area. Prairie Township is developing a planned residential conservation development overlay district to promote the creation of conservation developments. Brown Township's recently adopted Comprehensive Plan identifies conservation development as the preferred land use for a majority of the rural township. Policies must be adopted and in place to allow for conservation development, as described in Section 4.0. Developers often cite local regulations as the primary reason more innovative designs are not used. More flexible regulations does not mean "anything goes," however. Traditional codes must be replaced with new design standards that address the goals of conservation development, such as open space preservation, etc.

however, a large amount of homes are located on isolated parcels. Typically, rural communities maintain a limited expectation of urban services and infrastructure such as sewer, water, urban roads, curbs and sidewalks Conservation development is a design strategy for residential development that can lead to increased protection of existing natural resources on and off-site. Conservation developments incorporate open space as part of the design with consideration of existing site topography, soils, vegetation, natural drainage patterns, and other sensitive or unique landscape features. Protected natural areas provide wildlife habitat, protect biodiversity, and can contribute to improved water quality, regional greenways and natural area networks. Like other land use types, conservation developments integrate stormwater Best Management Practices (BMPs) throughout the site, utilizing the site's natural features to protect and restore natural hydrology, habitat and water quality. Development costs for site preparation and stormwater management infrastructure is often reduced since only a portion of the site needs modification.

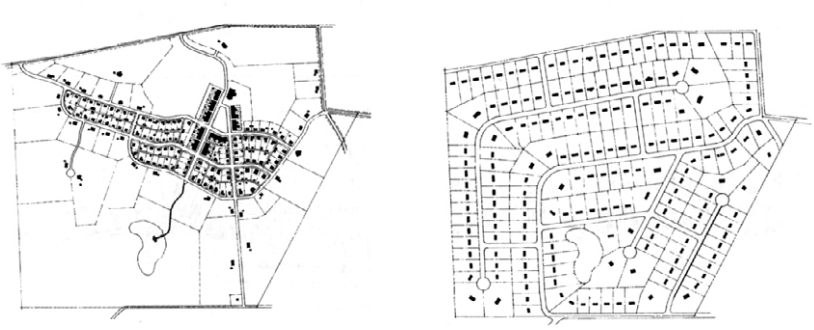
Conservation developments differ from traditional developments in several ways. Conservation developments usually site homes on smaller lots with less emphasis on minimum lot size. The same number of homes is clustered on a smaller portion of the total available land. The remaining land, which would have been allocated to individual home sites, is now converted into protected open space and shared by the residents of the subdivision and possibly the entire community.



20 lots
25 acres open space
Pond access for all residents



20 lots
No open space
No pond access except from four lots



These two plans provide the same number of dwelling units. The conservation develoment, left, uses smaller parcesl and a range of unit types on a much smaller footprint, allowing the surrounding area to be maintained as open space. The conventional development, right, more typical of current residential zoning, offers no open space and limits access to the pond to those homes which front along it. The amount of roads and infrastructure required for the conventional site development would most likely be greater than costs for the conservation development. Source: Arendt, 1994.

3.3.3. Other Residential Uses

Along West Broad Street, east of Hellbranch Run, residential development of 3 to 5 units per acre is identified. These areas are expected to have access to central sewer through the extension of the Big Run Trunk sewer line to the town center.

Another residential category, identified on Figure 3.7 as Special Pilot Leadership in Energy and Environmental Design (LEED) Residential, is located north of I-70, between Clover Groff and Hamilton Runs. Due to the sensitive nature of this location and gateway into the watershed, this area should serve as a model development for sustainable design through application of LEED principles. Application of LEED principles should be encouraged throughout the entire planning area. LEED is further described in Section 3.4.

3.3.4 Mixed Use

The mixed use areas identified on the general land use plan are intended to occur at key locations within the planning area. The Mixed-Use areas are intended to be neighborhood or community centers that provide a focus for locating uses that will support surrounding residential

communities. The mixed-use designation provides some flexibility in what uses could occur in these areas, however, a blend of residential, retail, commercial, and institutional is recommended. The density of mixed-use areas should be slightly higher than the surrounding lower density residential areas they would serve. The overall density of the proposed mixed use areas is envisioned as 5 to 8 units per acre along with supporting commercial uses. The goal of these areas is to create a "village center" environment, encouraging development within a limited area that could support some commercial uses oriented toward the street and create an attractive pedestrian environment.

3.3.5 Agriculture

The Accord Plan recognizes that farming is an important local and regional industry. Development patterns, increased traffic, demand for higher yield crops and costs associated with farming have caused many local farmers to sell their land for development in order to realize a return on their investment.

Active agriculture uses are expected to continue within the planning area; agriculture is a permitted use within the proposed conservation development areas. Over time, it is anticipated that many of today's active farms will transition into conservation development and as a result active agriculture is not a dominating land use on Figure 3.7.

The Accord should work with local farmers to implement practical best management practices to reduce the impacts that farming practices have on local water quality. Many existing, local programs, such as agriculture easements, can result in tax savings for land owners. In cooperation with local organizations like Ohio State University Extension, FSWCD and NRCS, new programs should be promoted in the watershed that creates financial incentives encouraging farmers to reduce pollutant loadings.

3.3.6 Transportation Considerations

With I-70 and US Route 40 being major east-west arterials that traverse downtown Columbus and serve the overall region via interchanges with I-270, it is only logical that development will continue to progress westward along the US 40/I-70 corridor. Based on the general land use plan, the Town Center would have its primary access via a major gateway on US 40 and a new interchange on I-70. Murnan Road could provide access to the Town Center from areas south of US 40 while Feder Road could link the Town Center with Alton-Darby Creek Road.

Based on an initial 5,000 dwelling units, the Town Center could generate up to 10,000 work-related vehicle-trips during the morning and afternoon commuter peak hours. With the primary employment zones being to the north in Hilliard and Dublin, to the east toward downtown Columbus, and around the I-270 corridor, the majority of the drivers will desire to use Alton & Darby Creek Road (and Cosgray Road), I-70, and US 40.

As the primary east-west roadway providing direct access to developments along the US 40/I-70 corridor, steps should be taken to protect and improve mobility and traffic flow along US 40 – while at the same time balancing this regional need with proper access for major developments. A significant portion of US 40 east of Big Darby Creek to I-270 is under the jurisdiction of Ohio Department of Transportation (ODOT). Access points for new developments must adhere to the guidelines set forth in the State Access Management Manual. Unfortunately, much of the area east of Hilliard-Rome Road has been developed and numerous access points and intersections (together with excessive traffic demands) yield traffic delays and sluggish traffic flow.

In order to yield a successful Town Center development with appropriate access, considerations should be given to improving and enhancing the US 40 corridor.

As the Town Center continues to develop, consideration should also be given to the establishment of a new interchange on I-70. A new interchange will further improve accessibility for the Town Center and will relieve traffic demands on Feder and Renner Roads (as they feed the Hilliard-Rome Road interchange). This will also reduce traffic demands at the Hilliard-Rome Road interchange and create a more balanced regional roadway system.

As shown on the general land use plan, the proposed I-70 interchange would be "one-sided" and not have a roadway extending to the north. The intent is to primarily serve the Town Center to the south. However, it is recognized that any new interchange will provide the "opportunity" for drivers to access points to the north. The impact of this travel on the roadway systems to the north of I-70 will have to be carefully evaluated in an Interchange Justification Study that will need to be submitted to ODOT and the Federal Highway Administration.

The Interchange Justification Study will need to address the potential for new development within the interchange area. It is common for intense auto-oriented development to surround freeway interchanges. If proper land-use controls are not in place new development at the new interchange could quickly overwhelm the area. The Accord jurisdictions will need to work together to ensure that any development near the interchange is consistent with the Accord Plan and proposed Town Center Master Plan.

3.4 LEED Principles of Design

Another key concept that should be incorporated in site design and community planning in the Accord planning area is outlined by Leadership in Energy and Environmental Design (LEED). LEED is a rating framework that has been developed for buildings – also known as the Green Building Rating System. The general land use plan identifies an area of about 350 acres for residential development that is encouraged to develop using LEED techniques. Many communities and developers around the country are adopting LEED practices and seeking to have their buildings certified as LEED rated buildings. Arlington, Virginia for example requires all public buildings have a goal of achieving a silver rating for new buildings. For the purposes of a large planning area like Darby Accord, the focus is less on individual buildings and more on community and site planning. LEED is developing a new rating system called LEED ND (Neighborhood Design) that focuses on elements that bring the buildings together into a neighborhood and relates a neighborhood to its larger region. It is strongly encouraged that Accord jurisdictions incorporate these concepts into development – particularly the areas that include higher densities that can achieve the goals of LEED ND.

The LEED ND rating system is divided into "prerequisites" and "credits". To achieve a basic LEED ND certification, a project must achieve all the prerequisites to achieve a higher certification such as silver, gold or platinum, a project needs to achieve a certain amount of the credits.

The categories included in this system are:

- **Location efficiency** which addresses the issue of development (or redevelopment) within the urban environment versus development on Greenfield areas at the edge of the region
- **Environmental preservation** which includes protection of ecological communities, sensitive environmental areas, and site design that supports protection and creation of high quality natural environments.
- **Compact, Complete, and Connected Neighborhoods** which includes providing for a diversity of uses, creating pedestrian friendly environments, and cluster of development

A goal of the Big Darby Accord should be to integrate the LEED ND standards into the day to day practices making the Accord area a leader in Central Ohio for sustainable design.

3.5 Water Quality

Water quality considerations of the land use plan have been addressed through a hydrological modeling exercise and an assessment of stormwater management policies and best management applications. The modeling process and outcomes are described in the following section, followed by a discussion of stormwater best management practices. Appendix A provides a more detailed discussion about the modeling process.

3.5.1 Water Quality Modeling

The purpose of water quality modeling was to determine the impact on water quality, measured in terms of pollutant loading, related to proposed land use changes within the planning area. Using the Soil and Water Assessment Tool (SWAT) software, a baseline condition model was created similar to the Generalized Watershed Loading Functions (GWLF) model established by the Ohio EPA (OEPA) for the Big Darby Creek TMDL analysis and report. The SWAT baseline model was calibrated for flow to the U.S. Geological Survey (USGS) gage along Hellbranch Run; the model was then calibrated to the EPA's GWLF model results for Total Nitrogen (TN), Total Phosphorous (TP), and Total Suspended Solids (TSS).

Although the Ohio EPA did not publish calculated TN loadings in the TMDL report, the Ohio EPA provided detailed and summary model results that included those values for the Hellbranch Run watershed and other subwatersheds that are at least partially within the Big Darby Accord planning area. The final calibration model's parameters were then used to analyze the effects of the land use plan,

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	Overland Runoff TSS (kg)	Construction/ Channel Erosion TSS (kg)
TMDL Existing	NA	NA	59/41	NA	16,359	3,051,200	17,594,074
TMDL Allowable	NA	NA	NA	NA	3,175	1,086,249	
SWAT Baseline model + PS	344.4	39.3	54/46	190,885	15,944	3,439,721	17,594,074
SWAT Final Land Use Scenario model + PS	369.8	42.2	62/38	113,617	4,517	1,023,087	17,594,074

Figure 3.8 Calibration and Final Land Use Model Results
PS – Point source loading
mm – millimeters
cfs – cubic feet per second
SF/BF – surface flow / base flow

comparing the pollutant loadings predicted by the SWAT model to the target water quality goals published in the Ohio EPA TMDL report. The model results were also used to evaluate the requirements for stormwater BMPs, in an effort to mitigate the impact of changing land uses and development on pollutant loadings.

Pollutant Loading Considerations
The pollutant constituents analyzed are those that are commonly considered and are most likely to be affected by changing land use conditions including TN, TP and TSS. Heavy metals, especially within the Big Darby Accord planning area, did not appear to be a significant consideration in the published TMDL. Furthermore, there are no anticipated future industrial land uses or other point source contributors within the planning area that would be a significant contributor of those pollutants.

Planning area
The modeling planning area is essentially comprised of two large sub-watersheds: the Hellbranch Run sub-watershed and all other areas within Franklin County that are directly tributary to Big Darby Creek. Each of these sub-watersheds was divided further into 51 sub-basins to allow for a more detailed analysis.

Calibration Model
The calibration model represents the existing land use condition within the planning area. The land use coverage used in the calibration model was provided by the Ohio EPA and is identical to that used in the TMDL analysis.

After all data input was completed, the SWAT baseline model was calibrated for flow to the USGS gage along Hellbranch Run; the model was then calibrated to the EPA's GWLF model results for TN, TP and TSS. All calibration operations were performed using data for the Hellbranch Run sub-watershed.

The results of the calibration modeling serve as the baseline for comparison to the final land use plan, described below. This comparison allowed for a determination of the changes in pollutant loading related to the changes in land use for the planning area.

Final Land Use Plan Model
The final land use plan model was established from the baseline (calibration) model by changing the land use coverage to reflect projected build-out conditions. The fundamental changes related to the final land use plan are described below.

1. Converting existing agricultural land uses to a variety of urbanized land uses, varying from a low density (conservation development) residential to a commercial level of development.
2. Converting existing agricultural land uses to preserved open space (conservation areas).

Pollutant	Percent Loading Reduction[1]	
	Hellbranch Run Watershed	Entire Planning area[2]
TSS[3]	70% (95%)	44%
TP	72% (81%)	65%
TN	41% (N/A)	40%

Figure 3.9
Comparison of Baseline Condition to Land Use Plan
[1]Compared to SWAT Baseline model
[2]Includes areas directly tributary to Big Darby Creek
[3]Pertains only to the overland runoff component of TSS
(%) – percent reduction prescribed in the TMDL; no value published for TN

Conclusions

The modeling analysis was successful in duplicating the results from the TMDL study, in particular for the Hellbranch Run watershed. With that modeling serving as a baseline for comparison, it has been determined that the general land use plan for the Big Darby Accord will ultimately reduce the level of pollutants that are contained in stormwater runoff and discharged to Hellbranch Run or directly to the Big Darby Creek main stem. The percent reduction in the various pollutants for Hellbranch Run and for the larger planning area is shown in Figure 3.10. As expected, the increase in impervious area associated with the urbanizing land uses contained within the land use plan will increase the calculated average annual flow rate and cause a re-distribution of the surface flow/baseflow relationship within the planning area.

The percent reductions noted in Figure 3.9 for the Hellbranch Run watershed are less than those specified in the TMDL to obtain the target levels for those pollutants (Note: TN is not presented in the TMDL). Furthermore, the comparison of TSS only pertains to the overland runoff component of that pollutant. The TMDL contains additional information relating the additional loading associated with construction activities and channel bank erosion. Considerations to reduce these individual components include comprehensive erosion and sediment control criteria and incentives to promote stream bank stabilization and/or restoration activities within the watershed.

It is important to note that the results represented by the SWAT modeling exercise represent and summarized within Appendix A are only an analysis of land use changes within the Accord planning area and do not account for stormwater BMP applications or specific site planning practices, such as low-impact design, that would further reduce pollutant loading or increase infiltration from urbanizing land uses. Other important observations regarding the modeling and the accompanying results are described below.

- The significant reduction in pollutants when comparing the final general land use plan to the baseline condition can be attributed to the replacement of agriculture with urbanizing land uses and the representation of conservation open space that replaces a considerable amount of land currently being used for agriculture.
- The analysis performed does not represent the presence of field tile that exists in conjunction with agricultural land uses. Eliminating field tile would likely reduce the change in flow rate and the surface flow/baseflow relationship.
- Stream restoration activities can have a beneficial impact on multiple facets of the modeling provided for this study. Stream restoration to add floodplain storage can mitigate the impact of increased flow associated with urbanizing areas and can increase the assimilative capacity of pollutants conveyed within the stream channel, particularly TSS.

Impervious Surfaces

The percentage of the total impervious area (PTIA), or the amount of the watershed covered by surfaces preventing water infiltration, has been found to be predictive of the amount of stress and degradation to streams. An estimate of impervious surfaces for the land use plan at build-out within the planning area indicates an increase from approximately 6 % (existing conditions) to approximately 10%.

While there is some degree of variability for threshold PTIA levels, ranging between 5% and 15% according to various studies, the goal of 10% is a commonly identified threshold for many

Researchers	State	PTIA Threshold
C. May (1997)	Washington	5-10%
R.D. Klein (1979)	Maryland	10%
E.J. Shaver, G.C. Maxted, D. Carter (1995)	Delaware	8-15%
T.R. Schueler & A. Gali (1992)	Maryland	15%
G.C. Maxted (1996)	Delaware	10-15%
R.C. Jones & C.C. Clark	Virginia	15-25%

Figure 3.10 Percent Total Impervious Area (PTIA) Variability
Source: Schueler, T.R. 1994. The importance of Imperviousness, Watershed Protection Techniques 1 (3): 100-111.

watersheds within the United States (Figure 3.10). It is also important to understand that 'imperviousness' is merely an indicator of various cumulative hydrological impacts to the waters and is not by-itself the cause of degradation. This concept is important within the context of the Darby Accord Plan which emphasizes best management practices and low-impact development to minimize effects of development with a comprehensive multi-strategy approach. The Appendix provides a more detailed analysis of water quality modeling efforts.

3.5.2 Stormwater Management

Stormwater management involves managing the volume, the intensity and the quality of stormwater discharges into receiving waters. Changes in land use and development can alter both the quality and quantity of stormwater runoff. To meet the water quality goals of the TMDL, application of a comprehensive stormwater management program will be required, incorporating various aspects of both structural and non-structural BMPs.

In areas undergoing new development, such as the Accord planning area, the most effective methods of controlling impacts from stormwater discharge are to limit the amount of rainfall that is converted to runoff and to capture and treat the runoff that is generated. By utilizing structural and non-structural techniques for achieving these goals, site development activities can be planned and designed in such a manner that the impacts on the watershed associated with development can be mitigated.

Structural BMPs are constructed features often included with or adjacent to a development site that receive, capture and provide some mitigating treatment for stormwater volume and pollutant constituency associated with runoff from that site. Non-structural BMPs are best represented by low-impact development techniques that are reflected in how a development site is planned to reduce the amount of impervious surface and/or the connection between impervious areas. The application of these different approaches to the site development process may depend on the type and density of development permitted by the land use zoning.

The Ohio EPA has released a draft permit for the Big Darby Creek watershed (Ohio EPA Permit No. OHC100001) related to water quality controls to be used during construction, titled *Authorization for Storm Water Discharges Associated with Construction Activity Located Within the Big Darby Creek Watershed Under the National Pollutant Discharge Elimination System.* The draft NPDES permit details the measures that developers must implement to control runoff during construction activities and provides criteria for post-construction water quality. Along with the guidelines of the Ohio EPA permit, several strategies have been identified to address water quality related to development in the watershed. Policies related to stormwater management are further described in Section 4.0

Low-Impact Development

Increased development typically brings increased stormwater runoff volumes in conjunction with an increased pollutant load from the runoff. The increased quantity of stormwater and the associated pollutants can lead to degradation of the stream channel, water quality and habitat, increased channel erosion and overbank flooding. The core principle of low-impact development is the planning and design of development projects that have a reduced impact on watersheds, accomplished through the basic principles listed below.

1. Reducing the amount of impervious cover within proposed developments.
2. Increasing the natural land set aside for conservation.
3. Using pervious areas for more effective stormwater treatment.

These practices, recommended for stormwater and stream protection by the Hellbranch Watershed Forum, result in the conservation of natural features and resources, reduction in impervious surfaces for roadway and parking lot areas, concentration of development in less sensitive areas and the use of natural areas for stormwater management. Better site design practices address both water quality and quantity management from developments. The practices result in a more natural and cost effective stormwater management system that reflects the natural hydrologic conditions of the site and can reduce long term maintenance.

A previous stakeholder initiative, referred to as Central Ohio Regional Forum Darby Watershed Advisory Group, developed twenty-two model development principles related to land use development and best management practices that are applicable to the Accord process. These model development principles can be found in the document entitled *Darby Creek Watershed Stormwater Management Strategies and Standards for New Development, 2001.* Many of the principles relate to site design recommendations to minimize stormwater impacts while others

are more closely tied to treatment mechanisms. Those that directly reference BMPs (not including site design principles) have been listed below. In addition, principles adapted from the document entitled *EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002,* provide a solid foundation for future development policies regarding BMPs; these have also been included below. Together these principles provide a solid foundation to begin considering a BMP toolkit suitable for the Darby watershed that will provide a level of protection that promotes watershed stability.

- Incorporate landscaped areas with cul-de-sacs to reduce impervious cover and provide stormwater treatment (Principle 4, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Where density, topography, soils and slope permit, vegetated open channels should be used in the street right-of-way to convey and treat stormwater runoff (Principle 5, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Advocate open space development that incorporates smaller lot sizes to minimize total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space, and promote watershed protection (Principle 10, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Wherever possible, provide stormwater treatment for parking lot runoff using bioretention areas, filter strips and/or other practices that can be integrated into required landscaping areas and traffic islands (Principle 9, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared drives that connect to two or more homes together (Principle 13, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas and avoid routing rooftop runoff to the roadway and the stormwater conveyance system (Principle 15, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Create a variable width, naturally vegetated buffer system along all perennial streams that also encompasses critical environmental features such as the 100 year floodplain, steep slopes and freshwater wetlands (Principle 16, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- The riparian stream buffer should be preserved or restored with native vegetation that can be maintained throughout the plan review, delineation, construction, and occupancy stages of development (Principle 17, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Clearing and grading of forests and native vegetation at a site should be limited to the minimum amount needed to build lots, allow access and provide fire protection. A fixed portion of any community open space should be managed as protected green space in a consolidated manner (Principle 18, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Conserve trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native plants (Principle 19, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- New development should not discharge unmanaged stormwater (Principle 21, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Enclosing, straightening, and relocating streams should be discouraged during all new development (Principle 22, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Clearly specify how community open space will be managed and designate a sustainable legal entity responsible for managing natural, recreational, and stormwater management open space (Principle 14, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Incentives and flexibility in the form of density compensation, buffer averaging, property tax reduction, stormwater credits, and by-right open space development should be encouraged to promote conservation of stream buffers, forests, meadows, and other areas of environmental value. Off-site mitigation for open space, stormwater management and forest resources (excluding riparian buffers) within the same watershed should be encouraged (Principle 20, Darby Creek Watershed Stormwater Management Strategies and Standards, 2001).
- Maintain predevelopment site hydrology by using site design techniques that store, infiltrate, evaporate, or detain runoff (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).
- Use natural hydrology as a design element and avoid alteration, modification, or destruction of natural drainage features (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).
- Protect areas that provide important water quality benefits, habitat areas or are particularly susceptible to degradation (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).

- Site plan review and conditional approval should address and ensure that the integrity of environmentally sensitive areas and areas necessary for maintaining natural hydrology and water quality will not be lost (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).
- Limit land disturbance activities, such as clearing and grading and cut-and-fill, to reduce erosion and sediment loss and limit disturbance of natural drainage features and vegetation during site development (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).
- Protect and retain existing vegetation to help control erosion (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).
- Minimize imperviousness to the extent practicable (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).
- Incorporate open space and natural areas into site designs with an emphasis on creating an interconnected green infrastructure that has positive benefits to water quality and quality of life (EPA National Management Measure to Control Nonpoint Source Pollution from Urban Areas, 2002).

Approach to LID Site Design

LID site design should begin with an inventory of existing site conditions and natural features of the site to determine protection areas as well as what natural features can be incorporated into the LID stormwater management system. An inventory of natural features would likely include streams, floodplains, wetlands, groundwater recharge protection areas, soil characteristics, slopes and conservation areas. The inventory will reveal the overall development envelope, defining where development will have minimal impact on hydrology and other sensitive features of the site and surrounding area. Reducing the overall development envelope allows for a larger portion of stormwater to seep into soils gradually, removing contaminants, replenishing soil moisture, and recharging the shallow groundwater condition naturally without piping infrastructure leading to a centralized end of pipe approach to stormwater treatment.

Once site characteristics are inventoried, potential site development layouts can be configured. Site layouts should be designed to minimize impervious areas, retain natural topography and use existing natural drainageways, swales, depressions and storage areas, ultimately minimizing the volume of runoff that must be treated in a stormwater management system. Methods that will help reduce site coverage include clustering development, increasing building heights (within the allowable zoning regulations), building parking structures instead of lots, reducing road widths and using permeable paving and green roofs.

Conventional stormwater treatment systems use a piped system leading to a central stormwater treatment center. Low impact development takes advantage of a decentralized stormwater system that is integrated into site design for both the function of treating water and as a landscape amenity. The goal of a low impact system is to increase the time of concentration through stormwater retention close to the source, open drainage systems (vegetated swales and filter strips), long drainage paths and vegetated paths. Decentralized structures may include swales, bioretention areas, infiltration structures, and filter strips that can be dispersed throughout a site.

A variety of techniques can be used in low impact development, allowing for customization according to local codes and management requirements, site constraints and opportunities and topographic and climate conditions. Although low impact development techniques have become more common recently, codes and regulations may be outdated and may not allow for such practices. Zoning bylaws, site plan review, subdivision rules and regulations, wetland regulations and building codes should all be revisited. Some of the more prevalent site design techniques include (Whole Building Design Center):

- Minimizing imperviousness with permeable paving or landscaping to break up expanses of impervious surfaces;
- Directing runoff into or across vegetated areas to filter runoff and encourage groundwater recharge;
- Preserving or enhancing natural vegetation near parking areas, buildings, and other impervious expanses in order to slow runoff, filter out pollutants, and facilitate infiltration;
- Reducing street and sidewalk widths where appropriate;
- Removing curbs and gutters from streets, parking areas, and parking islands to allow storm water sheet flow into vegetated areas;
- Using devices such as bioretention cells, vegetated swales, green roofs, infiltration trenches, and dry wells to increase storage volume and facilitate infiltration;
- Installing vegetated roofs or garden roofs;
- Grading the site to encourage sheet flow and lengthen flow paths to increase the runoff travel time in order to modify the peak flow rate;
- Disconnecting impervious areas from the storm drain network and

maintaining natural drainage divides to keep flow paths dispersed;
- Disconnecting roof downspouts and directing storm water into vegetated areas or water collection devices;
- Installing cisterns or sub-surface retention facilities to capture rainwater for use in irrigation and non-potable uses;
- Using native plants (or adaptable species) to establish an adaptable and low maintenance landscape that requires less irrigation and are appropriate for the climatic conditions;
- Using naturally occurring bio-chemical processes in plants located in tree box filters, swales, planter boxes.

Minimize Impervious Surfaces

Although roads are a basic component of any development, minimizing the overall road network coverage can serve as a significant component to implementing low impact development practices. Streets comprise the largest share (40 to 50%) of impervious cover in residential developments. Narrower streets can result in an impervious cover reduction of 5 to 20% for a typical residential subdivision (Schueler, 1995). Residential streets rank as a major source area for many stormwater pollutants, including sediment, bacteria, nutrients, hydrocarbons and metals (Steur; Bannerman). The majority of pollutants deposited on or along street surfaces gets washed up during storm events into the storm drainage system. Reduction of impervious surfaces allows for increased natural filtration and less stormwater runoff and pollutant loadings.

Promoting the use of narrower streets will reduce the amount of impervious cover created by residential development, reducing associated stormwater runoff and pollutant load levels. Many residential streets can accommodate two travel lanes and two parking lanes. Streets can be narrowed without sacrificing emergency access, on street parking or vehicular safety. The applicability of requiring narrower residential streets may be dependent on the development size. According to the Stormwater Manager's Resource Center, narrower streets can be used in residential developments settings that generate 500 or less average daily trips (ADT) (generally about 50 single family homes) and may sometimes also be feasible for streets that are projected to have 500 to 1,000 ADT. Reducing road widths may not be suitable for roadways that carry greater volumes of traffic or are not expected to have a constant traffic volume over time. Implementation of narrowed road widths may require a revision to local road standards and zoning codes.

When laying out new roads, consideration should be given to existing natural drainage patterns, sensitive areas and surface waters. Road design should give consideration to natural features and post development conditions, including topography, natural drainage patterns, soils, climate, existing land use, estimated traffic volume and sensitive land areas. These factors all influence the impacts of nonpoint source pollution, erosion and sediment problems. Consideration for these natural features can greatly minimize erosion and sedimentation and prevent NPS pollutants from entering watercourses during and after construction.

Structural BMP Applications

Stormwater runoff generated from proposed development areas must be controlled before it is released from the development site. Stormwater controls will address both the quantity and quality of stormwater discharge from a development site in order to maintain and/or improve the quality of the streams and receiving waters within the planning area.

For new development that occurs within the planning area, the application of structural BMPs will be an integral component of meeting the water quality goals of the TMDL. The various aspects of structural BMPs associated with site development can be distinguished within the categories described below.

- Stormwater quantity control – the application of stormwater detention facilities to address the increase in the volume and peak rate of flow associated with runoff from a development site.
- Groundwater recharge – the application of infiltration practices to reduce the amount of surface runoff that is discharged from a development site and increase the contributions to groundwater that sustains stream baseflow.
- Stormwater water quality – the application of stormwater features that capture and may also treat pollutants captured within stormwater runoff. This approach applies to both construction and post-construction phases of a development site.

An increase in development and the associated impervious surfaces increases the volume of runoff from a development site and can, therefore, increase the quantity of physical and chemical substances that have a detrimental impact on the water quality of the receiving stream. The primary pollutants of

concern within the planning area, identified in the TMDL, are TSS, TN and TP. All three of these pollutants have the potential to impact the aquatic health of the streams. Excess sediment within stormwater runoff can limit the areas in which certain species will locate, and can create many other problems. Nitrogen and phosphorous can lead to excessive algal growth, and a reduction in the available oxygen within a stream. As development occurs, there are two distinct periods of time where the control of water quality parameters must be considered: during construction and post-construction. Construction related water quality controls must primarily address the excess sediment that is present during construction activities, but are temporary in nature. By contrast, post development water quality controls must be able to control multiple pollutants over a long period of time. Considerations for both types of control are presented below.

Construction Phase Stormwater Control

The control measures included in the construction phase of development address runoff and sediment control.

Runoff control measures are applied to prevent or minimize the occurrence of erosion from disturbed areas. Acceptable BMPs recommended for use by the draft NPDES permit for the Big Darby Creek Watershed include rock check dams, pipe slope drains, diversion around exposed areas and protective grading practices.

Erosion control measures are applied to abate the release of eroded sediment from a disturbed area. Applications such as silt fence are significantly less effective at erosion control than sediment settling basins. The EAG recommends the use of sediment control ponds for all development sites, regardless of size. The current statewide NPDES permit (and the draft permit for the Big Darby Creek watershed) require that sediment basins be constructed for areas that receive drainage from disturbed areas of 5 acres or greater. At a minimum, the requirements of the Ohio EPA's permit must be followed within the Accord planning area, allowing for the use of silt fences and other erosion control BMPs to control sediment from sites less than 5 acres in size.

The draft NPDES permit for the Big Darby Creek watershed contains a target discharge of 45 mg/l TSS for up to a 0.75 inch rainfall in 24 hours that must be met for land area disturbances and is measured at the outfall of a sediment settling basin. The permit also requires the outfalls of such ponds be monitored initially and then quarterly through the project duration to insure compliance with the targeted sediment discharge limit from the basins.

More information regarding acceptable practices for both runoff and sediment control is contained within ODNR's *Rainwater and Land Development Manual.*

Post-Construction Stormwater Control

The unique sensitivity of the Darby watershed and particularly the Big Darby Accord planning area will require the application of techniques to ensure that the watershed is protected and that impacts of new development are minimized. Existing development and agricultural practices are already contributing to the impairment of streams including Clover Groff, Hamilton and Hellbranch Run and retrofitting existing development to address impacts may be beneficial and necessary to meet water quality goals.

The approach to developing within the Big Darby Creek Watershed will need to consider the unique environmental constraints and incorporate elements of good design and sustainability to ensure protection of important natural and biological resources, including water quality. Best management practices that incorporate innovative technologies are one mechanism available to assist with this effort. Best management practices are typically intended to control non-point source pollution on a development-site scale; however, their application can have positive watershed-wide impacts and can be applied to individual property owners, neighborhoods and municipalities.

Principles of Mitigating Water Quality Impacts

Information within this section is derived from the Northern Virginia Best Management Practices Handbook, prepared in 1992 by the Northern Virginia Regional Planning Commission and Engineers Surveyors Institute. The Northern Virginia BMP Handbook, which is a regionalized update of the nationally acclaimed BMP Handbook for the Occoquan Watershed, is intended for use by designers and reviewers of urban BMPs in meeting the water quality requirements and reflects initiatives related to improving water quality within the larger Chesapeake Bay watershed.

The basic mechanisms of pollutant removal operating in BMP facilities are the gravitational settling of

pollutants, infiltration of soluble nutrients through the soil profile and, to a lesser extent, biological and chemical stabilization of nutrients, discussed below. Extended detention stormwater basins utilize settling as the primary removal process, with some nutrient uptake by the vegetative cover and soils. Wet ponds utilize settling as their principle removal method as well, but the existence of a permanent pool also promotes biological and chemical uptake and some infiltration through the soil horizon. Infiltration trenches rely heavily on filtration through the soil profile for pollutant removal with some biological and chemical stabilization of pollutants.

Settling
The establishment of a temporary or permanent pool of water, as is utilized in both extended detention dry and wet ponds, results in conditions which can settle out particulate pollutants between storms. The particulate materials settle into the pond bottom sediments while some of the soluble pollutants may pass through the sediment to the soil profile below by means of infiltration.

Biological and Chemical Processes
Removal of soluble pollutants is accomplished primarily through the mechanisms of chemical and biological stabilization of nutrients. The biological activities of some species of plants, algae and other aquatic organisms can serve as a mechanism for removing soluble nutrients from the water column. Dissolved oxygen levels, temperature, sunlight and pH affect the biological stabilization of a pond. The underlying soil has also been identified as contributing to chemical transformation of nutrients in wetlands and BMP facilities.

Soil Infiltration
Infiltration is usually achieved by lining a trench with a stone aggregate and a surrounding filter fabric to act as a filter medium and to remove much of the suspended sediments and attached contaminants before entering the soil horizon. Subsequent passage of water through the underlying soil column provides further filtering and pollutant removal through aerobic decomposition and chemical precipitation.

An important concern which arises from the infiltration process is the potential infiltration of polluted stormwater through the soil column to the water table. In some instances this could add contaminants to the underlying aquifer system. This is of special concern if the aquifer is to be used as a potable water supply in nearby areas. In addition, the contribution of nutrients to groundwater may affect local streams whose baseflow derives significantly from groundwater, thereby re-introducing nutrients into the surface water that the BMP was designed to protect.

Where soils are appropriate, infiltration provides substantial hydrologic benefits. Structural practices treat runoff, but more is needed to effectively prevent and minimize impacts. Therefore additional management practices are strongly encouraged such as stream setbacks or reduction of impervious areas that influence the layout and design of a development site so that important hydrologic areas are maintained and impervious surfaces are limited. (ODNR)

3.5.3 Performance Goals

The TMDL report for the Big Darby Creek defines the maximum loading for pollutants of concern within the Accord planning area to meet the objectives of water quality within the watershed. To achieve these maximum loadings values, the TMDL defines a percent removal for each of those pollutants from the existing conditions within the watershed. Within the Hellbranch Run watershed, the total allowable TSS load is 1,086,000 kilograms per year, which is a 95% reduction from the TSS load reaching the stream under existing conditions. Based on this information, the stormwater BMPs that will be utilized within the planning area will have to meet the removal requirements of the TMDL. Additional information regarding BMPs and their ability to remove pollutants from stormwater runoff is presented in Section 4.

It should be noted that discussions involving representatives of The Ohio State University, Ohio EPA, the Ohio Department of Natural Resources (ODNR) and other parties are on-going regarding the most appropriate measure of a performance goal that would meet the objectives for water quality suggested by the TMDL. These discussions are contemplating a numerical pollutant loading value (or concentration) requirement for release from a development site rather than a percent removal efficiency as currently defined in the TMDL. The numerical load number would allow developers to calculate an absolute pollutant load value, likely in milligrams per liter, which the development site could discharge to the receiving stream or downstream system.

Water Quality Volume
The pollutants of concern within the planning area are largely settleable pollutants in that, if the velocity of the stormwater runoff is decreased to nearly zero, then the pollutants will settle out of the water column. This is true not only of the TSS components in stormwater runoff, but other pollutants that bind themselves to the solids and can then be captured through the settling process. Much of the pollution potential within a watershed comes from the most frequent rain events, which has been found to correlate to approximately the initial 0.75 inches of rainfall, often referred to as the "first flush" of stormwater runoff. The water quality volume is, therefore, that volume of water that is generated from a site during a 0.75 inch rainfall event. If the water quality volume is then captured within the limits of a development site for a certain period of time (usually varying from 24 to 48 hours) it is assumed that a large percentage of the pollutants of concern would be removed by the settling action that occurs during this time period.

The Ohio EPA has recognized the benefit that can be obtained by requiring a water quality volume draw-down time (the amount of time it takes for the water quality volume to be discharged from a development site), and within their draft permit include an equation to determine the actual water quality volume for a development site. In addition to the water quality volume calculation for all sites, the Ohio EPA includes draw-down times that are different for several different types of stormwater BMP applications.

BMP Pilot Study
A study of the application of various BMPs within a portion of the planning area was conducted to establish a scenario wherein the specified goals of the TMDL could be met. A summary report of that effort is provided in Appendix A.

Addressing Developed Areas
Many areas in the eastern portion of the planning area are already developed, especially in areas along Clover Groff and Hamilton Runs as well as Hellbranch Run. Similarly, these same areas are associated with declining water quality. As parts of the watershed develop, it will be equally important to identify ways to improve the conditions along these corridors. Developing areas typically provide considerably more opportunities to incorporate quantifiable land use-based and control-based structural and nonstructural BMPs. Once a landscape is firmly established, room may not exist to implement these techniques, or public reaction to change may prevent their implementation. In general, public education-style pollution prevention measures are the most applicable for "retrofitting" existing areas since they require no physical change in the landscape. However, these programs often do not result in quantifiable results. Street sweeping, as a control technique, is also highly applicable to existing urban areas and is often desirable for its positive aesthetic impact on the urban environment.

In agricultural areas, techniques to address water quality are also very important. Non-structural BMPs are more often associated with retrofitting an agricultural land use. Promoting stream setbacks as riparian corridors and filter strips are the most obvious and prominent techniques for addressing water quality impairments in these areas. A concept for "controlled drainage" has also been developed and promoted by individuals affiliated with The Ohio State University. This unique application utilizes control structures placed on-line with existing field tiles to create a mechanism for manipulating the ground water table within a agricultural field. The application promotes a higher groundwater table during the growing season when fertilizer and pesticide applications are most prevalent and impedes the release of the residual components of those chemicals to the receiving stream.

A major consideration will be the willingness of property owners, and the amount of adequate space and condition of the area. The identification of potential retrofit sites should be developed in cooperation with ODNR, Metro Parks, the local agricultural community and other key agencies that are already actively pursuing efforts in the watershed to improve water quality. Multi-agency pursuits often have added weight when it comes to funding priorities.

3.6 Stream Restoration

The TMDL for the Big Darby Creek watershed and other related Ohio EPA publications identify areas of impairment along the major watercourses within the planning area. The impairment constitutes a physical degradation of the stream channels that has led to a low or non-attainment of aquatic life use within the channel. Based on those findings, it is clear that the areas of highest degradation are along the upper reaches of the Hellbranch Run watershed, associated with Clover Groff and Hamilton Runs. The TMDL cites the conditions associated with an urbanizing

watershed, as it impacts Clover Groff Run and is conveyed to Hellbranch Run. Other than the consequences of an urbanizing watershed, the most obvious component of impairment within both of these channels is that they have been hydromodified through the ditching process. The ditching process constitutes a widening and deepening of the channel and is most commonly associated with the drainage of adjoining agricultural fields. As an additional form of impairment, the riparian buffers along both Clover Groff and Hamilton Runs have been encroached upon by the practices of the adjoining urban and agricultural land uses.

A stream channel that has undergone the ditching process will most likely suffer from the significant impairments described below. In each case, it would take some physical correction to the channel morphology and/or adjoining buffer area to reverse the condition of impairment.

- A stream channel that is over-deep and over-side has a shallow gradient (slope) that reduces the ability of the channel to convey bedload materials that are a component of habitat within the stream. Low gradient streams are often characterized by a condition of aggradation, where sediment runoff from within the watershed accumulates within the channel, smothering substrate material and filling pools that are a source of habitat to the macro invertebrate and fish community, part of the overall ecosystem within a stream.

  The channel is often further impaired by the fact that it is now incised, meaning that it is disconnected from the natural floodplain. This disconnection leads to a condition where the channel now is required to carry a flow volume in excess of that associated with a stable channel condition. The resulting instability often leads to a higher rate of channel bank erosion that contributes more sediment loading to the stream system. The incised channel also loses the ability to utilize the floodplain for deposition of sediment and the other storage and filtering properties that could contribute to enhanced water quality.
- A stream channel with an impaired riparian buffer corridor loses a significant habitat attribute. The loss of the buffer removes a feature that provides several attributes. A vegetative corridor provides stability to channel banks while also enhancing the aquatic environment.

The findings of the TMDL are consistent in terms of the type and nature of the impairments to the stream channels within the Hellbranch Run Watershed. The TMDL indicates a large amount of the observed TSS within the watershed is attributed to channel bank erosion. Other collected information reveals a lower habitat value within segments of the channel system. These observations suggest that the conditions described above are associated with hydromodified stream channels, a leading cause of the degradation affecting the watershed. Based on the degree of degradation that has been documented for both Clover Groff and Hamilton Runs, and along the upper portions of Hellbranch Run, it seems unlikely that significant ecological benefit can be obtained by simply preserving those channels in their present conditions. In this case, stream morphology must be enhanced through some level of restoration to sustain a more desirable aquatic life use designation and to provide a meaningful contribution to the overall water quality within the watershed.

Although not the focus of any previous studies, there are numerous smaller tributary watercourses that discharge directly to the Big Darby Creek main stem. Observances of some of those stream channels suggest that they are also beginning to or are susceptible to degradation, due to either their position in the landscape (steep gradient) or because of adjoining land uses. Development within these smaller watershed areas can have an even more immediate impact to stream channel stability that would not only impact the tributary channel but also contribute sediment loading directly to Big Darby Creek.

3.6.1 Hellbranch Run Watershed Restoration Opportunities

The Hellbranch Run Watershed Forum (HWF) conducted an extensive investigation of restoration opportunities within the watershed, intending to identify a specific project to implement in cooperation with the U.S. Army Corp of Engineers under their Section 206 Ecosystem Restoration Program. Based on a specific and detailed evaluation process, the HWF has identified a stream restoration project in the vicinity of the confluences of Hamilton, Clover Groff and Hellbranch Runs. Further details regarding the nature and extent of the project and the program for implementation will be developed by the HWF.

The Accord general land use plan indicates a priority stream restoration zone for the entirety of the Clover Groff and Hamilton Runs. The degradation aspects noted previously are pervasive throughout this area. Meaningful restoration of these watercourses will likely require extensive physical alteration of the existing

stream channels to provide for the appropriate morphology and habitat features, described later in this section. In identifying restoration opportunities within this watershed, the following should be considered.

- **Available land area along the stream corridor.** The width of the corridor needed to accomplish the restoration can depend on the restoration technique and should account for an adequate buffer area to allow for the vegetative corridor that is vital to the restoration goal. At a minimum, the width of that corridor should be the setback calculated in accordance with the criteria for the Stream Corridor Protection Zone (SCPZ), discussed in more detail in Section 4.0.
- **Position of the project along the watercourse.** From the standpoint of stream ecology, there is an added benefit to the restoration project if there is some connectivity to other areas of the watercourse where there is a sustained aquatic habitat condition. Considering this aspect, initial stream restoration activities should focus on areas in the lower portions of the both Clover Groff and Hamilton Runs to gain the benefit of the connectivity to portions of Hellbranch Run that have achieved a higher aquatic life use designation.

3.6.2 Other Restoration Opportunities

For the portion of the planning area that is directly tributary to the Big Darby Creek main stem, there is no specific priority for stream restoration. Opportunities should be identified in conjunction with development activities as they occur within the smaller watershed areas. Because of the small nature of these tributary channels, restoration should focus on channel stability to account for the changing watershed hydrology that may result from the pending development activities. Aquatic habitat use should also be enhanced but that consideration is on a different level of magnitude than the stream channels referenced within the Hellbranch Run watershed.

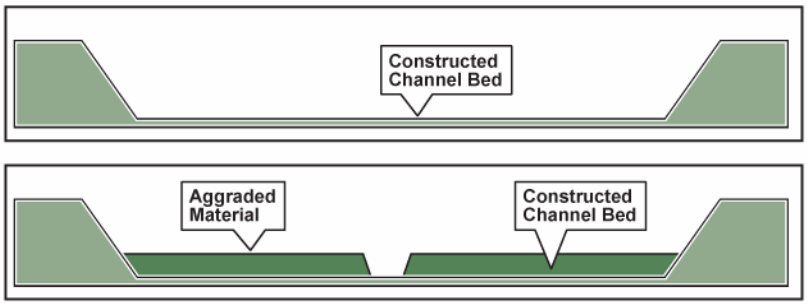


Figure 3.11 Over-wide Channel Design
Source: Attachment B, Ohio EPA Permit No.: OHC100

3.6.3 Stream Restoration Techniques

The approach to stream restoration depends on the objectives and goals that are being sought related to the ecosystem. The two approaches described below have different value in relationship to benefiting the aquatic life use attainment and water quality. The cost of stream restoration can vary depending on the technique applied; however, either approach can incur a significant cost. The majority of the costs are related to land acquisition, design and construction. It is foreseeable that stream restoration on a large scale can only occur if financial resources from a variety of sources are pooled together.

Over-wide Channel Technique

The over-wide channel technique is one that is often described by ODNR and has been developed as a concept specific to headwater streams that may develop a different ecosystem than expected in a typical stream system. The technique is defined by the excavation of the overbank area along an incised (over-deep) channel to bring the elevation of the floodplain down to or nearly to the flowline of the existing channel. The excavated floodplain is expected to be no less than 5 times and maybe up to 10 times as wide as a stable channel width for that stream. The result of the application of this technique is a valley that continues to have the shallow gradient (slope) of the impaired stream channel, as that is not adjusted through the restoration process.

Application of over-wide channel technique.
Source: EMH&T

The primary function of this restoration technique may be that it is now capable of assimilating a significant load of sediment transported through the stream system. The accumulation of sediment within the over-wide channel is expected, reducing the loading further downstream in the system, and can lead to the formation of a stable channel feature though the natural process of aggradation. Alternatively, portions of the excavated valley can take on the qualities of a wetland environment, due to the connection to groundwater and stream baseflow. The wetland environment, although not conducive to aquatic habitat conditions, can provide water quality benefits through the capture of sediments and the capture and treatment of nutrients that are processed by the evolving vegetative community.

Benefits
A simple design process that is also not complicated to construct. Since the flowline of the existing channel is not affected, this technique can either be applied on a large-scale or on a localized level. Water quality attributes are likely to occur related to the assimilation of TSS, TN and TP within the stream system.

Drawbacks
The resulting ecosystem within the stream channel may not facilitate the aquatic life use designations promoted by the Ohio EPA. There is some uncertainty regarding the formation of either a channel or functional wetland, which will be affected by the nature of pollutants being conveyed in the stream system and the watershed hydrology.

Natural Stream Channel Design Technique
Natural stream channel design follows the principles of conventional geomorphology, which identifies a fairly distinct structure related to a functional and stable stream structure. The Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) is based on the physical components of a channel that are consistent with this technique. Essentially, this technique includes channel features such as functional pool (deeper water areas) and riffles (high-energy grade control features) and a substrate material consistent with the bedload capacity of the stream. All of these features are conducive to both macro invertebrate and fish habitat expected to achieve a certain aquatic life use designation.

The application of natural channel design requires the determination of stable channel geometry through the collection of data from an existing stable channel reach and the application of empirical design methods. Applied to channels within the Hellbranch Run watershed, this technique would likely involve both the excavation of the overbank area to establish the stable channel geometry and re-connect that channel to the floodplain, and the placement of in-stream material to accomplish the pool-riffle complex and to alter the gradient of the stream channel. Furthermore, the pattern of the stream channel would be altered to be less linear and have the characteristics of a meandering stream.

Benefits
A functional natural stream channel design will be more likely to attain the aquatic life use designations promoted by the Ohio EPA. The measure of a healthy stream, which relies on stable stream geomorphology and the success of macro invertebrates and fish, will more likely be met. A stream channel with the attributes described above is more likely to be a feature that is appreciated by the community and integrated as a passive recreational attribute.

Drawbacks
The complexity of design and construction may lead to higher overall project costs when compared to other techniques. Due to the likely alteration of stream flow line elevation and gradient, it is often not possible to apply this technique unless it is over a longer contiguous reach of channel, which would require that it be accomplished only as part of a large-scale project.

Stream Naturalization
The concept of stream naturalization is discussed in an article published in *Environmental Management, Volume 24, No.3,* entitled "Interaction Between Scientists and Nonscientists in Community-Based Watershed Management: Emergence of the Concept of Stream Naturalization". From that article, it is stated "that the goal of naturalization is to drive the (stream) system as a whole toward a state of increasing morphological, hydraulic and ecological diversity, but to do so in a manner that is acceptable to the local community and sustainable by natural processes, including human intervention". This approach to stream restoration is derived from the premise that restoration activities should consider both the social and ecological consequences of that activity. The social consequences are related to the perceptions of the residents of the watershed regarding the purpose and value of the watercourses,

particularly those who rely on them for agricultural drainage or flood control.

Stream naturalization includes natural stream channel design but allows for a departure from that approach, recognizing the fundamental limitations described below. The factors listed below are not intended to discount the growing and evolving body of knowledge and practice related to stream restoration using natural channel design. In recent years, considerable knowledge has been gained by the collective interests who continue to draw from experience and apply new solutions toward finding a correct balance that supports sustainable designs.

- Restoration of a stream channel to a "natural" state indicative of the pre-disturbed condition will be based on anecdotal references, influenced by changes in the environment that are a departure from the actual pre-disturbed condition of the watercourse that is being restored.
- The watershed associated with the stream channel may contain conditions, such as land uses, that are not conducive to sustaining a "pristine" restored channel. Altered hydrology and or the influx of sediments and other pollutants attributed to either agricultural or urbanized land uses are examples of these conditions.

The premise of stream naturalization is that a stream system may "passively recover from past channelization activities, eventually assuming a form and function generated by and compatible with the prevailing environmental conditions". This suggests that a watercourse, left alone, can regain ecologically sound characteristics; however, it also suggests that those characteristics will be influenced by the surrounding watershed. Given the substantial hydromodification along Clover Groff and Hamilton Runs and the mix of land uses anticipated within the watershed, it is reasonable to assume that the passive recovery of those channels will require an extended period of time, likely decades, and that the final outcome will be unpredictable. Conceivably, they may never fully recover. To address these shortcomings and accelerate the naturalization process, a variety of physical modifications that essentially de-channelize the stream can be performed. The predominant modification is to reestablish the stable bankfull condition and create an adequate connected floodplain to accommodate the dynamic condition that would allow for the naturalization process. In an incised channel, that typically means excavation of the overbank areas to an elevation consistent with the bankfull depth of the channel. From that point, it is anticipated that the on-going process of stream degradation and opposing aggradation will eventually begin to influence the pattern and profile of the channel, trending toward a point of morphological stability.

The benefits and drawbacks listed below assume that the stream naturalization technique is applied as a departure from the strict interpretation of natural channel design; otherwise, the benefits and drawbacks of that technique can be referenced from the earlier discussion. The assumption is that a more passive approach to stream naturalization is being considered that may include re-establishment of the bankfull condition and a connected floodplain.

Benefits

As with the over-wide channel technique, this stream restoration approach can involve a simple design and construction process, reducing costs associated with those activities. A stable bankfull channel dimension must be determined, but the other morphological parameters associated with natural channel design are not associated with this approach. Assuming the flow line elevation and gradient of the channel will not be altered, the stream naturalization process can be applied to shorter as well as an extended reaches of a watercourse.

Drawbacks

Similar to the over-wide channel technique, the outcome of stream naturalization may be difficult to predict. Whether a geomorphically stable channel evolves and whether that channel contains elements supporting a higher aquatic life use designation may only be determined over the course of time. That outcome is a common link between all of the stream restoration techniques described in this document. There can be no certainty on how each will perform in the long run when it comes to biological integrity; however, in this case, some of the known elements to support that condition are left to evolve over time.

3.6.4 Funding for Restoration Activities

Typically, funding for stream restoration must come from a combination of resources. Stream restoration can be identified as a priority when determining how funding from the general revenues generated by the Accord should be allocated. In doing so, the Accord could identify the stream corridors along Clover Groff and Hamilton Runs as priority areas for acquisition of open space. Where development is anticipated, the set-aside of that stream corridor will ultimately occur. Alternatively, the Accord revenue could be used to provide supplemental funding for the stream restoration activities in support of grant applications, described below.

There are grant funding programs that may be available to the Accord or other entities that would assist in funding stream restoration activities. Examples of these programs are the Clean Ohio Fund, administered locally through the Mid-Ohio Regional Planning Commission, and the 319 Grant program, administered through the Ohio EPA.

Another method of developing funding for stream restoration is through the process of mitigation. For the purpose of this discussion, mitigation is a process associated with impacts to stream corridors that may occur in conjunction with site development or public infrastructure improvements. The draft NPDES permit for the Big Darby Creek watershed stipulates mitigation for impacts to stream buffers, requiring restoration of other stream buffers or actual channel restoration. Furthermore, impacts that occur directly to existing stream channels must meet both state and federal permitting guidelines that also require mitigation. Typically, mitigation is in the form of an equal or greater amount of channel restoration and stream buffer preservation.

To apply this concept to stream restoration opportunities within the Accord planning area may involve a system that is based on an in-lieu fee payment whenever development activities impact stream corridors within the planning area. Fees collected for the purpose of mitigation would then be pooled and applied to stream restoration. This process requires a responsible entity to 'manage' the collection of mitigation funds and apply them to stream restoration opportunities that would meet he criteria of the NPDES permit and other state / federal permitting guidelines. There is a defined process for establishing this mechanism that would need to be followed by the Accord or some other designated entity.

3.6.5 Regional Planning for Stream Restoration

Numerous variables may influence stream restoration within the Accord planning area, including the chosen restoration technique and where and when restoration opportunities may arise based on future development. To establish more formal guidelines that promote uniformity and a coordinated approach to stream restoration, it is recommended that there be an oversight group responsible to the Accord Advisory Panel that is comprised of individuals knowledgeable in the field of stream restoration and connected to the implementation of the various components of the land use plan. The knowledge of these individuals should encompass the various sciences that deal with stream restoration, including geomorphology and ecology. The group should also contain non-scientists who are representatives of the watershed and can share the perspective of the individuals who will "use" the restored stream channels.

Section 5.3.1 discusses the formation of an Environmental Monitoring Group (EMG) to oversee the recommended water quality monitoring. This group would likely have the technical capabilities required for coordinated stream restoration oversight and should therefore assist with developing guidelines for stream restoration. A primary goal of this group should be to establish priority goals for stream restoration. Consideration should include demonstration of ecological integrity and achieving the aquatic life use designations in accordance with the TMDL.

3.7 Floodplain Management

Communities participating within the National Flood Insurance Program (NFIP) have adopted regulations that determine the extent to which encroachments can occur within the 100-year floodplain and floodway. The regulations must meet a minimum standard established by FEMA. Within the ten participating jurisdictions of the Big Darby Accord, there are some variations on what the standard is for floodplain management, but they are consistently applied in that all grading/filling activities within the 100-year floodplain require a permit from the local jurisdiction. Generally speaking, the NFIP-derived regulations create the restrictions listed below.

- Within the designated floodway, no activity shall occur that would cause an increase in the 100-year flood elevation, unless there is prior review and approval of the project by FEMA. The affirmative response from FEMA in this situation is a Conditional Letter of Map Revision (CLOMR) that must be issued to the local jurisdiction prior to the issuance of a permit for that project.
- Within the remaining portion of the 100-year floodplain, outside of the designated floodway, grading and filling activities may be permitted by the local jurisdiction without the benefit of a technical analysis to determine the impact to flood elevations. In this case, fill may be placed to remove areas from the 100-year floodplain, with the likely intent to change the land use in that area.

The regulations contain specific provisions that provide adequate protections for any development that would occur within the floodplain, requiring that any structures be properly elevated. Using the City of Columbus as an example of a higher standard with respect to floodplain management, they have adopted criteria requiring that structures be elevated at least 1.5 feet above the 100-year elevation and that there be a minimum setback of 20 feet from the revised limit of the floodplain. Due to the restrictions related to encroachment within the designated floodway, grading/filling within that area related to development is generally avoided. Encroachments within the floodway related to roadway crossings are common as a practical measure to avoid bridge or culvert designs that are excessively expensive to construct.

It should be noted that Brown Township has adopted a comprehensive plan recommending that no grading/filling occur within the 100-year floodplain. Furthermore, as one of Columbus' higher standards, their revised *Stormwater Drainage Manual* requires that any fill placed within the 100-year floodplain be mitigated with an equal volume of excavation, performed in such a manner that there is no loss of floodplain storage.

Stream restoration is an anticipated activity within a designated 100-year floodplain and floodway. Furthermore, referring to Section 4.2, there may be circumstances where fill is placed within the 100-year floodplain in conjunction with stream restoration. Policy recommendations for floodplain management pertaining to these circumstances are presented in Section 4.7.4.

4.0 Land Use and Development Policies

With ten jurisdictions in the planning area, a number of land use policies are in place, including comprehensive plans and zoning codes, to address planned and permitted development within the watershed. In addition, several existing regulations, policies and environmental initiatives have been considered in the development of this plan as described in Chapter 2. A key factor in implementing the Big Darby Accord Plan will be finding an approach to coordinating and enforcing current policies and new policies in a consistent manner to ensure the watershed is protected. This chapter describes the supporting policies that each jurisdiction will need to consider as they implement and pursue adoption of the Big Darby Accord Plan.

4.1 General Development Practices

Protection of Environmentally Sensitive Areas

The main goals of the Big Darby Accord planning effort are to preserve and protect areas that contribute the most to water quality, to protect them from degradation from development land uses and to improve the overall aquatic habitat within the Franklin County portion of the Big Darby watershed. To establish some priority to the protection of different environmentally sensitive areas, conservation tiers have been established based on best available data (see Section 3.1). These areas can be protected through policies and programs established by each jurisdiction and through land conservation efforts between the Accord and its partners.

- Tier I – floodplain, riparian corridors, in-stream habitat areas, wetlands, critical groundwater recharge areas, pollution potential zones
- Tier II – highly erodable soils, wooded areas greater than 3 acres
- Tier III – trails, habitat buffer areas, connectivity corridors

Green Building

Each jurisdiction should encourage development that meets the prerequisites identified within the Leadership in Energy and Environmental Design (LEED™). LEED™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted standards, tools and performance criteria (USGBC, 2006). Guidelines for LEED™ for Neighborhood Design (LEED ND) are in draft form and should be encouraged for residential developments. If a development meets or exceeds identified LEED™ targets the jurisdiction should consider providing some type of financial incentive to the developer.

4.2 Environmental Components

Recommended polices related to the protection of the riparian corridor, floodplain and wetlands are described in the following sections.

4.2.1 Riparian Corridor Protection

Riparian corridor protection is essentially the establishment of a stream setback that, once implemented, precludes certain activities from occurring within a specified certain distance of all stream channels. The setback would apply to all changes in land use within the planning area. It may also apply as a retrofit to existing agricultural land uses under a prescribed incentive program. This plan assumes that the policy for riparian corridor protection applies to future development activities where the

Erosion and down-cutting along "Son of a Ditch" Tributary
Source: The Nature Conservancy/ Anthony Sasson

Improved stream corridor zone
Source: EDAW

Section Outline

Key Recommendations

- Adopt permitted, conditional and prohibited uses for open space areas based on Plan recommendations.
- Perpetual easements should be required for open space areas in conservation developments along stream corridor protection zones.
- All easements should be held jointly and in perpetuity by home owners association or local conservation group and either local jurisdiction or Franklin Soil and Water Conservation District.
- Jurisdictions should develop consistent guidelines for easement maintenance.
- Easement should have a 5 year staggered performance bond to ensure successful planting and design.
- Land areas associated with Tier 1, 2 and 3 resources may be counted toward the calculation of gross density of a development site.
- Development in proximity of regional trail system should be required to provide connections.
- Develop a regional trail along Big Darby and Hellbranch.
- Require 50% open space in all conservation developments and offer incentives for increases in open space.
- The location of open space in conservation developments should be dictated by environmentally sensitive resources in Tiers 1, 2 and 3.
- Open space in conservation developments should link to adjacent open space.
- At least 75% of the open space area in the conservation development should be contiguous.
- Development in conservation development should not front external roadways.
- Large lot development applicants should collaborate in lot layout and design.
- Large lot development should encourage that at least 50% of the site be place in conservation easement.
- The County should adopt proper legislation to review all development proposals that are greater than 5 acres in size.
- Establish an Open Space Advisory Council.
- The proposed mixed use Town Center should set a new standard for sustainable urban development.
- Brown and Prairie Townships should coordinate the development of new zoning for the Town Center area.
- The proposed Town Center should include a mix of housing types as well as commercial, retail, office, institutional and park uses.
- The stream corridor protection zone (SCPZ) shall be the greater of either the 100 year floodplain boundary, the calculated streamway (beltwidth) or a minimum of 100' setback from centerline of intermittent, perennial and ephemeral streams.
- The SCPZ should include designated wetlands and slopes exceeding 15%.
- Adopt permitted, conditional and prohibited uses for SCPZ based on Plan recommendations.
- Allow stream restoration as a permitted or conditional use within the SCPZ.
- Protect the integrity of wetlands and diminish their loss within the planning area.
- Mitigation of any filled wetland should occur in the Darby Accord Planning Area.
- The SCPZ used to compute gross density must be delineated on plan and on site and must be placed in a joint easement.
- Pursue acquisition along Clover Groff and Hamilton Run streams for stream restoration.

stream setback can be incorporated into the development process. The commonly applied terminology for the stream setback is Stream Corridor Protection Zone (SCPZ).

Determination of the Stream Corridor Protection Zone

There is consistency among the referenced policies and environmental initiatives with regard to establishing the width of stream setbacks. Research conducted cooperatively by The Ohio State University and the Ohio Department of Natural Resources (ODNR) determined the stream corridor necessary to accommodate stable stream channel geomorphology. The research examined the meander pattern of streams within Ohio and compared it to information for streams outside of the state, and related that physical condition to the watershed area of the stream. The research determined an equation for calculating a 'streamway', also referred to as a 'beltwidth'. The original streamway/beltwidth equation was used to determine the Tier 1 stream setback (riparian buffer) areas in the environmental sensitivity analysis, is referenced by the Hellbranch Overlay and the Ohio EPA's draft stormwater general permit, and is a consensus recommendation of the EAG.

Key Recommendations (continued)

- Stream setbacks should provide adequate area for restoration activities.
- Incentives should be considered to encourage regional stream restoration efforts.
- Explore wetland mitigation banking.
- Work with the farming community to implement BMPs.
- Post construction groundwater recharge rate must equal or exceed pre-development recharge rates (NPDES/OEPA permit).
- Groundwater recharge areas should be protected through binding conservation easements.
- All site development plans must include a Stormwater Pollution Prevention Plan (construction phase).
- A sediment settling facility must be provided with a goal of releasing a max of 45 mg/l of TSS for up to a .75" rainfall in 24 hours (construction).
- Water quality volume control is defined by OEPA draft permit & siting requirements should be developed as part of the site design.
- Stormwater treatment and BMP design criteria must meet water quality targets set by the OEPA TMDL for TSS, TN and TP.
- Non-structural BMPs should be evaluated as part of the conceptual site design process.
- Minimize directly connected impervious areas.
- Follow the 8 step BMP planning process to determine required level of BMPs for site development.
- Utilize BMPs as identified in the BMP toolkit or other appropriate practices to meet water quality targets and plan goals.
- All post construction BMPs require submission of a maintenance plan.
- Easements are required for all BMPs to provide access.
- Regional stormwater facilities in Town Center should be maintained by a public entity, and site level BMPs should be maintained by the homeowner or homeowner association with proper operation and maintenance plan.
- Available sewer capacity for Town Center is 5,000 equivalent dwelling units; additional capacity may be available in the future.
- Provisions for extension of sewer service have been developed by City of Columbus.
- Town Center will receive central sewer through extension of the Big Run Trunk sewer.
- The Hilliard growth area and LEED area will receive central sewer through extension of the Roberts-Millikin sub trunk sewer.
- Franklin County Sanitary Engineer is identified as candidate for owning and operating the central sewer lines in Town Center.
- Areas not receiving central sewer would receive sewer service through alternative community-based sewage treatment systems.
- New standards and regulations related to methods, application and regulation of both community based systems & on-lot systems that meet OEPA and Board of Health requirements must be developed & applied
- Franklin County Sanitary Engineer has been identified as candidate for owning and operating community based sewage treatment systems
- Limit the proliferation of single-lot sewage treatment systems and encourage alternative community based systems.

W - width of streamway/beltwidth
DA – drainage area in square miles

Original equation:

$W = 117 \times DA^{0.43}$
(for DA less than or equal to 16 square miles)
$W = 87 \times DA^{0.43}$
(for DA more than 16 square miles)

A more recent version of the equation is presented in the City of Columbus' revised Stormwater Drainage Manual. The final policy recommendation from the Accord is to apply the updated equation for determining the SCPZ, which is consistent with HWF recommendations.

Updated and recommended equation:

$W = 129 \times D.A.^{0.43}$
(for DA less than or equal to 16 square miles)

Note: Research related to the development of the streamway/beltwidth equation is on-going and is anticipated to result in changes to the equation. Further coordination with ODNR would be required to determine the suitability of a revised equation to conditions within the Accord planning area.

For watercourses meeting the definition of a stream channel, the SCPZ shall be the greater of the boundaries described below.

- The FEMA designated 100-year floodplain (see floodplain discussion below and in Section 4.7).
- The calculated streamway/beltwidth using the updated equation.
- A minimum of 100 feet extending from the centerline of the stream channel on both sides of the watercourse.

Presently the Ohio EPA is considering a change to the draft NPDES permit for the Big Darby Creek Watershed that would allow the SCPZ to be less than the width of a designated 100-year floodplain. This allowance applies only when stream restoration is to be performed along the specified reach of the watercourse. In this case, the physical modifications to the watercourse may redefine the SCPZ. Furthermore, it may provide opportunities for different land uses within the residual portions of the 100-year floodplain. This approach is a strong incentive for stream restoration and is recommended for use within the Accord planning area.

Ashy Sunflower
Source: Metro Parks/John Watts

Although there is an incentive for stream restoration, consideration should be given to the larger goals for restoration that are discussed in Section 3.6. Stream restoration activities within the planning area should be guided by a committee that understands the restoration needs in a regional context. Restoration activities that are not consistent with the larger goals throughout the planning area should not be encouraged.

Permitted, Conditional and Prohibited Uses

Permitted uses are allowed within the SCPZ without restrictions. Conditional uses may occur only after further consideration by the overseeing authority and may require the application of conditions to be met as a component of that activity. An example of such a condition would be mitigating activities to restore disturbed areas. Prohibited uses may not occur except if granted a variance or exception by the overseeing authority. The variance or exception process has not been developed; however, it is foreseeable that the process would include a multi-step evaluation intended to demonstrate that the use, if approved, would have no degrading impact to water quality and/or habitat within the stream channel and would require mitigation as in the case of a conditional use.

A detailed discussion of permitted, conditional and prohibited uses within the SCPZ is provided within the EAG final report, Appendix 9-3 of the draft revised 208 Plan and in the policy recommendations provided by the HWF. Given that extensive documentation, a detailed discussion of those uses is not presented here; however, general descriptions are provided below.

- Permitted Uses: passive recreation, vegetative enhancement, and arterial street crossings.
- Conditional Uses: stream bank stabilization, public utilities and non-arterial streets (Notes: the City of Columbus' Stormwater Drainage Manual allows for wetland mitigation and enhancement of existing wetlands to occur within the SCPZ. While there is no precedent for this in the reference materials described above, it is suggested that the SCPZ policy account for certain stormwater BMPs to occur within this area as a conditional use. These BMP's, such as grassed or enhanced swales, should only be allowed where they are necessary to facilitate an outlet to the receiving stream channel.)
- Prohibited Uses: grading activities and land uses commonly associated with a development process and land application of waste water effluent.

It is recommended that activities related to stream restoration be considered either a permitted or conditional use within the SCPZ. Designation as a conditional use would give the overseeing authority the ability to review stream restoration proposals and establish and apply conditions for consistency related to restoration activities within the larger planning area.

Other Considerations

Other recommended policies related to SCPZ are described below.

- Area set aside within the SCPZ may be used in computing gross site density associated with a development.
- The extent of the SCPZ must be clearly delineated and labeled on all zoning, platting and engineering documents associated with a development. The location of the SCPZ must be delineated in the field during construction and permanently designated in an aesthetically

harmonious fashion (often interpreted as intermittent split rail fencing with appropriate signage).

- The SCPZ must be platted as a 'reserve' area, not included within any individual platted lots and placed in a permanent easement held jointly by an established homeowners association (residential) , land conservation group (501c3), or other property ownership (commercial) and either the local jurisdiction or FSWCD. A planting plan and management plan should be developed for the easement that outlines a program for planting the easement and the regular inspection and maintenance of the dedicated SCPZ easement.
- Enhancement of a degraded riparian area in the form of planting of appropriate vegetation may be required or could be implemented under an incentive program.

Application of the Stream Setback Requirement

The stream setback requirement applies to all perennial, intermittent and ephemeral streams, as defined by the US Army Corps of Engineers. When determining the setback boundaries, the following considerations must be accounted:

- The boundaries of the 100-year floodplain should be interpreted using the published 100-year flood profile and the best available topography along the watercourse. The use of published flood hazard information, including 100-year flood elevations or flood boundaries, should include any Letters of Map Correction (LOMC) issued by FEMA that include revisions to that information. LOMCs include Letters of Map Revision (LOMR) and Letters of Map Amendment (LOMA).
- The width calculated from the streamway/beltwidth equation is a total width including both sides of the stream. The mapping of this width along the watercourse should reflect the current meander pattern of the stream channel and may not be uniformly distributed on both sides.
- The SCPZ should be extended to include designated wetlands and slopes that exceed 15-percent where those features begin within the established SCPZ.

Exceptions Within the SCPZ

The draft NPDES permit for the Big Darby Creek watershed contains provisions related to mitigation for any impacts that may occur within the specified stream setback area. Furthermore, state and federal permitting guidelines related to impacts to perennial, intermittent and ephemeral streams require a suitable mitigation. In both instances, the provisions would result in restoration to riparian buffer areas and/or stream channel restoration that vary depending on the extent of the proposed impact. Section 3.6 provides information regarding the mitigation process and how it can be used to generate beneficial restoration within the Accord planning area.

Areas within the Town Center are likely to be a higher density of development and may encounter difficulties when applying the SCPZ to all stream channels, particularly ephemeral streams. In recognition of the importance of the Town Center to the economic viability of the General Land Use Plan and the need to generate beneficial opportunities for stream restoration within the planning area, it is proposed, as an exception to the stated criteria that the Accord permit impacts to those channels within the Town Center area where avoidance is not practical. When impacts to stream channels corridors occur, both the NPDES permit for the Big Darby Creek watershed and state and federal permitting guidelines for mitigation should be followed with the intent of contributing to stream restoration opportunities within the Accord planning area.

4.2.2 Wetland Preservation and Mitigation

One objective of the Darby Accord Plan is to preserve existing wetlands to the extent possible. Identification of existing wetlands within the planning area was limited by existing information available through the National Wetland Inventory. The actual determination of jurisdictional wetlands within the planning area must occur as part of any development process, wherein a verified delineation should be required. As stated within the SCPZ policy recommendations, any wetlands at least partially within the SCPZ is included within and wholly protected under the provisions of the SCPZ.

For wetland areas not protected by the SCPZ, the U.S. Army Corps of Engineers and the Ohio EPA have anti-degradation requirements related to jurisdictional wetlands. Under Section 404 of the Clean Water Act, the Corps of Engineers can require a permit for fill of a jurisdictional wetland. Depending on the size of the wetland fill, the requirement may be for a Nationwide Permit (NWP) or for an individual permit, including a Section 401 permit from the Ohio

Wetland
Source: EDAW

EPA, which requires mitigation for the loss of wetland area. Mitigation is typically in the form of replacement wetland acreage within a larger watershed area. Whether a delineated wetland is preserved or impacted by development activity on a site, policies should protect the integrity of wetlands and diminish their loss within the planning area.

- All delineated wetlands should be properly documented and shown on zoning, platting and engineering documents associated with the development process.
- Site development design should ensure that adequate hydrology is maintained to any preserved wetland under the post-construction condition; however, the wetland cannot be used as part of the stormwater management scheme for a development. Preserved wetlands should be adequately delineated in the field and protected from stormwater runoff during construction.

Verification of any required permitting for wetland fills must be provided as a condition of final approval of the site development plan. Due to the length of time commonly associated with an individual permitting process, some consideration may be given to allowing a demonstration that the permitting process is substantially complete.

Mitigation of any filled wetland areas should occur within the planning area and incentives can be provided. Allowing wetland mitigation to occur within the SCPZ or within converted (from agriculture) or preserved conservation open space that is part of the Accord planning area should be considered.

At Serenbe, a conservation development in the hill country of Georgia, 70% of the land is protected in open space.
Source: EDAW

4.3 Open Space

The Accord jurisdictions should work cooperatively to permanently protect Tiers 1, 2 and 3 areas. The protection of these areas will be made possible through adopted policies as well as programs and new funding sources that will be created by the Accord. Efforts to protect land must be coordinated across jurisdictions and among agencies that are already working in the planning area such as ODNR, Metro Parks and FSWCD.

The identification of environmentally sensitive resources should be a requirement for all development proposals as part of a development review checklist that is further described in Section 5.0. Development plans and proposals should demonstrate the protection of resources to the maximum extent possible. The location of open space on any development site, such as a conservation development that sets aside 50% of the site, should be dictated by the location of environmentally sensitive features within the tiers and the topography and features of the land. Development should be permitted within the Tier areas, subject to all zoning, subdivision regulations, permitting and environmental standards set forth in this Plan and other regulatory requirements such as those issued by the Ohio EPA.

Permitted uses within open space areas should first consider environmental regulations described in earlier sections that may prohibit certain uses in stream corridor protection zones or wetlands.

- Permitted Uses: passive recreation including trails, vegetative enhancement, reforestation, removal of damaged or diseased trees, stream bank stabilization/restoration, public utilities, non-structural best management practices, minor disturbances related to the construction of the permitted use, land application of waste water effluent (outside SCPZ or wetlands)
- Conditional Uses: active recreational uses limited to multi-purpose fields, playgrounds
- Prohibited Uses: grading activities and land uses commonly associated with a development process, development

Land Acquisition

The Accord should support Metro Parks, FSWCD, The Nature Conservancy, NRCS, ODNR and others in their efforts to acquire and protect land. The Accord General Land Use Plan and conservation tiers should in no way limit or hinder conservation efforts of other organizations for lands that may be outside the tiers. To implement the plan and help protect water quality

goals, Accord jurisdictions should target acquisition efforts to Tiers 1 and 2. Elements within these areas that include:

Tier 1

- Floodplain
- Riparian Zones
- Wetlands
- Critical groundwater recharge areas
- Pollution potential zones

Tier 2

- Highly erodable soils
- Wooded acres greater than 3 acres

Open Space Advisory Council

The Accord should establish an Open Space Advisory Council to provide guidance for land acquisition, funding and other conservation efforts. The Advisory Council should include representatives from Metro Parks, Franklin Soil and Water Conservation District, The Nature Conservancy, ODNR, OEPA, NRCS, OSU Extension and the local affected jurisdictions. Consideration can also be given to including interested land owners and local conservation organizations. Members on the Advisory Council should have a role in land ownership and/or oversight in the Accord planning area. The Accord and Open Space Advisory Council should organize a series of roundtable discussions to encourage dialogue among residents about the benefits of land conservation and to encourage participation in programs. This effort should emphasize the value of open space and can be coordinated to educate property owners about best management practices.

Easements

To ensure that open space areas are properly maintained and managed over the long-term and to ensure continuity of care between property owners, easements should be created for the open space areas that are part of any conservation-style development and along SCPZs. Easements can provide economic benefits to property owners. For larger lot developments that occur outside of conservation developments, local jurisdictions should encourage at least 50% of the site be placed in a conservation easement to ensure proper care and natural vegetative features.

All easements should be held jointly and in perpetuity to allow for perpetual inspection and enforcement. Appropriate parties for the joint easements include Home Owners Associations, qualified conservation groups (501c3), local governmental entities, or the Franklin Soil and Water Conservation District.

Appropriate uses for the open space, maintenance requirements, and overall treatment of the easement should be stipulated in the easement agreement. A 'double' easement will allow access to the site for inspection, enforcement, and monitoring of the open space and enforcement of easement requirements. In the event the party responsible for maintenance of the open space easement fails to maintain all or any portion in reasonable order and condition, the appropriate governing body should assume responsibility for its maintenance and should enter the premises to take corrective action, including the provision of extended maintenance. The costs of such maintenance should be charged to the homeowners association, or to the individual property owners that make up the homeowners association and may include administrative costs and penalties. Such costs should become a lien on all subdivision properties.

Maintenance of Open Space Areas

All jurisdictions should adopt consistent guidelines for the maintenance and care for privately held open space lands or land held within easements. These guidelines should be developed in coordination with Open Space Advisory Council. Overall, it is the desire that open space in conservation subdivisions is managed such that the recharge rate is maintained or improved. If onsite infiltration is infeasible, or if open space is inadequate to maintain this infiltration rate, mitigation with off site infiltration may be allowed.

To encourage the proper and most ecologically beneficial conversion of denuded areas to areas with native vegetation and plantings, developers should be required to work with Franklin Soil and Water Conservation District and the local jurisdiction to develop a planting plan for any open space easement. The planting plan should be submitted at the time of application and should identify appropriate native plants, soil requirements and water requirements for the open space area.

Developers should be required to plant the initial cover and should be subject to a 3 year performance bond too ensure a successful outcome followed by a 2 year bond at a reduced rate to ensure maintenance procedures are followed. The performance bond will be released upon inspection by the local jurisdiction. The use of stewardship fees should also be considered as a way to cover administrative, inspection and legal costs associated with perpetual enforcement of easements. FSWCD has developed a stewardship fee model that should be consulted for applicability.

Furthermore, as part of the planting plan, the applicant should submit a long-term management plan that provides for the following:

1. Allocates responsibility (easement) and guidelines for the maintenance and operation of the open space and any facilities including ongoing maintenance and long-term capital improvements;
2. Cost estimates and staff requirements for maintenance, operation and insurance for the easement and identification of funding sources;
3. Provides for any changes to the plan to be approved by the local governing body; and
4. Provides for future enhancement of the plan and allows for stream restoration activities.

4.4 Conservation Development

Conservation development is the recommended land use approach for new development in areas outside the Town Center, in the Hilliard growth area, and in select locations along the eastern border of the City of Columbus. Conservation development will provide increased opportunities to protect important natural resource features and water quality, provide opportunities to reduce costs related to best management practices through natural applications and provide opportunities for the application of approved community wastewater treatment technologies. A minimum parent tract size of 20 acres of contiguous land is suggested for conservation developments in the rural and Hilliard growth areas.

Local ordinances must facilitate conservation-style development. Accord jurisdictions should work together to develop an (overlay) zoning classification for conservation development areas consistent with the General Land Use Plan map. It is recommended that Brown, Prairie and Pleasant Townships work together with the County to develop an overlay ordinance that could be applied to all three jurisdictions to address the rural conservation development land use category. The City of Hilliard should create a conservation development zoning district that parallels the rural conservation overlay but is oriented to 1 unit per acre. Collaboration among the jurisdictions will ensure continuity and consistency in application and provide property owners and developers with more clarity. At a minimum, the conservation development zoning should address:

- Purpose and Authority
- Definitions
- Requirements for clustering
- Designation and treatment of open space
- Regulations for open space
- Permitted land uses and residential densities
- Minimum acreage requirements
- Bonuses/Incentives
- Requirements for easements, maintenance and oversight of open space
- Provision of underground utilities
- Other development standards (setbacks, signage, trees)

It is strongly recommended that the Accord jurisdictions discourage conventional subdivisions, which are inconsistent with the goals of this plan, by building in flexibility and incentive opportunities with conservation development. In addition, conservation developments should strive to provide a mix of residential options and housing types.

Character

Conservation developments should celebrate the rural character of the watershed. Housing types should be varied within developments and encourage creativity to meet the needs of mixed incomes. Dwelling units should not be permitted to front along any existing external roadway.

Design and Open Space Requirements

Development potential of any conservation development will need to take into consideration environmental site conditions, required best management practices, environmental policies and the availability of on-site sewer and water. Development should minimize site disturbance and promote the efficient use of land.

	Open Space Preserved	Land Conserved Acres	Land Developed Acres	Bonus Density	# of Lots or Units
Rural Area 100 acres	50%	50	50	Zero	20
	60%	60	40	15%	23

Figure 4.1 Example Rural Conservation Development Area Incentives
Source: EDAW

Development in these areas must be designed using a cluster approach with a minimum of 50% of the gross area of a development site set aside as natural open space. This concept is commonly associated with and promoted by Randall Arendt in a book entitled "Rural by Design." At least 75% of the open space within a conservation development (based on gross area of the site) should be a contiguous tract. (OEPA 208 Plan). The open space should adjoin any neighboring areas of open space, other protected areas and non-protected natural areas that would be future candidates for protected open space. The contiguity requirement may be waived if the use of the open space in another fashion is necessary to achieve important ecological protection or to maximize ecological benefit.

Any area of natural open space that is proposed to be disturbed during construction or otherwise not preserved in its natural state should be shown on development plans and should be restored with vegetation that is compatible with the natural characteristics of the site.

Density
Greater open space set asides are encouraged in all conservation development areas by a sliding scale approach that allows the gross density to rise if the net area consumed by development is reduced. Appropriate density increases must consider impact on local utilities and should be evaluated on a case by case basis.

When considering density incentives, it is recommended that the maximum increase of units be limited to a 10-15% increase over the gross permitted density. Additional density bonuses may be appropriate in the rural areas if the development proposal can demonstrate it meets requirements for community-based sewage treatment. Figure 4.1 shows how a density bonus can be applied.

Accord jurisdictions should consider offering incentives for applicants that agree to complete stream restoration. The method for stream restoration should be consistent with Accord Plan recommendations and should be encouraged on a regional scale where maximum benefit can be achieved.

Impervious Surfaces
Overall, impervious surfaces within conservation developments should be minimized through design and application of low impact development techniques. Accord jurisdictions should review subdivision regulations to ensure built in flexibility to allow for appropriate reductions in road width requirements, parking and driveways. Roadways in conservation developments should consider widths of no more than 18 to 20 feet to reduce impervious surfaces and encourage the slowing of traffic. If homes are provided with garages and driveways roadways should not be required to provide for on-street parking. Common driveways should also be encouraged. Other reductions in impervious surfaces may be achieved through the elimination of curbing or application of pervious surfaces for sidewalks, driveways and pathways and flexibility in turning radii. General street design guidelines should allow flexibility.

The design of conservation developments should be flexible to reserve the best available soils on the site for sewage treatment purposes (Arendt, 1994). In addition to meeting proper regulations and standards, community based sewage systems will require dedicated land area to function, and will have other design impact considerations that will need to be factored into development processes.

4.5 Rural Development

Large lot development is defined for the purpose of this Plan as exceeding 20 acres per unit. This style of development is currently permitted throughout the planning area and will continue to be permitted, subject to applicable regulations and standards. Current regulations also allow for lot splits of less than 20 acres. It is recommended the County adopt proper legislation to review all development proposals that are greater than 5 acres in size. This measure would create an opportunity for the County to discuss potential incentives and alternatives to conventional development, including conservation development.

If there are multiple applications for large lot developments or smaller lot splits in a concentrated area, the local jurisdiction, or county, should coordinate the developers and identify an agreeable approach to achieving the conservation areas in a contiguous manner and providing shared driveways and internal access roads to eliminate frontage lots on external roadways. It is strongly recommended that large lot owners maintain at least 50% of their home site as a conservation easement with natural, vegetated landscape such as prairie grasses to minimize the application of fertilizers and improve infiltration capability.

Homes on large lots should incorporate a range of best management practices at the unit level including rain gardens, native plantings and pervious pavements as well as native landscaping.

Large lot developments will most likely require on-site septic systems and will be subject to regulations regarding the inspection and monitoring of those systems. Lot design and layout will be impacted by the approach to on-site treatment.

4.6 Town Center

Policies related to the development of the Town Center are intended to provide basic guidelines. As a priority, development of the Town Center should minimize impacts to any existing environmental features that currently exist in the area and strive to set a new standard for sustainable urban development.

Master Plan
The Accord jurisdictions should immediately and jointly pursue the completion of a Town Center Master Plan.

The portion of the Town Center that falls within Prairie Township is already zoned at densities that could support higher density residential development. However, the goal of the Town Center is to promote a mix of uses including parks and open spaces, a mix of residential housing types, commercial and office. To maximize the presence of adequate infrastructure, the Town Center should encourage development at high densities. As part of the master planning process, Prairie and Brown Townships should jointly develop zoning regulations that allow for this mixed use Town Center. Section 5.0 describes the recommended steps and considerations for completing a joint master planning process for the Town Center.

Development Capacity of the Town Center
The level of growth in the Town Center will be dependent on both the ultimate sewer capacity as well as the success of the Big Darby Accord in discouraging development in conservation areas and focusing it in the Town Center. For these reasons, the Town Center should be developed in a series of phases related to the extension and capacity of centralized sewer. Planning for sewer capacity should consider the long-term needs of the Town Center and should be designed to allow the Town Center to grow over time as improvements to the sewer system are funded and completed and the ability to meet water quality standards is demonstrated.

Detailed phasing of the Town Center should be addressed as part of the master planning effort. However, based on the proximity to existing sewer lines, Phase 1 should include areas along West Broad Street. Later phases should extend to I-70 where it would be appropriate to locate more regionally oriented uses that have access to I-70 via a new interchange.

Character
The organization of the Town Center should reflect traditional Town Center practices and recommendations of the Big Darby Accord Town Center general design standards described below. Town Center development should have the following characteristics:

- A mix of uses both horizontally and vertically
- A mix of residential housing types including affordable housing
- Pedestrian orientation/ADA Accessible
- Quality streets
- Well organized public spaces, including formal and informal parks
- Architectural variety and interest
- Energy efficiency and sustainable design
- Maximization of density

The Town Center should accommodate uses and densities that allow for transitions from the high density Town Center to the low density rural character surrounding the Town Center, as described in Section 3.0.

Town Center Land Use
Policies related to defined land use types in the Town Center should be further developed in the Master Plan process. The overall goal for the Town Center is to create a dynamic community with a high quality of life for residents and visitors.

Mixed-Use Development
Mixed use development should be encouraged particularly along the major pedestrian oriented streets. Mixed-use includes retail on the 1st floor with either office or residential uses above. Mixed-use

development should include continuous retail uses along key streets with generous pedestrian areas to encourage walking.

Individual Lot Commercial Development
Individual lots should adhere to an established streetscape plan. Town Center jurisdictions should establish a street hierarchy and accompanying street typology to dictate the form of individual sites. This will result in a street of consistent and strong character. All buildings located along the public roadway in the Town Center should meet all standards established for the street including build-to lines, pedestrian access, architecture and use.

Large Scale Commercial Development
Large scale developments that may include a 'big box' anchor store and outparcels should not be isolated developments. They should relate to and connect to all other development in the Town Center and adhere to the established street hierarchy and typology. Vehicular and pedestrian connections should be made on all sides of the development to reduce traffic pressure. The building arrangement should be well organized and any internal circulation efficient and effective. Pedestrian amenities should be provided throughout the site.

Large Footprint Buildings
To achieve good design for a large footprint building, careful attention to siting and architecture is critical. Efforts should be made to minimize the mass of the building by breaking up any building façades. Vertical elements should be incorporated to break up the length of each face and horizontal elements should be used to reduce the building massing. Fenestration detail, recesses, extrusions, windows, pitched roofs, step backs, etc., can be utilized.

Residential Subdivisions
A variety of residential units should be available throughout the Town Center, including multi-family and single family. It is recommended a portion of the housing units in the Town Center be affordable units. Multifamily units should be arranged in a traditional fashion with traditional building types, either in townhomes or apartment buildings in the H, U or I form or a donut form where residential units surround a parking structure. Single family homes should also be traditional in architecture, scale and siting but allow for creativity and uniqueness. Garages should not dominate the façade; alleys should be provided at the rear to allow garages to locate behind a house.

Design Standards
The following are recommended design standards for the Town Center.

Site Design
Site design will be the greatest contributing factor to the eventual quality of life in the Town Center.

Build-to lines should be established to create a built edge along any public roadway. This will contribute to the street character and organize the development. All buildings should address all public roadway and have strong relationship with the primary roadway. The front door of a building should be accessible by pedestrian walkways.

Parking, Circulation and Access
Parking should not be a dominating land use in the Town Center and internal circulation should be well organized. Parking requirements should be flexible; on street parking spaces on public roadways should count toward parking requirements and shared parking should be strongly encouraged.

The building presence on a primary roadway should not be dominated by pavement. Parking should be placed behind buildings or in parking structures where feasible. Curb cuts should be limited on primary roadways for vehicular and pedestrian safety.

Any parking associated with a large footprint building should be minimized by reducing the paved areas, incorporating low impact development options (such as pervious pavement, swales, etc.) and integrating landscape islands, or other means. Parking ratios should be established as part of the master plan process.

Street Design
All roads within the Town Center should adhere to an established hierarchy based on the type, amount of traffic and proximate uses. A streetscape plan should be created as part of the master plan to establish the typology for all roads and address sidewalk width, lawns, street trees, distance from building to curb, relationship of the building to the street, etc. Alleys should be located behind all developable parcels to provide rear access locations. Pervious materials should be considered for alleys. Streetscape improvements should be enumerated and required as part of each development.

Connections
Strong, safe and attractive pedestrian and bicycle connections should be created throughout the Town Center. Pedestrian and car conflict points should be avoided and pedestrians should be able to safely maneuver from the street to any building door. Direct connections from sidewalks to

buildings should eliminate the need to navigate through a parking lot to access a building.

Five foot sidewalks should be the minimum width for any sidewalks within the Town Center. Increased sidewalk and street widths may be required to accommodate bicycle facilities. Design and construction of sidewalks should consider a variety of options including impervious materials. A multiplicity of vehicular connections should be made throughout the Town Center whenever possible to help relieve traffic congestion and connect neighborhoods. There should be no isolated developments.

Landscaping
Landscaping and vegetation will be a necessary element for achieving the overall goals of the Accord plan related water quality. Vegetated and natural areas reduce impervious surfaces and can provide benefits for stormwater management. Landscaping should be required within all setback areas abutting an existing or planned public right-of-way and be required in all off-street parking areas in order to visually break up large areas. Landscaped areas may serve many functions and should be integrated into the overall stormwater management plan where applicable.

Screening
Screening should be required for parking, all utilities, dumpsters, mechanicals and other building necessities from all sides.

Buildings
Building types within the Town Center should vary. All buildings should have a strong presence on a primary street. Building details should be traditional in nature and incorporate natural materials that evoke architectural interest and variety to achieve design goals – faux storefronts and thin facades above rooflines should not be permitted. Multi-story buildings and pitched roofs should be encouraged. Green roofs and other sustainable design elements (LEED) should be encouraged.

Public Spaces
Well organized and well designed public spaces will be essential for the success of the Town Center. Not only should the preferred location of public spaces be designated, a hierarchy should be established so that all public space needs are met, passive and active, formal and informal. Leisure trails should provide connections within and out of the Town Center.

4.7 Stormwater Management

Development in Accord planning area will need to meet a new standard of quality in order to meet the water quality goals of the Ohio EPA and of this Plan. Stormwater management policies for the Big Darby Accord Plan are tied to maintaining and improving water quality and the aquatic life use attainment within planning area watercourses. Stormwater management requirements will become applicable as development applications are submitted and reviewed.

Better Site (Low-Impact) Design Principles for Stormwater Management
It is recommended that better site design practices, as defined in Section 3.0, be incorporated into local zoning ordinances, planning policies and/or subdivision regulations within the Accord planning area. Further investigation is required to determine the nature of the changes that will need to be made to the current ordinances, regulations and policies used by the various jurisdictions to oversee the development process. To simplify this process, a single set of policies, rules and regulations should be developed that is unique to the Accord planning area and can be administered throughout the entire area.

4.7.1 Stormwater Quantity Control
The recommended detention (quantity) controls are adapted from the City of Columbus' recently revised Stormwater Drainage Manual. The criteria represent an approach to stormwater detention referred to as the critical storm method.

- The runoff volume from a site during a 1-year, 24-hour storm event is calculated for pre- and post-development conditions. The critical storm for sizing the stormwater detention facilities is then determined based upon the percent increase in runoff volume due to the proposed development (pg. 3-3 of City of Columbus Stormwater Drainage Manual).
- Runoff from storm events less than or equal to the critical storm calculated event is to be released from the development site at a rate no greater than the peak runoff during the 1-year event under pre-developed conditions.
- Stormwater detention facilities are to be sized so that the peak runoff during the 100-year storm event with the post-developed condition is released at a rate less than or equal to the peak runoff from a 10-year storm under pre-developed conditions.

4.7.2 Groundwater Recharge Criteria
Evaluation of the post-construction groundwater recharge rate from the structural and non-structural best management practices (BMPs) within the developed area is required as part of the Ohio EPA's draft NPDES permit.

The draft permit requires that the post-construction groundwater recharge rate must equal or exceed the pre-developed recharge rates, as defined within the permit. It is recommended that recharge areas include areas such as low elevation undisturbed hydric soils, floodplains and riparian corridor areas. An equation and table to be used for calculation of the annual average groundwater recharge rates from various land uses and soil groups is included in the draft version of the NPDES permit. Furthermore, the draft permit recommends that the groundwater recharge (infiltration) areas be protected through binding conservation easements that identify a third party management agency, such as a homeowners/condominium association, political jurisdiction or third party land trust. The implementation of ownership of groundwater recharge areas may vary depending on the chosen practice for meeting the requirements.

If the determined post-development recharge rate is less than the pre-development rate, two options are available:

1. Additional land within the planned development can be converted to a land use with higher recharge potential. This area should be part of the conservation open space that is part of the development site or allocated off-site open space areas that are required to achieve the proposed development density in non-conservation development areas. In this scenario, the groundwater recharge areas would be allocated within land that is likely to be held in public trust as part of the open space component of the Accord planning area.
2. A portion of the runoff from a development can be directed to a stormwater BMP that promotes infiltration. Implementation of infiltration-based BMPs must take into account soil suitability and the potential for groundwater pollution. In this scenario, the groundwater recharge facility would most likely be owned by and the responsibility of the property owner or homeowners association. A majority of the soils within the Accord planning area have characteristics not suitable for implementation of infiltration practices. For most of the "filtering" BMPs discussed in Section 4.8, it is assumed that an underdrain system will be necessary; however, even those systems provide an advantage toward promoting the interaction of surface flows and the shallow aquifer that is a contributor to a sustained stream base flow condition.

4.7.3 Stormwater Quality Control

Recommended policies related to addressing water quality are associated with stormwater runoff criteria stipulated by the Ohio EPA's draft NPDES permit for the Big Darby Creek watershed, including the specific criteria for the portion of the watershed contained to Franklin County. The Ohio EPA is currently in the process of re-visiting some of those criteria, and some of the specifics of those policies may be changed in the final version of the permit; however, when final, the permit will be a mandate for all development within the watershed. The various components of the NPDES permit as they pertain to water quality are listed below. Each of these was discussed in detail in Section 3.

Construction Phase Stormwater Control

All development site plans must include a Stormwater Pollution Prevention Plan (SWPPP) that contains details and specifications for runoff, erosion and sediment control measures that will meet the requirement of the permit. For sediment control, specifically, a sediment settling facility must be provided that has a measurable goal of releasing no more than 45 mg/l TSS for up to a 0.75 inch rainfall in 24 hours. The size of the disturbed project area (greater than or less than 5 acres) may determine the type and size of sediment settling facility required. For sites smaller than 5 acres, other measures of sediment control than a settling facility are permitted; however, the likelihood of obtaining the target rate of TSS becomes reduced.

Post-Construction Performance Goals

The TMDL report for the Big Darby Creek defines allowable release rates in kilograms per year for the pollutants of concern within the Accord planning area in addition to defining a percent removal for each of those pollutants from the existing conditions within the watershed. For example, within the Hellbranch Run watershed, the required percent reduction in the existing TSS and TP load within the watershed is 95% and 81%, respectively. There are separate values for percent pollution reduction presented in the TMDL for other areas within the Accord planning area; however, it is anticipated that a performance goal related to post-construction water quality will be adopted that is uniform throughout the planning area. Presently, the Ohio EPA is contemplating a numerical pollutant load requirement that would apply to stormwater runoff released from a development site rather than percent removal efficiency as defined in the TMDL. The pollutant load number, likely in milligrams per liter, would allow for a quantifiable measure of success simplifying the design and

monitoring process related to implementing BMPs.

Furthermore, this plan includes requirements for monitoring of individual site developments to determine compliance within an established performance goal. Chapter 5 discusses the implementation of the monitoring program and its associated performance bond.

Water Quality Volume
The water volume criteria contained within the Ohio EPA's draft permit will be the determining requirement for the design of stormwater BMPs sufficient to meet the drawdown times also stipulated in the permit. Calculations prepared as part of a development site design would need to be prepared demonstrating that the BMP feature is capable of providing the storage volume and has an outlet structure adequately sized to meet the drawdown time criteria.

4.7.4 Floodplain Management

The determination of the extent of the 100-year floodplain boundary is described in conjunction with establishing the SCPZ (Section 4.2). Within that section, it is generally established that a FEMA-designated 100-year floodplain can serve as the limits of the SCPZ. The protection of the 100-year floodplain from encroachment due to fill placement is regarded as a measure to both provide an adequate riparian buffer along significant watercourses within the planning area and to also address flooding concerns along those watercourses.

As mentioned in Section 4.2, the Ohio EPA is considering a provision within their changes to the draft NPDES permit for the Big Darby Creek watershed that would allow the SCPZ to be less than the extent of the 100-year floodplain if stream restoration occurs along that reach of the channel. Given this consideration and the discussion of existing floodplain regulations under Sec. 3.7, the criteria listed below are recommended.

Floodway Encroachment
Stream restoration activities along degraded stream channels that are FEMA-studied will certainly involve grading/filling within the designated floodway. In order to permit this activity, it is recommended that the established minimum standards of the NFIP be followed, requiring a determination through a technical analysis of the impact of the activity on 100-year flood elevations. The same criteria apply to any proposed bridges or culverts involving components within the floodway. It is possible that a CLOMR will be required from FEMA before the local jurisdiction can issue a permit for these activities. Given the recommended SCPZ criteria, no other activities are anticipated that would require floodway encroachment and the application of these criteria.

Floodplain Filling
The contemplated changes to the NPDES permit for the Big Darby Creek will leave residual floodplain areas outside of the SCPZ that could be filled for development purposes. Should fill be allowed within the 100-year floodplain under this condition, it is recommended that documentation be provided with the permit application demonstrating there will be no loss of floodplain storage. The documentation should consist of volume (of fill and excavation) calculations and a certification from a registered professional engineer that the calculations accurately reflect the proposed activity.

4.8 Stormwater Best Management Practices

As recognized in the Columbus Stormwater Drainage Manual, stormwater management, particularly in the area of stormwater *quality* management, is an evolving science. Therefore, it will be important to review stormwater policies when updating this plan as science, technologies, industry and design will likely evolve. Information within this section has been compiled from a number of resources including the Ohio Department of Natural Resources (ODNR), the Hellbranch Watershed Forum (HWF), the Darby Creek Watershed Task Force, the City of Columbus Stormwater Drainage Manual, the United States EPA, the Northern Virginia BMP Handbook, the City of Olympia, Washington Stormwater Manual and the Chesapeake Bay.

Best Management Practices (BMPs) are structural or non-structural practices, management practices, or a combination of these techniques, that when used in solitude or in combination, minimize the impacts of agricultural or urbanized land uses on water quality by removing or reducing pollutants.

BMPs are most commonly associated with post-construction storm water management techniques that treat runoff from a development site *after* construction is completed. BMPs capture and treat pollutants found in runoff and manage the frequency, volume and energy of the runoff so that water resources are not degraded (ODNR). Historically, storm water ponds were used to reduce downstream flooding because they detain water and release it at a slower rate while also allowing settling of sediments (ODNR). The application of BMPs as a way to protect stream and water quality in addition to stormwater flow control provides an added benefit to the watershed.

BMPs have been categorized to focus on those techniques most commonly used for residential development. The application of BMPs is typically associated with an entire residential development or subdivision. The BMPs discussed herein span watershed level applications and individual property applications. The actual design of a BMP typically falls into one of three categories: structural, non-structural or management/ policy related.

The Hellbranch Watershed study reviewed BMPs and similarly categorized them based on type:

> *The most common examples of structural BMPs include extended detention dry ponds, wet pond, and infiltration trenches. Some non-structural BMPs, which may be used in conjunction with structural controls, include street cleaning, vegetative buffer areas, grassed swales and fertilizer application control. Some BMPs such as ponds and swales, are generic features often provided in contemporary developments; however, unless they were designed as BMPs, they may be ineffective at removing pollutants from the stormwater runoff. BMPs have specific design and construction criteria and maintenance requirements that must be adhered to in order to achieve the reported pollutant removal efficiencies (Hellbranch Watershed Pollutant Modeling report, March 2005).*

Pollutant removal processes vary considerably among BMPs. Due to differences in these removal processes, identifying target constituents is crucial for optimum BMP selection. Most BMPs are effective at removing large particles, while well-vegetated basins and infiltration methods are more suited for removal of fine sediments and dissolved constituents. Dissolved contaminants require long residence times, high soil-water contact, and the opportunity for vegetative uptake (Hellbranch Watershed Pollutant Modeling report, March 2005). Combining BMPs can often result in a more efficient and effective treatment system. For example, a BMP system may incorporate a structural facility in combination with grassed swales, vegetative buffer areas, marsh vegetation or other nonstructural BMPs in order to achieve the desired storage volume and site coverage requirements. At times, non-structural BMPs may be required or desirable in order for the structural BMP to operate at maximum efficiency. Because BMPs must slow down or temporarily detain the stormwater runoff in order to achieve the desired pollutant removal efficiencies, BMPs also provide a measure of water quantity control as well. The extent to which peak runoff rates are reduced varies depending on the type of BMP applied.

4.8.1 BMP Planning Process

As part of the preliminary planning process for development within the planning area, decisions will need to be made regarding the types of BMPs that will be utilized on each site. Information was compiled to help both developers and plan reviewers in determining the appropriate BMPs for a site. The information presented here is not meant to be exhaustive or exclusive; other BMPs not listed here may be acceptable, but they will require additional review and documentation to ensure that the goals of the Big Darby Accord are being met.

Limited performance and design information is presented here; this

information should only be used for determining which BMPs should be selected for a site to meet the appropriate design criteria. It is the responsibility of the site designer to identify the specific design criteria necessary to complete the design of the BMP and present it to the reviewer. Much of the information presented here is adapted from the State of Minnesota's *Stormwater Design Manual*, November 2005.

Green roofs, pervious pavement and rain water harvesting (e.g. rain barrels, lot level rain gardens, dry wells) are not primary BMPs, and should not be considered part of the required treatment train for a development. The implementation of these particular BMPs will allow the designer to decrease the amount of impervious cover on a site, which can have an impact on the design of the other BMPs specified.

The summary information presented in Figure 4.2 and Section 4.8.3 includes an overview of information on design criteria, benefits and limitations as well as the mechanism by which the BMP functions, the pollution removal efficiency (in percent removal), site design factors such as maximum drainage areas tributary to the BMP, depth to the water table, and the scale at which each BMP is most effective (development level versus lot level). Filtration practices, as described below, include grass channels, dry swales, wet swales and filter strips. Infiltration practices, as described below, include infiltration basins, infiltration trenches, dry wells, and underground detention. Filtration devices and hydrodynamic devices are proprietary systems that are available from multiple manufacturers, and evidence of independent testing of the performance of these devices should be required prior to development plan approval.

BMP Selection Considerations

Selection considerations presented here are aimed largely at water quality control but do not remove the requirement for a development site to control the quantity of stormwater runoff from their site.

Non-structural BMPs, which reduce the volume and peak flow of stormwater runoff from a development site, should be evaluated as part of the conceptual site design process. The benefits to both the developer and the community from incorporating non-structural BMPs is reduced runoff, reduced pollutant load for BMP treatment, reduced cost for drainage infrastructure, and reduced long-term site maintenance. Several approaches, discussed in detail as part of "Better Site Design" principles (Section 4.7) include methods to reduce impervious areas and to increase infiltration through placement of grass buffers and swales.

Minimizing the directly connected impervious area requires a change in land development design philosophy. Traditional land development practices do not focus on water quality concerns but rather promote runoff from the site to a curb and gutter stormwater conveyance system. This practice concentrates runoff quickly, resulting in large peak runoff rates during small storms.

The first step of planning for stormwater management BMPs within a development begins with the collection of data on the local receiving waters and information regarding pollutants of concern within the downstream watershed area. The OEPA has already compiled this information for the planning area in the Big Darby Creek TMDL report, however, it is possible that information exists for individual development sites and it is suggested that the developer review all available resources to determine if additional data exists for their site.

The following BMP planning process can then be used by both developers and by reviewers to select appropriate BMPs that address both the proposed development and the pollutants of concern listed in the TMDL or any other documentation that may become available in the future.

Step 1. Determination of whether development is large or small development

If a development disturbs five or more acres of land or is part of a larger common plan of development or sale that will disturb five acres of land, the BMPs chosen for the site must either be capable of treating the larger drainage area, or the site must be split up into smaller, distinct sub-watersheds such that the BMP limitations noted in the summary table are not exceeded.

Step 2. Determine whether or not development site is tributary to a regional stormwater management facility.

It is anticipated that parts of the planning area, particularly the town center area, will develop in such a manner that regional stormwater management facilities will serve as part of the BMP treatment train for multiple developments. If a development site is located within an area that is tributary to one of these regional facilities, it is likely that the on-site BMPs for the development will have to meet a different pollutant removal efficiency that has been previously specified, as the regional

facility will meet a portion of the required control for the area. The removal efficiency required at the site level would then be determined on a case by case basis.

If a development site is not tributary to a regional management facility, the responsibility of meeting the target pollutant removal efficiencies must be accomplished within the site.

Step 3. Determine site conditions related to stormwater runoff

The site conditions that a developer must determine include runoff volume, peak flow rates and water quality considerations. The stormwater runoff conditions should be calculated for both the pre- and post-development condition such that the controls necessary for the post-development condition may be tailored to meet the requirements outlined in other sections of this document. It is during this step that the developer should determine the post-development pollutants that are likely to be present to assist in BMP selection.

Step 4. Determine the need for oil control BMPs.

Oil control BMPs should be applied to sites likely to generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil and gas. The following urban area land uses should be considered as high use sites requiring oil control BMPs: railroad yards; fueling stations; vehicle maintenance and repair sites; construction businesses; industrial machinery and railroad equipment maintenance areas. If the proposed development is likely to generate excessive concentrations, an oil control BMP should be selected. BMPs which control the oil content in runoff include oil/water separators, catch basin inserts, and manufactured systems.

Step 5. Determine if infiltration is practical for pollutant removal.

Infiltration BMPs are effective alternatives for both treating stormwater runoff and for addressing groundwater recharge. The effectiveness and applicability of infiltration BMPs is dependant upon local soil properties. Factors which determine if infiltration is practicable include soil type, location and depth to bedrock, the water table, presence of impermeable layers, and proximity to wells, foundations, septic tank drainfields, and unstable slopes. Soil types which are appropriate for infiltration BMPs include coarse sand to loamy sandy deposits. Infiltration practices can also be used in clayey soils with the use of an underdrain system, connected to the stormwater conveyance system for the site. It is recommended that infiltration BMPs be preceded by a pretreatment facility such as a pre-settling basin to reduce the sediment load entering the infiltration BMP. Infiltration BMPs include infiltration basins, infiltration trenches, and bio-infiltration swales. If infiltration is considered a practicable BMP for the site, a pre-treatment BMP and infiltration BMP should be selected and sited within the proposed development.

Step 6. Determine level of phosphorous control required.

The need for phosphorous control is outlined in the TMDL for the Big Darby Creek watershed. The level at which phosphorous control is needed will be dependent on the type of development proposed and whether or not the site is tributary to a regional facility that may provide some phosphorous removal. BMPs that reduce the phosphorous content in runoff include large wet ponds, wetland systems, media filtration and manufactured systems. The site suitability and design criteria for each BMP should be reviewed to determine compatibility of the BMP with the specific development site.

Step 7. Select BMP application based on suitability to site

The factors a designer should consider as part of this step include the items discussed previously, and also include the size of the runoff area, the final appearance of the BMP and the functionality of the BMP. Information presented in Figure 4.2 details both the runoff area that each BMP is best suited to treat as well as the functionality of the BMP. The attached BMP summary information also has photographs of fully developed BMPs, so that developers can determine whether or not a specific BMP will visually fit within the overall site plan.

Step 8. Final Site Design and Layout

Following the selection and location of stormwater BMPs on the site, the developer should proceed to the final layout and design of the development. The development design must comply with all local zoning ordinances as well as with all Accord development policies and the Draft NPDES Permit for Construction Activities.

Final Review and Approval.

The developer must then submit the finalized stormwater management plan and report and development plan to the reviewing authority.

4.8.2 System Ownership and Maintenance

The long-term inspection and maintenance of the stormwater control facilities is critical to continued performance.

The NPDES permit for the Accord planning area requires submission of a maintenance plan for all post-construction BMPs. These plans are to be provided to the owner/operator of the site (including homeowners associations) prior to the completion of construction activities. A description of the funding mechanism must be included in the maintenance plan to ensure all BMPs are maintained in perpetuity.

For the planning area, maintenance of the stormwater facilities will be divided into these two basic categories:

1. On-site systems (bioretention cells, swales, filter strips etc.)
2. Detention systems (detention/retention basins or constructed wetlands).

Accord representatives have suggested that all on-site systems will be maintained through the owner or homeowners associations and all detention basins and constructed wetlands will be maintained by a public entity (county, community authority, municipality, township, etc.). Regardless of the ownership specified during the planning process, an easement will be required for all BMPs such that the public entity may gain access to ensure and facilitate maintenance as necessary.

The Town Center concept promotes regionalization for stormwater management facilities. These regional facilities would be maintained by a public entity. Any site level BMPs required in this area will be maintained by the development site owner or homeowners association.

If it is determined that a BMP is not to be publicly owned and maintained, the developer of a site should be required to submit an operation and maintenance report that details, at a minimum, who is responsible for maintenance of the facility, the frequency and type of maintenance that will be required for the facility and the method of reporting this information. Other details of the operation and maintenance of the facility may be required at the discretion of the reviewing authority. If it is determined that the responsible party is not meeting the goals of the operation and maintenance report, the public entity will have the ability to access the BMP through the required easement and perform maintenance required. There are several mechanisms for recouping the cost of this activity from the site owner/operator. Use of the performance bond (included in the discussion of monitoring) or assessments should be considered.

4.8.3 BMP Toolkit

Example of Green Roof
Source: Low Impact Development Center

Example of Pervious Pavement Blocks, Washington, DC
Source: Low Impact Development Center

Example of Pervious Pavement Application in Residential Area
Source: Low Impact Development Center

Green Roofs

Design Criteria

- Structural load capacity is a major factor in determining whether the green roof is "extensive" or "intensive"
- Vegetation selection is based on numerous factors including, growth depth, microclimate, irrigation and maintenance
- A leak detection system is recommended to quickly detect and locate leaks
- Modular products can increase installation and repair efficiency

Benefits

- Reduce, delay and cool stormwater runoff
- Insulate buildings and lower energy consumption and costs
- Provide habitat for birds and insects
- Increase longevity of traditional roofing systems by protecting from ultraviolet rays
- Reduce carbon dioxide levels and heat island effect

Limitations

- Cost is higher than traditional roofing systems – can be significant for retrofits
- Leaks can cause significant damage and can be hard to locate and repair without detection system
- Conditions can be harsh for vegetation establishment
- Maintenance needs can be higher than traditional roofing systems

Pervious Pavement

Design Criteria

- Pervious pavement is typically used in low traffic areas including overflow parking areas, emergency vehicle lanes, and pedestrian areas
- In-situ soils should have field-verified minimum permeability rates greater than 0.3 in/hr. Contributing runoff from offsite should be limited to a 3:1 ratio of impervious area to pervious pavement area
- The selected systems load bearing surface should be suited to maximum intended loads
- Design storms should be infiltrated within 48 hours

Benefits

- Good for highly impervious areas – particularly parking lots
- Reduces need for other storm water BMPs by reducing runoff
- Construction costs of some systems are less than traditional paving
- Soil-enhanced turf systems resist compaction, increase infiltration, and provide soils for healthier vegetation

Limitations

- Construction costs of some systems are more expensive than traditional paving
- Use depends on infiltration rates of underlying soils
- Maintenance costs are higher than conventional paving
- Not recommended for high traffic areas because of durability concerns

Rain Water Harvesting

Design Criteria

- The system should be watertight, have a smooth interior surface, be located on level and stable ground, have a tight-fitting lid, good screens on the inlet and outlet and have an emergency overflow device
- To prevent the breeding of mosquitoes, empty the water in less than 5 days or place a fine screen over all openings
- Material can withstand the pressure of water over long periods of time
- Disconnect and drain rain barrels and cisterns in the winter to prevent freezing and deformation of the rain water harvesting system

Benefits

- Protects water supplies by reducing use during peak summer months
- Mimics the natural hydrology of the area by infiltrating a portion of the rain water falling on the site
- Reduces volume of storm being delivered to downstream waterbodies
- Results in cost savings by reducing municipal water bill

Limitations

- Not suitable for the following roof types: tar and gravel, asbestos shingle and treated cedar shakes
- Depending on the design, requires a certain amount of operation and maintenance
- Proprietary systems can be expensive

Chemical and Biological Treatment

Design Criteria

- Properties of water to be treated (pH, sediment concentration, etc.)
- Level of treatment desired
- Requirements for discharge of treated water to receiving water bodies
- Type of facility required or present
- Pre-treatment or secondary treatment requirements
- Maintenance and monitoring requirements of the system

Benefits

- Quickly removes suspended clays and silts
- Can be used as pre-treatment to remove suspended sediments prior to infiltration
- Can help project meet stringent water clarity and sediment bound pollutant removal standards
- Suitable for cold climates

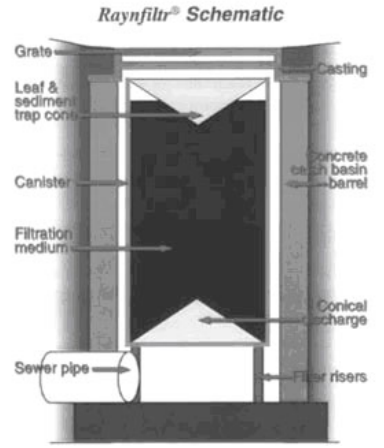
Limitations

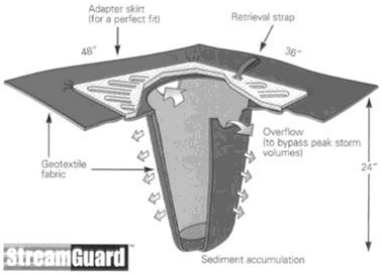
- Ongoing operation and maintenance of the chemical addition system may be required
- Monitoring may be required to determine the impact on downstream resources
- A pond or sediment collection area is necessary downstream of the treatment site for settling out the flocculants
- May require permitting from OEPA for discharge
- Expensive to build and operate

Example of Rain Water Harvesting
Residential rain barrel — Stillwater, MN

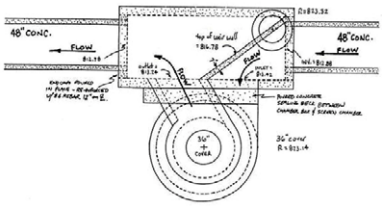
Example of Chemical and Biological Treatment
Tanners Lake alum injection facility — Oakdale, MN

Example of Rain garden
Source: EDAW





Examples of Filtration Devices
Proprietary systems used as examples only, NOT an endorsement



Example of Hydrodynamic Device
Courtesy of Minneapolis Public Works Department

Filtration Devices

Design Criteria
- Pollutants of interest for reduction
- Desired removal efficiency
- Design flow for volume, site constraints on size, desired location of treatment unit
- Pre-treatment requirements
- Installation and maintenance costs, life of unit

Benefits
- Units are typically underground or within existing structures and do not consume much site space
- Filtration devices can be customized to reduce a specific pollutant of concern
- Can often be easily incorporated into fully developed sites
- Can be used for pre-treatment prior to infiltration practices
- Relevant for use on industrial sites because filters can remove pollutants such as metals and oils

Limitations
- Efficiency has not been widely tested
- Each type of unit has specific design constraints and limitations for use
- Can be more costly than other treatment methods
- Treatment may be greatly reduced if frequent maintenance is not conducted
- Subject to freezing in cold climates

Hydrodynamic Devices

Design Criteria
- Expected flow rates
- Pollutants of concern
- Desired removal efficiencies
- Site constraints for size
- Installation and maintenance costs, life of unit
- Need for accessory structures

Benefits
- Units are typically underground and do not consume much site space
- Can often be easily incorporated into fully developed sites
- Can be used for pre-treatment prior to other practices
- Suitable for cold climates if installed below frost line

Limitations
- Each type of unit has specific design constraints and limitations for use
- Treatment may be reduced if frequent maintenance is not conducted
- May not meet local standards when used alone
- Generally good for solids and litter, but much less effective for other common pollutants

Bioretention

Design Criteria

- Infiltration requires suitable soils
- Minimum 10-foot setback and located down grade from home foundations
- Best applied to drainage areas with relatively flat slopes (5%)

Benefits

- Can be very effective for removing fine sediment, trace metals, nutrients, bacteria and organics (Davis et al. 1998)
- Provides many additional environmental (habitat, improves air quality, urban micro-climates), social (creates a unique sense of place), and economic benefits (reduces development and maintenance cost, greater lot yield, increases property values)
- Well suited for high impervious areas
- Reduces runoff volume
- Flexible design, affording many opportunities for creativity

Limitations

- Susceptible to clogging by sediment; therefore maintenance and pretreatment is necessary to maintain effectiveness
- Not effective for large drainage areas (use multiple structures, closer to source of runoff)
- Space consumption (5%-10% of drainage area)

Filtration Practices

Design Criteria

- Ensure adequate space for filtration system
- Some installations require 2-6 feet of head
- Removal potential of the key pollutant
- Parent material and potential for ground water contamination

Benefits

- Good for highly impervious areas with low sediment/high pollutant load (e.g. urban land use and retrofit scenarios)
- High pollutant removal rates
- May be used in a variety of soil types
- Good for treatment of hotspots because it can be isolated from ground water if contamination concerns exist

Limitations

- Higher maintenance requirements
- Some installations (media filters) have higher construction costs
- Potential to cause odor problems
- Minimal treatment of soluble nutrients
- Potential for nitrification in media filters where anaerobic conditions exist

Example of Bioswale Planting
Source: EMH&T

Example of Filtration Practices
Public Library, Alexandria, VA
Source: EDAW

Example of Infiltration Practices
Infiltration trench,
Lino Lakes City Hall — Link Lakes, MN

Example of Infiltration Practices
Underground storage and infiltration,
Bradshaw Celebration of Life Center — Stillwater, MN

Example of Stormwater Pond
Source: EDAW

Example of Stormwater Pond
Source: EDAW

Infiltration Practices

Design Criteria
- Contributing drainage area
- Underlying soil types
- Depth to the water table, bedrock or other impeding layer
- Proximity to buildings, drinking water supplies, karst features, etc.
- Source of stormwater runoff

Benefits
- Reduces volume of stormwater runoff
- Increases groundwater recharge
- Improves surface water quality
- Provides thermal benefits (e.g. to cold water fisheries)
- Mimics pre-development hydrology

Limitations
- Unusual construction considerations
- Potential for groundwater contamination
- Tendency to lose effectiveness over time due to clogging – if not properly constructed and maintained
- Not recommended for areas with steep slopes
- May require landscaping: consideration should be given to periods on inundation and drought

Stormwater Ponds

Design Criteria
- Irregularly shaped with a minimum length to width ratio of 1.5:1
- Permanent pool volume to 1800 cubic feet per acre draining to pond
- Permanent pool depth 3-foot minimum, 10-foot maximum at deepest points
- Extended detention (ED) storage sufficient to treat water quality volume
- Pre-treatment required (sediment forebay sized at 10% of pond area recommended)
- Stabilized emergency overflow and energy dissipation at all outlets

Benefits
- Able to effectively reduce many pollutant loads and control runoff flow rates
- Relatively straightforward design procedure
- Potential wildlife habitat and aesthetic or recreational enhancement
- May be used as temporary sedimentation basin during construction

Limitations
- Relatively large space requirement
- Tends to increase water temperature and may cause downstream thermal impact
- Potential for nuisance insects or odor
- Problematic for areas of low relief, high water table, or near surface bedrock
- Possible safety concerns

Stormwater Wetlands

Design Criteria

- Water budget should be calculated to ensure proper drainage area and to ensure that wetland conditions can be maintained.
- Minimum length to width ratio of 2:1 should be maintained during low flow or baseflow conditions.
- Minimum of 35% of the total wetland surface area should have a depth of 6 inches or less; 10% to 20% of surface area should be deep pool (1.5 to 6 feet deep)
- Constructed wetlands require about 2% to 4% of the area that drains to them.
- Thermal effects of discharged waters from stormwater wetlands on receiving bodies of water should be considered.

Benefits

- Good suspended solid and annual nutrient removal
- Provides good wildlife habitat and aesthetic value
- Low maintenance costs
- Provides ground water-surface water interface

Limitations

- Requires more land than other practices
- Requires careful design and planning to ensure wetland hydrology is maintained
- Water quality behavior can change seasonally

Example of Stormwater Wetland
Stillwater, MN

Minnesota BMP images were taken from the State of Minnesota Stormwater Design Manual, *November 2005*

Figure 4.2 Structural BMP Summary

Structural BMP Summary Information

BMP As defined in the Minnesota Stormwater Manual (November 2005)	Scale of Use			Management Suitability[1]			Water Quality Attributes of BMPs[1]								Filtering Capability of BMP (%)[1]						Limiting Design Parameters[1]						
	Watershed	Development	Individual Lot	Water Quality[2]	Recharge Volume[3]	Detention Capability	Infiltration	Screening/Filtration	Temp. Control	Settling	Evaporation	Transpiration	Soil Adsorption	Biological Uptake	TSS	Total P	Total N	Metals	Pathogens	Toxins	Drainage Area	Max. Slope	Min Depth to Bedrock	Min Depth to Water Table	SCS Soil Type	Freeze/Thaw Suitability	Potential Hotspot Runoff
Green Roofs			X	High	Low	NA		X	X		X	X	X	X	90	100	20	80	65	NA	Rooftop	NA	NA	NA	NA	Good	Suitable
Pervious Pavement			X	High/Med	High/Med	NA	X	X	X			X	X	X	NA	80	80	90	NA	NA	NA	2%	3 ft	3 ft	A, B	Good	Suitable
Rain Water Harvesting			X	High	High/Med	NA	X	X	X	X	X	X	X	X	100	100	100	100	100	100	Rooftop	NA	NA	NA	NA	Poor	Suitable
Chemical & Biological Treatment		X		High	NA	NA				X			X	X	Varies	Varies	Varies										
Filtration Devices		X		X	NA	NA		X							Varies			Varies									
Hydrodynamic Devices (Manufactured Systems)		X		X	NA	NA		X		X					Varies			Varies									
Bioretention		X		Med/High	High	Low	X	X	X	X		X	X	X	85	60	50	95	35	80	2 Ac Max, 1 Ac Imp.	20%	3	3	A, B (C & D w/under drains)	Good	Suitable
Filtration Practices Grass Channels Dry Swales Wet Swales Filter Strips		X	X	High	Med/Low	Low	X	X			X	X	X	X	85	50	35	50	35	80	5 Ac	20%	3	3	A, B, C, D	Poor-Good	Suitable
Infiltration Practices Infiltration Basin Infiltration Trench Dry Wells Underground Systems		X	X	High	High	Low	X	X	X			X	X	X	95	65	50	95	NA	NA	1/5/50 Dry well/Trench/Basin	20%	3	3	A, B, C, D	Poor-Good	
Stormwater Ponds	X	X		Med	Low	High				X	X			X	80	40	30	60	70	80	25 Min	25%	0	0	C, D (A & B require liners)	Poor	
Stormwater Wetlands	X	X		High	Low	High		X		X	X	X	X	X	75	40		40	75	85	10-25 Min	25%	3	3	A, B, C, D	Good	Yes

1. Adapted from the State of Minnesota Stormwater Manual, November 2005
2. Water Quality targets rainfall events that deliver the majority of the stormwater pollutants at the site.
3. Recharge targets rainfall events that create little or no runoff but produce most of the annual groundwater recharge at the site.

4.9 Utilities

4.9.1 Centralized Sewer

Centralized sewer service will be provided to both the designated Town Center and the proposed Hilliard growth area that resides within the City of Hilliard's contract service area. Hilliard's current contract service area is north of Roberts Road and extends west of Alton and Darby Creek Road. These central sewer systems would eventually discharge to a larger sewer system that is owned and operated by the City of Columbus. Current capacity limitations exist within the central sewer system. Additional central sewer capacity may be made available over time as improvements to the overall system are completed. Decisions regarding the allocation of any future capacity would need to be determined.

Centralized sewer service will also be provided to the LEED area east of Alton and Darby Creek Road. Capacity exists for approximately 1,400 equivalent dwelling units in this area. Central sewer service may also be provided in a manner consistent with the Accord general land use plan to some sites closer to the existing system that were previously annexed or are zoned for development.

Town Center

The Town Center will receive sewer service through the extension of and connection to the Big Run Trunk Sewer. Presently, the trunk sewer terminates near Broad Street at the eastern edge of the Accord planning area. The City of Columbus has suggested that service would occur in a manner similar to other contracted satellite communities within the central Ohio area, such as Hilliard. Without the area being annexed to Columbus, the local authority would own and maintain the sewer lines that extend or connect to the Big Run Trunk Sewer and then contract to the City of Columbus for treatment.

The Franklin County Sanitary Engineer, recognized as a Designated Management Agency (DMA) within the Regional Facility Planning Area (RFPA) that includes the Accord planning area, has been identified as a candidate to act as the local authority responsible for owning and operating the sewer lines in this area. As noted previously, there is a recognized sub-Regional Facility Planning Area that overlaps with the Town Center (Lake Darby Estates). If they are not, themselves, responsible for providing the sewer service within that area, then a formal agreement with Ohio American Water would be required under the 208 plan to allow the local authority to have that responsibility. A review of the provisions of the draft revised 208 plan and coordination with the Ohio EPA is necessary to determine the requirements related to establishing the Franklin County Sanitary Engineer as the recognized DMA for this area and address any issues related to the establishment of a sub-Regional Facility Planning Area or "satellite community" designation associated with the Town Center.

Based on an analysis of available capacity within the Big Run Sanitary Trunk Sewer line, the City of Columbus currently estimates the sewer capacity available to the Town Center area is 5,000 equivalent dwelling units. Additional capacity in the trunk sewer may be made available over time as improvements to the overall system are completed. Because this area would remain unincorporated, the City has requested that the local authority adopt and implement certain provisions, some of which are listed below. These provisions would become policy associated with the Accord planning process. The detail of these provisions and the possibility of other provisions are still being developed.

- The local authority must adopt the Big Darby Accord Plan
- The local authority must show evidence of adequate public service related to fire and safety to serve the development areas.
- The planning process must incorporate a provision for a component of affordable housing stock within the Town Center.
- The planning process considers environmentally sound mechanisms for providing wastewater treatment applications in areas of their RFPA that are not going to be served by central sewer systems.

The phasing of development within the Town Center will facilitate the initial extension of the trunk sewer to within proximity of the Town Center development area. It is possible that the local authority will have to develop a funding mechanism that would assist with the initial cost of extending the trunk sewer line, which would then be reimbursed as additional development occurs.

Hilliard's Growth Area

The Hilliard growth area will receive sewer service through the extension of and connection to the Roberts-Millikin Sanitary sub-Trunk Sewer. Presently, the sub-trunk sewer terminates east of Alton-Darby Creek Road and north of Roberts Road. Several smaller sewer lines extend from the sub-trunk sewer to other areas within Hilliard and within proximity to the extended contract service area; however, these were designed for local capacity only and some of these extensions include pump

stations. An analysis of the available capacity of this sewer line determined sufficient capacity exists within the Accord planning are for an additional 2,000 equivalent dwelling units.

Hilliard will likely annex this area as development occurs and, therefore, the development and associated sewer service will be subject to the provisions of Hilliard's service contract with the City of Columbus.

LEED Area

The Accord general land use plan designates an area east of Alton and Darby Creek Road and south of Roberts Road, known as the LEED area, for development at approximately 3 dwelling units per acre, in addition to an area of mixed use. The LEED area may be annexed by Columbus and is designated to receive central sewer service via the Roberts Millikin sanitary subtrunk. The capacity for this area is approximately 1,400 equivalent dwelling units, although the mixed use development will include non-residential uses.

Additional Central Sewer Areas

The Columbus central sewer system may also have additional capacity for some areas closer to the existing system, currently annexed or zoned for development and able to be served, in a manner consistent with the Accord general land use plan.

4.9.2 Non-centralized Sewer

A substantial part of the planning area is identified for rural conservation development. These areas are removed from where central sewer service is planned; therefore, these development areas would need to be served by an alternative community-based treatment system or would have household sewage treatment systems (HSTS) (also referred to as household sewage disposal systems). Presently, there is a proliferation of HSTS within the rural areas of the planning area and concerns have been raised regarding the operation and performance of these systems, particularly with regard to home aeration systems.

Section 2.2 references committees working on technical and regulatory issues pertaining to sewage treatment in non-central sewer areas (referred to as working groups). The technical committee has developed preliminary recommendations for alternative wastewater systems that are included in Appendix F.

Community-based Alternative Sewage Treatment Systems

The intent of these systems would be to collect sewage from a combined area for treatment, including land application of effluent, avoiding a direct discharge to any watercourse. The working groups (referenced in Section 2.0) discussing these systems have identified the Franklin County Sanitary Engineer as a candidate to be the local authority that would own and operate these systems. As with the issue of the central sewer systems elsewhere in the Accord planning area, the issues related to the provisions of the 208 Plan must be investigated to establish which are applicable to this arrangement. The working groups have identified the described approach to be the preferred method of wastewater treatment service for those areas that are not intended to be served by centralized wastewater treatment systems under the following conditions:

- The technology applied is appropriate. Land application, or drip irrigation, systems have various applications and the state-of-the-art is being sought in terms of meeting a high degree of certainty that the systems will provide a long-term and cost-effective solution to sewage treatment.
- The management and operations are effective, and regulatory oversight is sufficient. The working group recommends that the systems would be acceptable if they are publicly owned and operated, they are installed in compliance with an Ohio EPA *Permit to Install*, and they are operated in compliance with an acceptable Ohio EPA *Permit to Operate*. The Ohio EPA does not currently have a *Permit to Operate* mechanism for these systems. The Ohio EPA will be publishing proposed rules to create this mechanism in the near future. The working groups propose that these rules must adequately address the criteria listed below.
  1. *Effluent limitations*
  2. *Monitoring requirements*
  3. *Operator qualifications*
  4. *Siting criteria, considering field tiles, soil types and isolation distance*
  5. *Storage of effluent*
  6. *Application rates/conditions for both spray and drip irrigation*

  Upon issuance of the proposed Ohio EPA rules, the working groups propose to review and determine if all stipulated provisions have been adequately provided.

On-lot Systems

Although it is intent of the Accord Plan to limit the circumstances under which a single-lot sewage treatment system would be required, it is anticipated that some low-density development will continue to occur that is not part of community-based systems. As such it is anticipated that future home sewage treatment systems (HSTS) applications are likely. Current rules and regulations pertaining to permitting and oversight of these systems are inadequate.

Maintenance and care of these systems by individual homeowners is a concern and has likely resulted in malfunctioning systems that, collectively, are a contributor to water quality degradation within the Accord planning area.

The working groups discussed in Section 2.2 are considering this issue, standards and regulations governing these systems. Currently, these systems are under the authority of the Franklin County Board of Health and would remain under that authority. The Ohio Department of Health *Ohio Sewage Treatment and Disposal Rules* will become effective January 1, 2007. These rules contain most of the elements necessary for regulation, oversight and management of the alternative wastewater treatment and disposal systems proposed for consideration by the Darby Accord. These necessary elements are listed below.

1. Soil absorption criteria and site evaluations
2. Demonstration of competency in the performance of soil and site evaluators, septage haulers, designers, and installers
3. Responsibility (homeowner) for proper siting, design, installation, monitoring and operation/ maintenance
4. Oversight of the county Board of Health (BOH) by the Ohio Department of Health (ODH) on compliance with the new rules
5. Criteria related to subdivision development with HSTS
6. Installation Permit requirements
7. Operation Permit issued by BOH for all new HSTS
8. Requirements for on-going monitoring, operation, maintenance of HSTS by homeowners
9. Adequate separation from limiting soil conditions (e.g., seasonal high water table, etc.) to allow for treatment in the soil profile to protect human health from disease causing organisms in groundwater and surface water
10. Standards for bacteria, BOD5, and TSS, and enabling local government to establish nutrient reduction standards (e.g., nitrate, phosphorous, etc.)
11. Criteria for the installation of gradient drains (installed around the entire HSTS) and interceptor drains (installed upslope of a 'Wisconsin Mound' system)
12. HSTS design standards to protect human health and surface flow and groundwater
13. Installation inspection requirements of new HSTS
14. Education of the homeowner on the operation and maintenance of HSTS
15. Mandatory service contracts for drip distribution or any HSTS with a "pre-treatment" component approved by ODH
16. Mandatory one-time 18 month inspection of all new HSTS after effective date of rule

The Franklin County BOH intends to rescind their current rules and enforce the minimum State rules by the effective date of those rules. The working groups recommend for consideration by the Accord the adoption of the following local BOH rules by the effective date of the State Rules:

- Require mandatory monitoring, operation and maintenance service contracts in accordance with manufacturer's recommendations or BOH operational permit requirements for all new HSTS.
- Consider the establishment of an Operational Permit Program for all existing HSTS not regulated by such permit (e.g., septic tank and leach field type systems) and, further, for the Operational Permit to include the requirement for monitoring, operation and maintenance service contracts.

The technical committee addressing the issue of HSTS is determining recommendations on HSTS design standards. These recommendations will consider issues related to designing for curtain drains, the acceptable minimum depth to seasonal high water table, pre-treatment applications and whether to recommend household irrigation systems or lagoons.

4.10 Transportation

With the Town Center being the heart of development within the Big Darby Accord, it is imperative that a more detailed transportation plan be defined for the immediate area. Since the transportation plan has a significant influence on the appearance, character and vitality of the area, it must provide for safe, convenient and efficient movement of vehicular, pedestrian and bicycle traffic within and adjacent to the Town Center.

When an overall master plan is developed for the Town Center, traffic engineering and transportation studies should be undertaken as various land-use and urban design plans are considered. Through this process, traffic volumes can be projected and assigned to the roadway systems. Based on analyses of the projected link and intersection volumes, roadway needs in terms of number of lanes can be determined. The roadway cross-section needs can then be married with the desired street character (such as open ditch or curb and gutter, median, tree lawn, sidewalk, bike path, etc.) to identify desired right-of-way widths. Guidelines should also be established regarding access management for streets and roadways within the Town Center to maintain the integrity and mobility function of the roadway system – particularly along the

conceptual north-south spine road connecting US 40 with I-70.

Over time it will be important for the Accord jurisdictions to further consider long-term transportation implications of the plan for the broader planning area. A regional traffic study would help direct infrastructure investments. It could also provide guidance as local jurisdictions work with development proposals to ensure that proper access is provided and necessary improvements are made to the surrounding roadway system to ensure a minimum level of service. Regional traffic studies have been undertaken in Franklin County on several occasions with the multi-jurisdictional Northwest Traffic Study being a recent nearby example.

4.11 Trails and Greenways

The Accord should support efforts to develop regional and local trail systems that link parks and open spaces. Development of a regional trail along both the Big Darby and Hellbranch Run within dedicated easements should be pursued in coordination with developers, land owners and Metro Parks. In addition, the Accord should support the development of a trail along the existing rail corridor that extends from Columbus to the Big Darby.

The design and construction of greenways and trails should be a required improvement for all development plans that are within proximity of a regional trail and considered for smaller site developments. Developers should be required to provide and construct these amenities during the site development. The local jurisdiction should provide flexibility to meet this requirement evaluating whether it could satisfy any adopted parkland dedication requirement. The network of greenways and trails throughout the planning area should link neighborhoods with one another, with schools, parks and other natural areas.

Public and private trails should be developed for river access and the enjoyment of nature. Trail specifications include:

Paved Trails

- Trail surface: (hard) asphalt or concrete
- Trail width: minimum 10′ - maximum 12′
- Clearing width: maximum 20′ (clearing width not included as part of setback)
- Distance from the edge of the stream: minimum 300′
- River access points may be developed but must be unpaved
- Private trails should not have crossings and crossings on public trails are a conditional use and should be permitted only if they are part of a comprehensive trail plan

Unpaved Trails

- Trail surface: (soft) compacted gravel or approved natural surface
- Trail width: minimum 5′ - maximum 12′
- Clearing width: maximum 20′ (clearing width not included as part of setback)
- Distance from the edge of the stream: minimum 200′
- River access points may be developed

5.0 Implementation

Implementation of the Big Darby Accord Plan will require coordinated effort among a number of key stakeholders, including property owners that will be multi-jurisdictional, multi-level, and multi-faceted. Figure 5.1 has been developed to illustrate the major levels of activities needed to implement the Plan, including a new Big Darby Accord Advisory Panel, technical review activities among the jurisdictions and other regulatory agencies, a Community Authority and other partnerships. These levels are further defined in the following sections.

5.1 Big Darby Accord Advisory Panel

A fundamental goal of the Big Darby Accord is to ensure that the zoning and site development review processes are fair, consistent and apply evenly to all areas of the planning area so the plan implementation moves forward.

The processes for zoning and site development are different. Zoning changes the use and development requirements for a site and is usually the first step in development. Site development includes a building program, and site plans are created for development of the site. Both steps require review under existing jurisdiction processes; however, currently no mechanism ensures consistency among Accord jurisdictions when reviewing plans in accordance with this Plan.
A Big Darby Accord Advisory Panel is recommended to fulfill an oversight function to the review process and create a mechanism for collaboration among the jurisdictions. The recommended structure is similar to the Rocky Fork-Blacklick Accord Panel that has successfully reviewed development plans in the Plain Township area for Columbus and New Albany since 1997. The Big Darby Accord Advisory Panel enhances the standard review process that exists today, facilitating it for both the developer and Accord jurisdictions while ensuring the protection of the Big Darby Creek.

The broad role of the Big Darby Accord Advisory Panel would be to work together to implement the Plan. Confirming that land use changes and zonings are consistent with the general land use plan and plan policies, establishing open space conservation areas, ensuring

Key Recommendations

- Establish a Big Darby Accord Advisory Panel
- Establish an Environmental Monitoring Group
- Establish an Open Space Fund
- Establish a Land Stewardship Program
- Create a uniform parkland dedication ordnance
- Develop a Purchase of Development Rights Program
- Explore Density Transfer Charges and Transfer of Development Rights Programs
- Establish a backyard conservation program
- Prepare a Town Center Master Plan
- Establish a New Community Authority
- Establish Tax Increment Financing (non-school)
- Establish Developer Contributions with flexibility
- Establish level of service needs for community services
- Establish a Monitoring Program with watershed and site-level applications
- Appoint staff to carry out implementation
- Update the plan every 5 years
- Develop centralized tracking system for development/conservation
- Revise the development review process and incorporate a development review checklist
- Complete a Memorandum of Understanding among the Accord jurisdictions

Section Outline

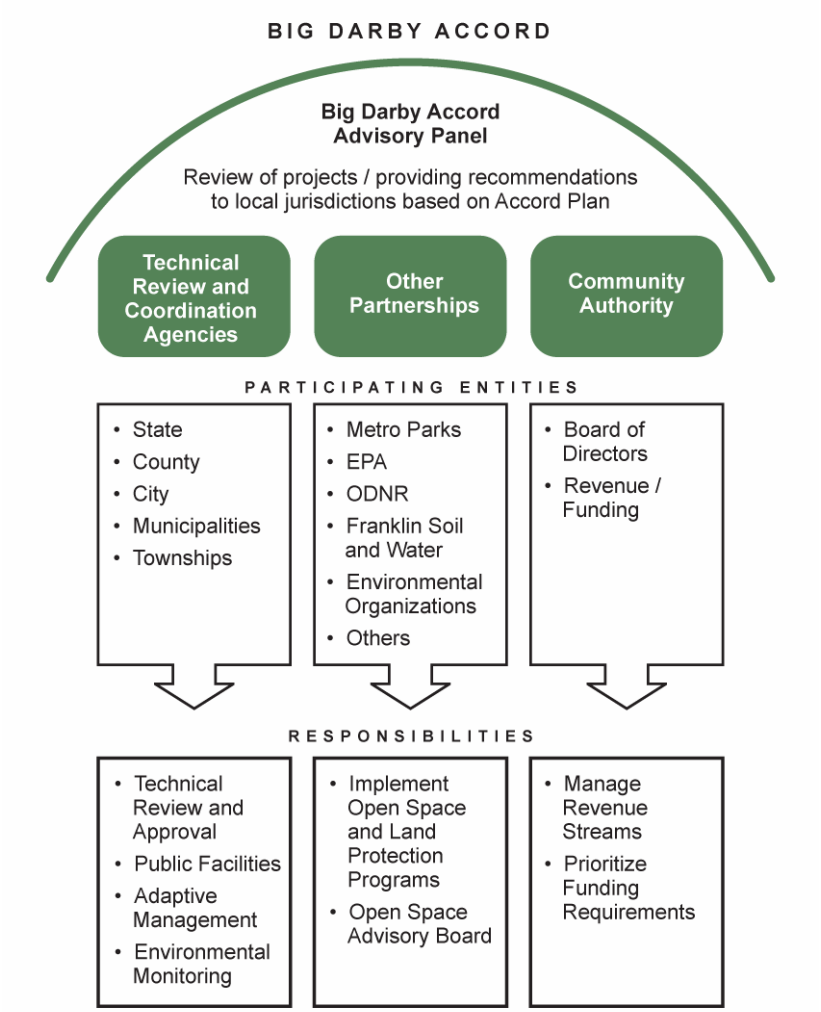


Figure 5.1 Various Roles and Responsibilities for Plan Implementation

adequate public facilities and overseeing adaptive management principals are the focus areas for the Advisory Panel.

The Big Darby Accord Advisory Panel would share responsibility with the local governing jurisdiction to review and render advisory, non-binding opinions on zoning applications and site development plans in terms of conformance with the Accord Plan. A Memorandum of Understanding among the Accord jurisdictions suggests that the panel recommendations would be strongly considered in the formal review process. Each jurisdiction will continue to be responsible for final plan approval or denial for proposals in their area.

Specific details related to the site development process would remain under the review of the jurisdictional authority. Established processes for coordinated technical review in the municipalities, and an established Technical Review Committee comprised of County departments and agencies for unincorporated areas of Franklin County should continue with the added responsibility of ensuring consistency with the Big Darby Accord Plan. Technical committee roles are described in Figure 5.2.

The Big Darby Accord Advisory Panel should be comprised of a combination of representatives from the Accord jurisdictions. The composition of the panel may be influenced by existing personnel resources and available expertise; however, it should represent the interests of all of the jurisdictions within the planning area. Figure 5.3 sets forth a recommended panel representation; the composition of the Panel will ultimately be determined by members of the Accord.

The Accord jurisdictions should consider the need for having dedicated staff to assist the Big Darby Accord Advisory Panel in its roles and duties. Dedicated staff could serve administrative duties and facilitate coordination among the jurisdictions and various technical agencies and partners.

5.2 Development Review Process

Coordination related to the development review process and the role of the Big Darby Accord Advisory Panel and supporting technical review is described this section.

The description of the zoning and site development review processes is intended as a general explanation of the steps that should be followed for any site within the Accord planning area.

Department or Agency	Development Issue
Board of Health	On-lot septic systems
Columbus/County Sanitary Engineers	Regional sewerage treatment issues
County Engineer	Roads, stormwater, public utilities, etc.
Soil and Water Conservation District	Stormwater, NDPES compliance
Development Department (City or County)	Zoning, lot splits, subdivision plats, etc.
Township Official	Zoning

Figure 5.2 Technical Committee Roles in Planning Area

Jurisdiction	Appointees
City of Columbus (City Council and Mayor appointments)	3
City of Hilliard (City Council and Mayor appointment)	1
Franklin County (Board of Commissioners appointment)	2
Brown Township (Trustee appointment)	1
Prairie Township (Trustee appointment)	1
Pleasant Township (Trustee appointment)	1
Suburban Municipality (Grove City)	1
At Large	1

Figure 5.3 Recommended Accord Panel Composition

5.2.1 Zoning and Site Development Review Processes

All applications for zoning, subdivisions, minor lot splits, and site development within the Big Darby Accord planning area should follow this process. The process outlined for review is meant to address future redevelopment and development efforts that affect land use change. It is not the intent of this Plan to evaluate minor changes such as minor house additions, new porches, etc. The zoning and development processes are described together due to significant overlap in steps. Where necessary for clarity, zoning and site development are articulated separately. Figure 5.4 depicts the general flow for zoning and site development approvals.

Zoning applications should not be considered without completing this process, and plat or minor lot splits should not be able to be recorded, nor a building permit issued, without completing this process. The site development process applies to all development applications that will result in the placement of habitable, non-agricultural structures.

Pre-Submittal Meeting

It is recommended that any applicant with a proposed project (zoning or site development) within the planning area meet with the jurisdiction's designated technical review body. This body outlines the process, provides initial feedback, answers questions and highlights key issues or red flags. The technical reviewers should be capable of analyzing biological, hydrological and scientific information and follow a development review checklist to ensure adequacy of plan information and detail, as described in Section 5.2.2.

Proposal Submitted

An applicant desiring to rezone land for development or develop in the planning area should submit an application to the appropriate jurisdiction (county/township or city). The application will ensure conformance to applicable criteria such as water quality monitoring, open space requirements, fees, etc.

Application Certified as Complete

The application materials for zoning or site development are reviewed by the local jurisdiction for completeness in light of jurisdiction and Accord Plan requirements. A complete application is forwarded to the Big Darby Accord Advisory Panel. An incomplete application would be held until all required materials are provided.

Jurisdiction Technical Review

At a regularly scheduled meeting, the designated technical review body reviews the details of all completed application plans for compliance with the Accord Plan and jurisdiction requirements. Staff should have technical expertise and be capable of analyzing biological, hydrological and other scientific information. Review should address environmental and infrastructure requirements related to issues such as best management practices, waste water treatment system, water quality monitoring, development fees, required

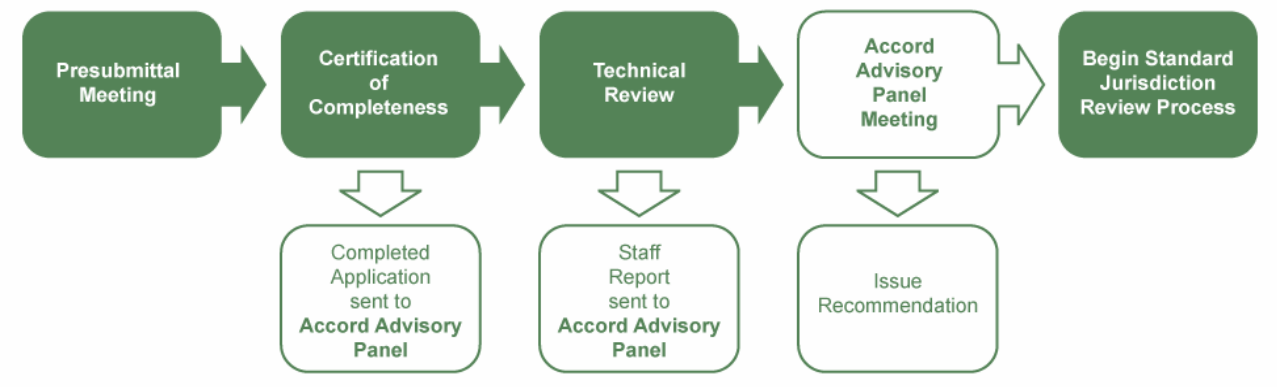


Figure 5.4 Generalized Development/Zoning Review Process

permits, open space, land use and density, etc. Technical reviewers should follow a development review checklist.

Jurisdictional Staff Review
The staff of the jurisdiction with authority over the project site prepares a staff report for the Big Darby Accord Advisory Panel. This report should be based on recommendations and input from the technical review body. The staff report should be shared with the appropriate staff of all Accord jurisdictions prior to the meeting.

Big Darby Accord Advisory Panel Meeting
All applications should be heard at a regularly scheduled meeting of the Big Darby Accord Advisory Panel. This Panel has non-binding review authority. This meeting would be similar to a Planning Commission meeting: public notices are sent in advance, the Panel members receive the application and staff report in advance, the responsible jurisdiction staff makes a presentation at the meeting, the applicant is heard, public comments are invited and the Panel votes on a recommendation for the project. The Panel has three options: 1) recommend the project for approval with any conditions, 2) recommend denial of the project or 3) table the project at the request of the applicant to allow provision of additional information at a future meeting.

Recommendation Forwarded to Jurisdiction
The recommendation of the Big Darby Advisory Panel meeting would be forwarded to the appropriate jurisdiction for inclusion into the regular review process in the form of a Record of Action prepared by the attending staff. This Record of Action should be shared with all Accord jurisdictions for their records.

Standard Jurisdictional Review Process Begins
Upon receipt of the recommendation (Record of Action), the controlling jurisdiction follows its standard zoning review process. Zoning submittals for land within the Accord planning area should not be considered by any jurisdiction without the non-binding recommendation of the Big Darby Accord Advisory Panel. Final legislative authority for the zoning continues to rest with the appropriate city Council or Board of Commissioners. Following final legislative action, a notice should be sent to all the Accord jurisdictions and the Darby Accord Advisory Panel indicating the action taken.

Following development plan approval (Prior to Construction/ Building Permit), final site plan review and a construction monitoring plan must be approved.

Final Site Plan Review
Following approval of the development plan, the final plan should be reviewed for technical compliance by the local review committee to receive final certification and sign-off that all conditions and requirements have been met. This step may not be necessary if the final plat is in accordance. Alternatively, this step may necessitate the need for additional review by the Big Darby Accord Advisory Panel, pending the outcome of final plan review.

Construction Site Monitoring Plan Approved
Prior to commencement of construction, all site protection and monitoring measures should be installed. These measures should be reviewed and approved on-site by a designated Chief Building Official and/or technical expert.
The final step before an occupancy permit can be issued involves an approval process involving a post construction review.

Prior to Occupancy Permit
Post-Construction Review
All Best Management Practices (BMPs) required as part of the approved plan should be certified by a technical expert. If discrepancies are detected, an as-built plan should be required of the developer and any issues resolved prior to issuance of an occupancy permit. Construction and post-construction water quality samples should be provided.

5.2.2 Detailed Review Process

A more detailed review process is described below to provide an understanding of the level of detail that will need to be part of any site development proposal in the planning area.

Step 1: Preliminary Site Approval

The first step of the process should establish the suitability of the site for development in accordance with the Big Darby Accord Plan. The developer should provide due diligence aimed at understanding the constraints of the site related to existing environmental conditions. Information collected during this process should be used to make informed decisions regarding the appropriate utilization of the property balanced with the need to protect environmentally sensitive areas. This step would result in the developer submitting a site development layout identifying areas of conservation and development, accompanied by the supporting technical documentation as described below. A complete site investigation should consider extending beyond the development site area to identify contributing resources on adjacent lands.

Site Investigations
Site investigation information should identify areas within the site, such as the stream setback areas and conservation open space that could be part of an easement or land dedication.

1. Soils

- Determine the location of hydric soils within the site, based initially on the published Franklin County Soil Survey Maps. On-site investigation of soils may be necessary to clarify the extent of hydric soils and sub-surface investigations may be necessary to determine the suitability of soil conditions for later evaluation of stormwater BMPs applications.

2. Environmental Conditions

- Identify existing topography and contours.
- Delineate the location of all jurisdictional streams within the limits of the project site, including all ephemeral, intermittent and perennial streams, identifying each watercourse by this classification system. Also identify and map existing drainage patterns on site and determine and map the extent of the SCPZ.
- Delineate the location of all jurisdictional wetlands.
- Identify existing tree cover on site and delineate large (greater than 3 contiguous acres) wood lots within the limits of the project site.
- Delineate critical groundwater recharge areas and pollution potential zones (information established by ODNR's DRASTIC mapping is an acceptable resource for this information).

3. Existing and Future Infrastructure

- Identify the location of existing utilities and their respective easements.
- Identify all existing road rights-of-way impacting the project site. The delineation of roads and their rights-of-way should include a reference to any available information depicting intended improvements to those transportation corridors represented by the Accord Plan or other planning documents associated with the individual jurisdiction where the project resides.

Preliminary Site Planning

1. Establish open space commitment within the development site. The open space commitment should be determined based on the ability of the site to preserve and enhance the existing environmental conditions.
   - For Conservation Development areas, the open space commitment must be equal to or greater than 50% of the land area dedicated to the development site.
   - For all other sites, establish areas for parkland dedication in accordance with the requirements of the Accord general land use plan or other planning documents associated with local jurisdiction.
   - For wetlands to be preserved within the site, delineate the buffer area in accordance with the criteria within ODNR's *Rainwater and Land Development (draft)* document.
   - Identify preliminary planting plan and management plan for all open space areas including easements.

2. Depict conceptual lot and roadway alignments within the development site.
   - Where low-impact development standards are to be applied, demonstrate noted exceptions to the current zoning ordinances, planning policies and/or subdivision regulations.
   - For wetlands proposed to be filled, provide information regarding mitigation alternatives to be considered during the anti-degradation process.
   - Depict and describe all proposed development activities that constitute permitted and conditional uses associated with the SCPZ.

3. Provide information regarding water and sewer service for the site.
   - For the portions of the land use planning area designated as the Town Center or within the City of Hilliard's designated contract sewer service area, sewer will be provided through a central collection system. The preliminary site development plan must indicate the intentions for and the ability to connect to that system.
   - For other development sites within the planning area, where central sewer is not provided, the sewer is intended to be provided through community-based alternative treatment facilities. Again, the preliminary site development plan must indicate the intentions for and the ability to connect to that system.
   - If on-lot septic systems are proposed, then the preliminary site development plan should be accompanied by evidence of coordination with the Franklin County Board of Health in determining the suitability of the site to that approach.

Step 2: Site Design Process

After completing preliminary planning for the site, the next step for site development requires a functional layout and design that incorporates the conservation principles represented by the Darby Accord. This includes developing a suitable approach for stormwater management and meeting the water quality standards through implementation of BMPs. The result of this process would be the submission of engineering documents, including a comprehensive stormwater management report, detailing all of the features of the site as well as management plans for identified easements.

Step 3: Permitting and Compliance

Prior to the start of construction, evidence of permits for all activities related to the site should be provided to the jurisdiction within which the development site resides. Additional information regarding relevant permits is described below.

- Environmental Permitting: A nationwide 404 permit from the U.S. Army Corps of Engineers, or individual 401 Water Quality Certification from the OEPA and a 404 permit are required for all proposed impacts to jurisdictional waters if the U.S., including filling of streams and wetlands. All such activities must be done in accordance with the established provisions of the Accord. Given the complexity and time consuming nature of this permitting process, the Accord may consider allowing for a demonstration that this process is substantially complete when approving development.
- Floodplain Permitting: A Special Flood Hazard Area Development (SFHAD) permit is required from the governing jurisdiction when any grading activity (fill or excavation) is proposed within a FEMA-designated flood hazard area. Again, all such activities must be done in accordance with the established provisions of the Accord. For certain activities affecting a FEMA-designated floodway and where those activities would cause an increase in flood elevations, prior review and approval of the activity are required from FEMA.
- Notice of Intent (NOI): A filing must be made with the Ohio EPA with sufficient advance notice prior to beginning earth moving activities that will disturb an area larger than 1.0 acre. The submission of an NOI must be accompanied by a Stormwater Pollution Prevention Plan (SWPPP) as prescribed in the statewide NPDES permit (refer to the permit being developed specific to construction activities within the Big Darby Creek watershed). The Ohio EPA will issue a permit directly to the project (site) owner and will request that the contractor performing the site work submit additional documentation as a co-permittee.
- Permit-to-Install (PTI): A filing must be made to the Ohio EPA that includes engineering plans related to any component of the project that includes the construction of sanitary sewer systems to extend an existing central sewer system. The Ohio EPA requires that all such plans bear evidence of review and approval by the governing jurisdiction where the sewer is to be installed, prior to their review and approval of those plans. The City of Columbus will also be signatory to any sanitary sewer plan approvals that involve an extension of or connection to the central sewer systems that will discharge to the City.
- Building Permit: individual jurisdictions may have different processes related to issuing building permits for individual structures or other aspects of a site development. The Accord should defer to and maintain those processes.

The compliance process represents the last step prior to the commencement of construction. Evidence of the relevant permits should be readily available for inspection at the construction site, in anticipation of site visits from the various regulatory agencies or the Big Darby Accord Advisory Panel. It is also recommended that each jurisdiction establish a reliable repository for permits issued to each development. Such a repository is mandated for all SFHAD permits under the jurisdictions' participation in the National Flood Insurance Program.

Step 4: Construction Phase

Once all permits have been obtained, site work may begin. The provisions of the approved SWPPP should be implemented to ensure

that erosion and sediment control practices are in place prior to beginning any significant earth-moving activities. Provisions for compliance with criteria related to monitoring and testing stormwater runoff from development sites must be accounted for. The performance goal for the monitoring of stormwater runoff during the construction phase of a project is prescribed by the Ohio EPA in the draft NPDES permit for the Big Darby Creek Watershed.

Site water quality monitoring during construction is not part of the monitoring program proposed by the Accord; however, evidence of non-compliance with the established performance goal should result in a course of action by the Accord to ensure that appropriate remediation action is taken.

Step 5: Post-Construction Phase

Upon completion of the construction of the development site (or individual phases of the development), the items listed below should be provided to the local jurisdiction and the Big Darby Accord Advisory Panel by the developer.

- An as-built survey of the various components of the stormwater management system. The submitted material should verify that these components were constructed to within an acceptable tolerance in terms of elevation, area and volume. For projects that vary from this tolerance, the developer may submit necessary calculations to determine that the stormwater management system will still function as needed; otherwise, physical modification to the system may be required.
- Evidence of implementation of the site-level monitoring plan, demonstrating the responsible party, and the means and methods by which information will be collected and analyzed. Monitoring information is to be collected and provided to the Accord in accordance with the provisions discussed in Section 5.3.
- Evidence of a performance bond that will be maintained throughout the prescribed site-level monitoring program.

Only once the required information has been provided to the Accord should the developer be allowed to begin the one-year warranty period for the public improvement portions of the project.

5.2.3 Development Review Checklist

To facilitate coordinated review and consistency, two review checklists should be developed for both technical review and Accord Advisory Panel review.

The first development review checklist should be adopted by Accord jurisdictions and used consistently by all staff as part of technical review efforts in each jurisdiction. Components of the technical review checklist should address plan requirements related to polices, standards and regulations.

It is important that both developers and reviewers consider the surrounding environment of a site and that development plans are not prepared in isolation. This concept is important to promote connectivity to existing resources such as natural or open space areas and to understand how activities at one site are part of an overall ecosystem. Early and frequent discussions between the local jurisdiction and developer should identify any opportunities to connect with adjacent or nearby amenities. A development review checklist should ensure the identification and/or mapping of the following elements:

- Surface Waters
- Drainage Patterns
- Wetlands
- Floodplains
- Stream Corridor Protection Zones
- Ephemeral, Intermittent and Perennial Streams
- Subwatershed boundaries
- Water Quality of Streams (based on OEPA Use Attainment)
- Significant Habitat (land and water based, including any listed species)
- Topography
- Wooded Areas
- Soils
- Field Tile
- Historical and Cultural Resources
- Open Space or Natural Areas
- Recreation Resources or Community Facilities (adjoining properties)
- Stormwater Management Facilities (on site and on adjoining properties)
- Steep Slopes
- Existing Wells and Septic Systems (adjoining properties)
- Easements Planting and Management Plan
- Monitoring Program

The Accord should also consider incorporating Low Impact Development concepts into the checklist to identify opportunities for incorporating such techniques into the design process. It is important that the development review process facilitates the application of low impact development techniques and does not make it more difficult to implement LID principles. For example, requirements for lot dimensions, parking, driveways and roadway standards should offer flexibility and not become obstacles to applying LID principles.

In addition an Accord Plan review checklist should be developed to help the Accord Advisory Committee in its review. The checklist is less about technical aspects of each development and

more about compliance with the overall goals of the Accord Plan. Appendix D provides an example of a preliminary Accord Advisory Panel review checklist.

Measuring Plan Progress
Monitoring overall conservation efforts and development activity across jurisdictions will be necessary to understand how the plan is being implemented and what, if any, changes are needed to ensure the plan is still meeting the mission of the Accord. To assist in this effort, the Accord should develop a method for tracking development that documents the number of units built across jurisdictions so that reports can be generated on overall development. In addition, information related to successful conservation efforts should be recorded. Reporting and entering this information into a centralized system should be part of the development review checklist requirement.

The Accord jurisdictions should work with the County to develop an approach for the centralized tracking of development and conservation activities. Yearly reports about development activity will help local officials and the public understand the relationship between policy and the plan and will identify any inconsistencies between local actions and plan recommendations.

The Big Darby Accord Plan should be updated every five to ten years. The Plan update should include a map update, policy review an overall evaluation on development and conservation efforts and updated implementation strategies.

5.3 Other Coordinated Activities

To initiate implementation of the Plan, the Accord will need to also coordinate activities related to establishing a monitoring program, developing a Town Center Master Plan, and providing adequate community facilities as addressed below.

5.3.1 Monitoring

To ensure that the integrity of the water quality within the portion of the Big Darby Creek watershed affected by the Accord land use plan does not decline due to implementation of the land use plan, monitoring of water quality parameters will need to be implemented throughout the planning area. The purposes of the monitoring program should be to determine whether or not the OEPA aquatic life use designations for the streams in the planning area are being met and to gather enough data to develop meaningful trend analysis of the health of the watershed. The monitoring program should be utilized to more precisely determine where water quality degradation may be occurring and the likely source of that degradation. Monitoring will allow for a timely response to potential problems before they have a long term impact on the health of the stream.

The recommended monitoring program involves both watershed level and development site level monitoring. The primary purpose of the watershed level monitoring is to ensure that the aquatic life use designations for all reaches of the stream are being met. The primary purpose of the development site level monitoring is to ensure these sites are not exceeding determined allowable release rates for pollutants of concern as defined by the TMDL.

Watershed Level Monitoring
A two-tier watershed approach is recommended with the tiers having different objectives in verifying the health of the ecosystem of the planning area. The purpose of Tier I monitoring is to determine that the Ohio EPA's aquatic life use designations for Hellbranch Run, Clover Groff Run and Hamilton Run are being attained, or at a minimum are trending towards attainment. The purpose of Tier II monitoring is to establish a cause and effect relationship between on-going land use changes and observed biological indices within the stream system. The two-tiered approach is described below.

Tier I

Monitoring at the Tier 1 level is envisioned as a long-term effort and, therefore, has no defined end date. Tier 1 monitoring points should be located in the Hellbranch Run Watershed and along the Big Darby Creek.

In some cases a geomorphic assessment is recommended which is a collection of specific physical parameters defining the stream channel, including cross-sectional data at pools and riffles, a longitudinal profile and a pebble count (a statistical measurement of substrate). A thorough geomorphic assessment must make note of any physical evidence of a bank-full indicator, such as forming bank-full benches or other abrupt change in the cross-section of an incised channel, changes in point bar composition (bed load indicators) and the overall stability of the channel banks. The assessment should comprise a length of stream channel that is between 20 and 30 times the measured (or anticipated)

bank-full width of the channel. As part of this assessment, it is recommended that permanent markers be installed at each cross-section location to allow for comparison of the physical features at the sites from observation to observation.

Hellbranch Run Watershed Monitoring Points
At the USGS gage for continuous flow monitoring:
- USGS provides monitoring of TSS, N, and P
- Geomorphic assessment (defined below) of the stream in the vicinity of the gage once every three years

Just downstream of the confluence of Hamilton Run and Clover Run:
- Flow monitoring
- TSS, N, and P during high-flow events between March and October
- Will likely require an automated sampling device
- Geomorphic assessment of the stream once every three years

At 14 of the established EPA monitoring sites as well as 4 additional locations:
- IBI, ICI, and QHEI once every three years
- Geomorphic assessment once every three years

Along McCoy Ditch near the confluence with Hellbranch Run:
- IBI, ICI, and QHEI every year for three years (to establish a baseline), then once every three years
- Geomorphic assessment of the stream once every three years

Big Darby Creek Monitoring Points
Just upstream and just downstream of confluence with Little Darby Creek:
- IBI, ICI, and QHEI once every three years

At three sites near the confluence with Hellbranch Run; just upstream, just downstream and along Gay Run just upstream of its confluence with Big Darby Creek:
- IBI, ICI, and QHEI once every three years

The next two sites are optional as they are indicators of what is occurring within the overall Big Darby Creek watershed, but outside of the Big Darby Accord planning area. The information they would provide is potentially useful in determining the source of any impairments to water quality, if they exist.

At the county line where Big Darby Creek enters Franklin County (2 actual locations):
- IBI, ICI, anf QHEI once every three years

At the county line where Little Darby Creek enters Franklin County:
- IBI, ICI, and QHEI once every three years

Tier II
Monitoring at the Tier II level should be collected for a minimum of three years and will require automated monitoring equipment (i.e. ISCO samplers). Tier II data gathering locations are described below.

At half of the established OEPA monitoring sites
TSS, P, and N based on flow characteristics, estimated to be 3 or 4 times a year
- Geomorphic assessment of stream in year 1 and year 3

At other sites that fit the purposes of the type of monitoring (exact locations to be determined) necessary to establish experimental and control levels of data.
- TSS, P, and N based on flow characteristics, probably 3 or 4 times a year
- Geomorphic assessment of stream in year 1 and year 3

Development Site Level Monitoring
The purpose of site level monitoring is to determine whether or not site level (or regional) BMPs are meeting their targeted pollutant removal rates, and that pollutant rates are not exceeded. The recommended monitoring period for site level data is for at least five years, but no more than ten years.

Locations for data collection include outfalls of all new stormwater conveyance systems. An automated sampler will be required at the outfall of the Town Center conveyance system and all other regional conveyance systems. Grab samples should be gathered at all other outfalls.

In addition, monitoring for TSS, P, and N should take place a minimum of twice per season - once during a dry period (no precipitation for three days), once during a rain event of 0.75 inches in 24 hours and as needed during other rain events.

A summary of monitoring recommendations is shown in Figures 5.5 and 5.6.

		Location		Data Gathered	Time Period	End Date
Watershed Level Monitoring	Tier I	Hellbranch Run	USGS Gage	Flow, TSS, N, P, Geomorphic	Flow-continuous TSS, N, P-at least once per month Geomorphic-once every three years	No defined end date
			D/S confluence of Hamilton and Clover Groff	Flow, TSS, N, P, Geomorphic	Flow, TSS, N, P-high flow events March-October Geomorphic-once every three years	
			14 EPA sites and 4 others	IBI, ICI, QHEI, Geomorphic	Once every three years	
			McCoy Ditch near Hellbranch Run	IBI, ICI, QHEI, Geomorphic	IBI, ICI, QHEI-every year for three years, then once every three years Geomorphic-once every three years	
		Big Darby Creek	Just U/S and D/s of confluence with Little Darby Creek	IBI, ICI, QHEI	Once every three years	
			Just U/S and D/S of Hellbranch Run and along Gay Run just U/S of Big Darby	IBI, ICI, QHEI	Once every three years	
		Optional	At county line where Big Darby Creek enters Franklin County (2 locations)	IBI, ICI, QHEI	Once every three years	
			At county line where Little Darby Creek enters Franklin County	IBI, ICI, QHEI	Once every three years	
	Tier II	Planning Area	Half of OEPA Established sites	TSS, P, N, Geomorphic	TSS, P, and N-based on flow characteristics, likely 3 or 4 times per year Geomorphic-once every three years	Minimum 3 years
			Other sites, to be determined	TSS, P, N, Geomorphic	TSS, P, and N-based on flow characteristics, likely 3 or 4 times/year Geomorphic-once every three years	
Site Level Monitoring		Planning Area	Outfalls of all new stormwater conveyance systems-automated at Town Center and other regional systems, grab samples at other outfalls	TSS, P, N	Minimum of twice per season -once during dry period (no precipitation for three days) -once during rain event of 0.75 inches in 24 hours -as need during other rain events	Minimum 5 years, no more than 10 years

Figure 5.5 Summary of Monitoring Recommendations

Rainfall Monitoring

In order to more accurately determine when water quality sampling is needed, a system of rain gauges is recommended within the planning area. It is anticipated that approximately 18 rain gauges will be needed, with the exact number and location to be determined. The information from the gauges would be used by those performing the sampling of water quality data to determine when 0.75 inches of rain has fallen in 24 hours, which is the threshold for gathering data. If the gauges are to perform this function, they will need to be tipping-buckets gauges that can transmit their information to a remote location for observation.

Data Collection Requirements

To meet the legal standard for establishing aquatic life use designation, Tier I data should comply with the OEPA Level 3 data as established under the Ohio EPA's Volunteer Monitoring Data guidelines. Level 3 data is equivalent to the methods used by the Ohio EPA personnel and is the only level of data that is able to be used for regulatory purposes by the Ohio EPA.

Any monitoring data collected should comply with the most recent OEPA requirements of the Credible Data Program as outlined in Ohio Administrative Code Chapter 3745-4, effective March 24, 2006. Monitoring of additional

parameters beyond those listed should be conducted on an as-needed basis. Additional monitoring locations will be incorporated as development occurs and as conditions warrant.

As data from the monitoring program are compiled and analyzed, it should be utilized to review the development requirements and determine whether or not changes need to be made to stormwater management requirements for water quantity or quality.

Partnerships should be developed between the Big Darby Accord and other organizations (e.g. The Ohio State University, Ohio EPA, Ohio DNR, Franklin Soil and Water Conservation District and others) to obtain the necessary monitoring data for the watershed level program. Site level monitoring data gathering is the responsibility of the developer for the site, and it also must comply with Ohio EPA's Credible Data Program. A developer could also rely on another organization to gather and interpret data from their site as long as it complies with the applicable requirements for monitoring of the planning area.

Environmental Monitoring Group

The Accord should establish an Environmental Monitoring Group (EMG) to assist with developing a comprehensive water quality monitoring program for a watershed. Initially this group should include The Ohio State University, Ohio EPA, ODNR, Franklin Soil and Water Conservation District and one outside environmental interest group (e.g. The Nature Conservancy). The EMG should assist in identifying the final locations for the rain gages and monitoring locations.

The EMG should also assist with developing consistent guidelines for stream restoration that can be used by local jurisdictions to evaluate stream restoration proposals that are part of development plans. Guidance from the EMG could include developing goals and priorities related to where stream restoration should occur and developing recommendations on preferred design criteria for stream restoration applications.

The EMG should produce a "State of the Darby" report every two to five years to report on water quality trends within the watershed compared to the TMDL and Plan goals. This report should state concerns and identify any recommended action for mitigating impacts.

Monitoring Funding Options

The USEPA Targeted Watersheds Grant Program is a competitive grant program that encourages the protection and restoration of the country's water resources. The program supports environmental stewardship and action by providing needed funding to watershed organizations for on-the-ground restoration and protection efforts designed to achieve quick, measurable environmental results (www.epa.gov/owow/watershed/initiative). Other funding sources may be available through potential partnering groups including OSU, Ohio EPA, Ohio DNR, FSWCD, the Nature Conservancy and others.

Performance Bond

Site developers should provide proof of a performance bond for all new development occurring within the planning area. The amount of the bond will need to be determined. The bond could be executed under any one of the following circumstances;

1. Submitted monitoring data indicates that the BMP is not meeting performance goals.
2. Submitted maintenance logs indicate that maintenance is not being performed as outlined.
3. Monitoring data is no longer being provided by the developer and the EMG must continue the monitoring program.
4. Maintenance records are no longer being provided by the developer and the EMG must continue the maintenance program.

The bond should be released to the developer once the required monitoring period outlined above has been completed satisfactorily.

Hellbranch Watershed Forum

The Hellbranch Watershed Forum (HWF) also developed monitoring guidelines for the Hellbranch watershed and a summary of their recommendations is presented below. The purpose for the HWF monitoring is "…to measure the changes that occur in the watershed and assess the impacts of those changes on the streams. The monitoring program results will be used to evaluate the effectiveness of management strategies designed to protect and enhance the watershed and to identify emerging issues including:

- What are the effects of watershed improvements?
- How have land use changes affected the health of the watershed?
- How have policy changes affected the health of the watershed?"

In order to meet the purposes of the HWF monitoring program, they recommend reviewing Franklin County Auditor aerial photography of the watershed to determine what land use changes have occurred. In addition to the land use changes, the HWF recommended in stream

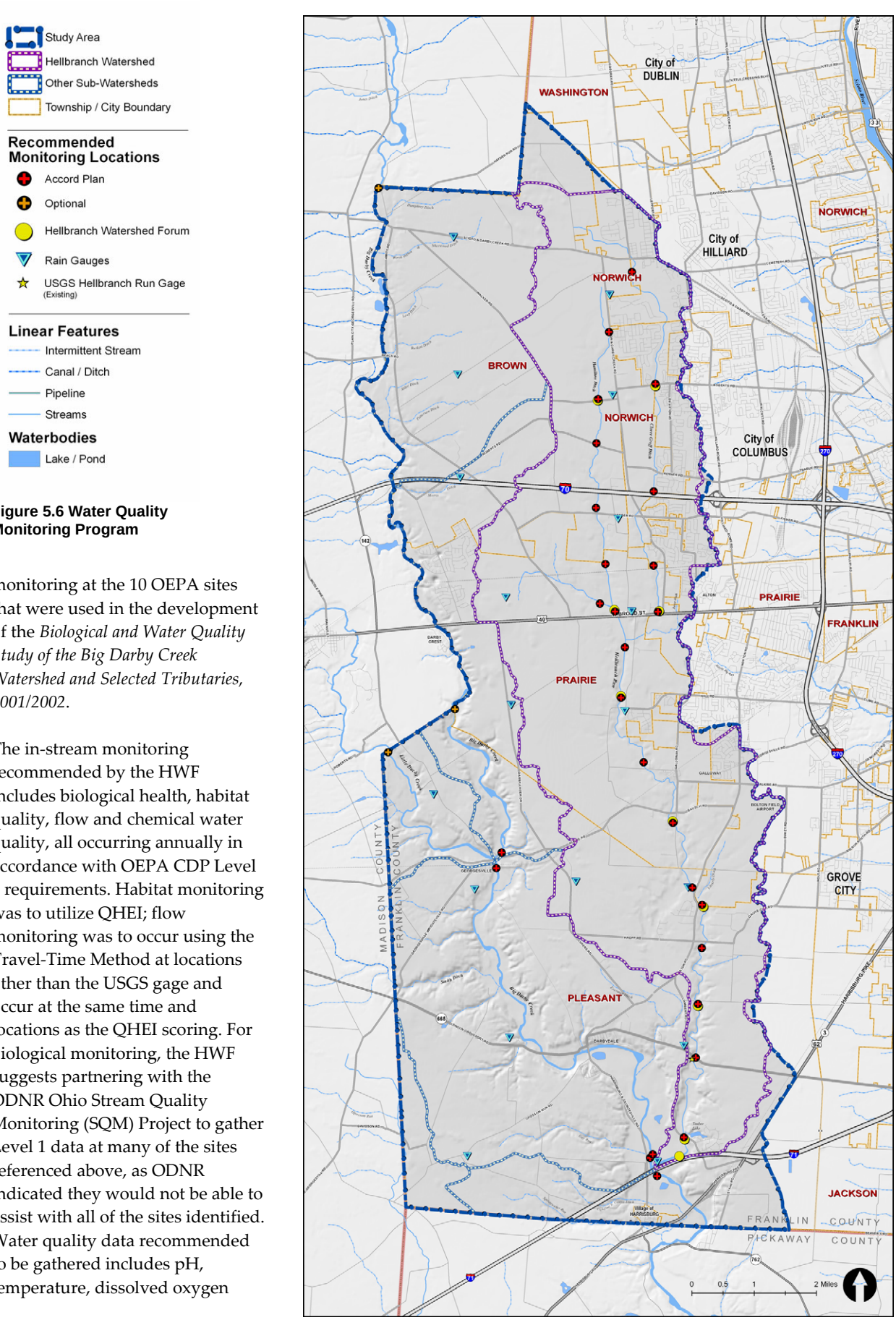


Figure 5.6 Water Quality Monitoring Program

monitoring at the 10 OEPA sites that were used in the development of the *Biological and Water Quality Study of the Big Darby Creek Watershed and Selected Tributaries, 2001/2002*.

The in-stream monitoring recommended by the HWF includes biological health, habitat quality, flow and chemical water quality, all occurring annually in accordance with OEPA CDP Level 1 requirements. Habitat monitoring was to utilize QHEI; flow monitoring was to occur using the Travel-Time Method at locations other than the USGS gage and occur at the same time and locations as the QHEI scoring. For biological monitoring, the HWF suggests partnering with the ODNR Ohio Stream Quality Monitoring (SQM) Project to gather Level 1 data at many of the sites referenced above, as ODNR indicated they would not be able to assist with all of the sites identified. Water quality data recommended to be gathered includes pH, temperature, dissolved oxygen

and specific conductance as they can all be gathered using probes or test kits in accordance with Level 1 data.

5.3.2 Town Center Master Plan

One of the key recommendations of the Big Darby Accord plan is the preparation of a detailed master plan for the town center area as identified within the general land use plan. This area generally falls between I-70 on the north, West Broad Street on the south, the Hellbranch Run on the east and Hubbard Road on the west. This plan would help establish a more specific vision for the development of the Town Center and would provide a detailed set of recommendations including level of development, infrastructure requirements, design guidelines and phasing. A Master Plan of this type would require approximately one year to complete and should include a number of key stakeholders in the process. The master plan should address not only the public and private properties within the Town Center but it should also incorporate the adjacent areas as part of the study. This will help ensure the town center complements and is compatible with the surrounding areas.

A number of steps are required in the preparation of the master plan. At a minimum Brown and Prairie Townships should lead the Master Plan effort, in coordination all members of the Accord, particularly the City of Columbus due to utility provisions. Process steps include organizing the stakeholders/sponsoring organizations prior to beginning the process, identifying a team to prepare the master plan, preparation of the master plan and implementing the master plan.

The following section provides a detailed description of these elements.

Step 1: Organizing Key Stakeholders and Sponsoring Organizations

A committee or task force should be established that includes a diverse cross-section of stakeholders. This group should include:

- Private Property Owners
- Jurisdiction Representatives
- Environmental Interests
- Real Estate/Development Interests

The goal of this committee would be to establish a process and schedule and to help define the final scope of work and required level of expertise and skill sets needed to perform the work. This group may also be involved in determining the approach to how to fund the study. Once these basic elements are agreed upon, a Request for Proposals (RFP) Process should be initiated. This should be sponsored by one of the jurisdictions; similar to how the contract for the Big Darby Accord operated.

Step 2: RFP Process to Select Consultant Team

The RFP process would include releasing the RFP, reviewing responses to the RFP, interviewing a short listed group of firms and identifying the preferred team. The RFP would include background information on the project, a suggested scope of work, schedule and identify the key stakeholders. The RFP should require that respondents provide qualifications on their firm or firms, key team member resumes, skill sets and experience, a proposed project approach and scope and a proposed fee. The responses to the RFP should be reviewed by a committee or subcommittee representing the stakeholders and jurisdictions they should also be involved in identifying the shortlist and preferred team for the project. The team should have a range of skills and demonstrated excellence related to land use planning, environmental planning, urban design, engineering, transportation, and market analysis.

Step 3: Preparation of the Master Plan

Once a consultant team has been contracted, the committee and consultant team should work closely in developing the master plan. This process should include a significant amount of community involvement and individual stakeholder involvement. The master plan should include the following key elements:

Existing Condition Analysis
This includes more detailed analysis of the physical conditions of the area including natural resources, infrastructure, roadway systems, existing development, and any other physical features. Emphasis should be placed on documenting sensitive environmental features.

Current Plans and Policy Review
This includes more detailed review of existing zoning and previously prepared studies that address the area (including local, state and federal studies).

Summary of Key Opportunities and Constraints
As a summary of the physical analysis and review of plans and policies a summary is prepared to identify key issues, opportunities and constraints for development within this area.

Case Studies
It may also be useful to prepare a brief set of case studies illustrating other comparable town centers

within Central Ohio or around the U.S. This should include pictures and illustrations to help everyone understand the physical development options for a town center. Emphasis should be placed on communities that incorporate low-impact development techniques and other innovative design.

Market Study
A detailed market study is recommended to provide some parameters for the level and amount of development that could be expected over a period of time. This study should provide an expected range in the number and types of housing units that could be constructed and forecast development demand measured in square footage, unit type and business type for five and ten year increments. The market study should also provide a range of pricing that could be expected for the various uses.

Town Center Alternatives
Based on the physical analysis and market study, a series of alternatives should be prepared for the town center. These alternatives could address both program and site planning variations. Development and evaluation of these alternatives should include public involvement either in a workshop or meeting format. The alternatives should include a program summary, a site plan and supporting diagrams and illustrations that help describe the ideas behind each alternative.

Preferred Town Center Master Plan
Once the Alternatives have been sufficiently reviewed and commented on by the stakeholders and community, a preferred Master Plan is to be prepared. The preferred Master Plan may include elements of each alternative or be based solely on one of the alternatives. This plan should again be reviewed by stakeholders and the community.

Supporting Master Plan Elements
Once a preferred plan is identified, a number of supporting plans should be prepared to provide key guidance in the ultimate development of town center.

- **Development Program**
  A development program includes a recommended range of development by type of use. This includes number and type of residential units, retail uses, commercial uses, institutional uses and other supporting uses. This program includes a geographic representation illustrating the level or range of development to occur on a block by block basis within town center.
- **Land Use Plan**
  A Land Use plan is a block by block level plan that provides detailed land use recommendations. This also includes specifics regarding recommended first floor uses within the mixed-use areas.
- **Open Space Plan**
  An open space plan provides a framework for open space, illustrating appropriate locations for the various types of open space including natural areas, wetlands, urban parks, neighborhood parks and passive recreation areas. This also provides program recommendations for the park areas such as playgrounds, ball fields, trails or other appropriate uses.
- **Infrastructure Plan**
  An infrastructure plan addresses anticipated sewer and water requirements, how these might be provided and the timeframe for providing this service.
- **Transportation Plan**
  A transportation plan provides a recommended road network to support the town center along with specific improvements required for the existing roads. This plan addresses number of lanes required, and intersection improvements. In addition, the transportation plan should address other modes of movement including trails and pedestrian systems. The plan should identify appropriate locations for these elements and suggested widths for sidewalks.
- **Stormwater Plan**
  A Stormwater Plan identifies appropriate locations and types of stormwater treatment based on the proposed land use plan. This plan addresses both the physical requirements as well as the treatment level requirements to ensure the development is meeting water quality goals stipulated in this Plan and per OEPA.
- **Design Guidelines**
  Design Guidelines provide recommendations for the physical development of the town center for both public and private areas. The design guidelines include architecture, site planning, streetscape, landscaping and parks and open space recommendations. Guidelines are largely graphic in content illustrating the concepts for the physical development.
- **Phasing Plan**
  A phasing plan is linked to the market analysis, infrastructure availability and land ownership. The phasing plan establishes a reasonable expectation of the timing for the development.
- **Regulatory Plan**
  A regulatory plan addresses any recommendations regarding zoning, density, land use, building heights. This plan provides the jurisdictions detailed recommendations that could be incorporated into the jurisdictions zoning or other regulatory requirements.
- **Draft and Final Master Plan Report**
  The Master Plan and supporting elements should be documented in a report. The preparation of the report includes a draft report for review and a final report incorporating the

comments on the draft plan. The report should be highly graphic and avoid extensive sections of text.

Step 4: Implement Master Plan

Once the Master Plan has been completed, the jurisdictions will need to adopt the necessary policy changes to implement the plan. In addition, the jurisdictions and stakeholders should work closely with the property owners and development community to move the plan forward and enable development to begin. It will be critical that property owners are willing to cooperate in this process to ensure a smooth process for development.

5.3.3 Community Facilities

As growth continues in the Darby Accord area, jurisdictions must be mindful that this growth will require additional facilities and expanded service areas. Jurisdictions should use the Accord Plan and land use maps as a guide for community facilities decisions. The Accord Plan should give insight to areas that will need future services and facilities.

The provision of the basic health, safety and welfare services is necessary, including reasonable access to health, education, recreation, police and fire protection, library and postal services. These services provide for a high quality of life for those living and visiting the area. As development is planned and constructed, service areas should be evaluated and established for various community facilities such as schools, parks, libraries, fire, police and emergency response services. Equally important, adequate funding and phased delivery of service must be considered.

Fire Protection	Average response time of 5 minutes or less; Average of 0.85 firefighters per 1,000 residents.
Police Protection	Average of 2.3 officers per 1,000 residents
Parkland	10 acres per 1,000 residents
Libraries	0.5-square feet per capita; At least 3 books per capita; Within 5 miles of a facility
Childcare	2.5 providers per 1,000 residents

Figure 5.7 Community Facility Level of Service (LOS) Considerations

Jurisdictions should work together to consolidate facilities (schools, libraries, post offices, parks) to create focal points of activity whenever possible. This will be especially important for the Town Center to foster community interaction and congregation. The Accord process has created increased opportunities to share amenities that would not otherwise be feasible on an individual jurisdictional basis. This can extend from basic functions such as grounds keeping and maintenance, trash collection and recycling to more specialized amenities such as recreation centers, senior centers and community pools. Joint contracting opportunities should be encouraged throughout the planning area and with surrounding jurisdictions.

The development practices of community facilities, particularly public buildings, should set an example for other developments within the Big Darby Creek watershed. Jurisdictions should be encouraged to go beyond standard practices and incorporate sustainable building techniques such as those designated by the U.S. Green Building Council (LEED). The design and construction of public buildings and facilities should demonstrate excellence in architectural design.

As the area grows and attracts new residents, local leaders will need to respond to changing demographics. Therefore, community facilities should be flexible in function to ensure adaptability to the changing needs and demographics of the Accord area.

Level of Service

A level of service (LOS) should be established by all jurisdictions within the watershed in Franklin County. The level of service that should be pursued is described below.

Town Center Community Facilities

The proposed Town Center will have a greater demand for services than the other parts of the Accord area (police, fire protection, social, healthcare and recreation), due to concentration of residents. However, the development pattern and density provided will allow it to be served very efficiently, maximizing the serviceable area. With cooperation between all jurisdictions, resources should also be shared. Recommendations for future community facilities and services for the Town Center are outlined below.

- Each jurisdiction should evaluate its current service capabilities for police, fire and medical response in order to gauge existing response times and coverage areas. Initial development of phases in the Town Center should utilize the existing services and facilities until further expansion is required. A Town Center Master Plan should address long term community facilities needs.
- As service demands for the Town Center increase, new facilities should be properly located and service areas re-districted to maximize the populations and areas served.
- Cooperative agreements between the township jurisdictions should be formulated to share health and safety services. Existing contracts for health and safety services such as those established with the County Sheriff should be expanded upon as needed.
- Provision of services within the Town Center could be financed through the Community Authority. The Community Authority should have the right to subsidize jurisdictions for the provision of services that is the most economically feasible. The Community Authority should serve as an advisory body to those entities providing protection services.

A number of facility amenities would be appropriate for the Town Center in order to promote civic identity, create interaction between residents and help spur surrounding business patronage. These include:

- Community recreation center
- Public pool
- Senior center
- Youth Activity Center
- Active Recreation Fields (ball fields, multi-purpose fields, courts, etc.)
- Fire station
- Neighborhood police sub-station
- Public meeting hall/auditorium
- Branch library
- Schools
- Health center

Parkland Requirements

Parkland requirements and level of service standards vary within the planning area. It is recommended that the Accord jurisdictions adopt level of service standards for parkland of 10 acres per 1,000 residents to anticipate future growth and demographic changes and evolving trends in recreation. The City of Hilliard has both open space and parkland dedication requirements for residential developments. In addition to requiring that 10% of the gross land to be developed be set aside within the residential development, Hilliard requires a land dedication for recreational facilities intended to serve the greater population of the City. The City of Hilliard has adopted a goal of providing 10 acres of usable recreational land for every 1,000 residents.

In the City of Columbus a dedication for parkland is required either through a land dedication or a monetary payment and is applied to both residential and commercial zonings. The City of Columbus has an overall goal of providing 5.5 acres of land for every 1,000 residents. Parkland dedication credits may be granted for a number of circumstances and are determined by the recreation and parks commission as appropriate:

- Credit may be given for private outdoor recreational facilities provided in residential developments. The maximum credit is 50% the required land dedication.
- In the event that a wet storm water retention area is proposed to be dedicated, it can constitute no more than 25% the dedication requirement.
- Credit shall be given for previous land dedications for land to be rezoned from one residential classification to another residential classification based on the incremental increase in density.

Accord jurisdictions should, likewise, provide flexibility in meeting parkland requirements. Both Columbus and Hilliard maintain that if there are a number of constraints in which a parkland dedication cannot be made, a fee-in-lieu (based on a determined fee or appraised value of the market value of land area) is acceptable.

Rural Residential Community Facilities

The proposed rural residential areas are intended to be developed as clustered developments. This pattern of development will bring with it unique challenges to community facility administration (police, fire protection, social, healthcare and recreation). Although the population will be less than what is intended for the town center, this area will increase in population from its current level which will require more services. To be effective in a lower density area, the community facilities must be properly sited not only to be effective, but also efficient.

Fire Services

Currently the Fire Services in the townships are addressed by Pleasant Township Fire Department, Prairie Township Fire Department, Norwich Township Fire Department and Washington Township Fire Department (Brown Township contracts with Norwich Township and provides a Fire House in Brown Township that is staffed by Norwich Township Fire Fighters).

Mutual aid agreements between the townships and the municipalities should be reviewed to ensure the quality of Emergency Services in not impacted by the increase in population.

Without centralized water, rural residential areas would be without the hydrant infrastructure to assist in fire fighting. Therefore, all new developments within the rural residential areas should provide amenities to assist township fire services. These amenities may include dry hydrants with the necessary easements of access for each subdivision.

Police Services

Currently all five townships within the watershed do not maintain their own township polices service. The Franklin County Sheriff's Department provides patrol services for the Townships with dedicated officers assigned to contracted areas.

With the increase in population in western Franklin County the dedicated patrol hours will need to be reevaluated. It is likely that an increase will be needed in the number of patrol cars and the amount of time dedicated. This is an opportunity for the townships to work together and with the Franklin County Sheriff's Office to determine the need and the most efficient means of serving that need.

Washington, Brown, Prairie, Norwich and Pleasant Townships should address the need collectively. While Brown Township and Prairie Township will service the Town Center, Pleasant Township is home to the largest Metro Park in the State of Ohio and with that comes its own additional service need. This need will likely grow as conservation areas grow and more destinations are created in the watershed. All of these factors should inform the five townships while making decisions about emergency services.

Schools

The two primary school districts located within the Franklin County portion of the watershed are the Hilliard School District and the Southwestern City School District.

The school district boundaries meet at the railroad tracks between Interstate 70 and Broad Street in the middle of the proposed town center.

Win-Win Agreement

The land developed as part of the town center is intended to remain in the township and will not be annexed to Columbus. This means that the residential units built there would not become part of the Columbus City Schools; students would remain in the suburban school districts as the boundaries are currently drawn.

School Construction

Any school construction in the watershed should adhere to the strictest environmental standards. Surface water quality and quantity should be managed to produce the fewest impacts on water quality. School sites, especially high schools, come with additional and unique challenges to environmentally friendly building and site design. It is recommended that school construction adhere to LEED principles for both building and site design.

Neighborhood Schools

Land within the town center should be provided for the location of neighborhood schools (for elementary and middle schools) for Hilliard and Southwestern school districts as the population increases. Neighborhood schools will be an important component to the success of the town center

Hilliard City Schools

The Hilliard City School District is experiencing rapid enrollment increases as the district continues to post strong residential growth. The district grew from 9,949 students in 1995 to 14,530 students in 2005 and it now has the 9th largest enrollment in the state. District officials expect the school population to increase at a rate of 300 to 400 students per year and project enrollment of nearly 19,000 students by 2015.

Recently the district residents approved a new levy to fund a third high school. The site for the third high school is located on Walker Road in Brown Township. The two existing high schools house 4,350 students with capacity for only 3,600.

In the Accord area the City of Hilliard has an expansion area that would allow 2,000 new housing units. Additionally, low density rural residential development and town center development will include new housing units within the Hilliard School District.

South-Western City Schools

South-western City Schools is the second largest school district in Franklin County and the sixth largest in Ohio. Southwestern City Schools will see an increase in the student population from the town center development as well as rural residential subdivisions that may occur in Pleasant Township. Currently, the district expects to exceed capacity in the next six to eight years and will need an additional high school, a middle school and 2 to 3 elementary schools.

5.4 Open Space and Land Protection Programs

The goal of this plan is to protect all lands within the Land Conservation Strategy through a suite of programs that balance individual landowner rights with the rights of the larger community for a clean and healthy environment. The best way of preserving land and permanently protecting sensitive areas is to purchase land and remove it from development potential; however, purchasing land requires money.

Sources of money at the local government level are often limited; therefore, relying solely on public funding for protection of land is often unreliable. Some communities will support general bonds or agree to increases in taxes to support preservation and conservation efforts. Establishing a recurring funding stream strengthens a community's ability to achieve conservation goals. Having multiple programs and a variety of funding mechanisms further expands these opportunities.

To leverage its ability to achieve this goal, the Accord will need to work with existing agencies, like Metro Parks, to secure funding and facilitate the transfer of lands into conservation and to enforce development policies that govern the management of conservation areas on public and private lands. Organizations like Metro Parks, Franklin Soil and Water Conservation District (FSWCD), the Nature Conservancy (TNC), Darby Creek Association, Ohio Department of Natural Resources (ODNR), Natural Resources Conservation Service (NRCS) and The Ohio State University (OSU) can provide increased visibility to conservation efforts and help the Accord reach its conservation goals.

Metro Parks represents a formidable and well respected organization that provides a valued resource to the watershed and the community. As part of their Strategic Plan, Metro Parks has identified a goal of preserving an additional 7,000 acres of land in the Darby Watershed in cooperation with public and private partners, focusing on land along stream corridors such as the Big and Little Darby Creeks, Hellbranch Run and their major tributaries. The Darby Accord should cultivate a relationship with Metro Parks to leverage available resources in the pursuit of conservation lands that meet both the goals of the Accord and Metro Parks.

Goals for Conservation

The conservation of Tiers 1, 2 and 3 could yield a conservation network of almost 15,000 acres. When combined with land that is already protected in Metro Parks, community parks and easements, as well as land within protected floodways or Beltwidth, (about 10,000 acres) the conservation potential reaches 25,000 acres.

As an overall goal, the Accord should work toward creating a conservation network of 25,000 acres of public land within the Franklin County portion of the Big Darby Watershed, including areas already held in parks and easements. Priorities for conservation efforts should be linked to the Tiers described in the Conservation Strategy in Section 3.1.

5.4.1 Land Conservation Tools

To accomplish the plan principle of providing mechanisms to acquire environmentally sensitive areas (Tiers 1, 2, and 3), a number of existing and new programs will be needed. Furthermore, jurisdictions of the Accord will need to enter into partnerships with established agencies that have experience and expertise in land management, real estate transactions that can assist with targeting available funding sources from federal, state and local resources.

As a newly established partnership, the Accord is not yet ready to take on land ownership and management of conservation lands. However, over time, the Accord could evolve and develop the ability to own and manage land within the planning area and could possibly have a role as a land conservancy at the local level or even watershed level.

Open Space Advisory Council

It is recommended that the Accord establish an Open Space Advisory Council to provide guidance for land acquisition, funding and other conservation efforts. The Advisory Council should include representatives from Metro Parks, Franklin Soil and Water Conservation District, The Nature Conservancy, ODNR, NRCS, OSU Extension, and the local affected jurisdictions. Membership could also be extended to interested landowners. Members should have a role in land ownership and/or oversight. The Accord and Open Space Advisory Council should organize a series of Roundtable Discussions to encourage dialogue among residents about the benefits of land conservation and how to participate in programs.

The Accord and the Open Space Advisory Council should play a lead role in monitoring the land conservation efforts in the planning area and promote regional conservation efforts. It is recommended the Accord and its conservation partners meet on a regular basis to review single and joint conservation efforts. The Accord, with the help of the Open Space Advisory Council, should produce a brief, annual summary report that indicates achievements, identifies cooperative future efforts and monitors overall progress for both public and private conservation efforts and effectiveness at overall protection of the watershed. By providing an annual summary the Accord can evaluate its efforts and help build public support for conservation efforts. Reporting should recognize local efforts and landowners for their contribution to the Accord efforts and consider the land that is being conserved through conservation style development.

Through the creation of a Community Authority and other creative revenue generating techniques discussed in Section 5.5, the Accord anticipates generating a substantial amount of revenue for land acquisition. Revenue raised for land conservation should be leveraged with funding from other agencies in the pursuit of conservation goals that meet the objectives of the Darby Accord Plan as well as the objectives of the agencies with who the Accord partners. The Accord Plan should in no way limit or hinder conservation efforts of other organizations for lands that may be outside the tiers. By partnering with key agencies, the Darby Accord can provide financial resources for land acquisition and avoid the burden of land management. Over time, the Accord should continue to evaluate its ability to take on more responsibility including the ability to own and manage land.

5.4.2 Recommended Conservation Programs

Across the country, communities are successfully developing tailored programs aimed at protecting environmentally sensitive areas, culturally important sites and quality of life values that contribute to community character and community health. The Darby Accord jurisdictions will need to establish a series of new programs that will allow them to work toward achieving the conservation of Tiers 1, 2 and 3 and the creation of the Darby Town Center.

A number of valuable programs already exist through the Natural Resources Conservation Service (NRCS), Franklin Soil and Water Conservation District (FSWCD), Ohio Department of Agriculture, Ohio Department of Natural Resources (ODNR) and Ohio Environmental Protection Agency (OEPA). Many existing programs are oriented toward a specific purpose, such as agriculture easements, conservation easements, or incentives for restoring grasslands. The Accord will need a broader suite of programs to meet the goals of the plan. All programs identified in the Plan such as easements, purchase and donation require willing property owners and funding. Another commonality among all programs is sufficient funding and resources for program implementation and management. In addition to the programs suggested below, policies for development are intended to create more opportunities for open space and are further described in Section 4.0.

The following new conservation programs should be considered:

1. **Open Space Fund**

   Many communities and agencies are already working with land owners to purchase land in the planning area for use as parks or other public facilities. The concept behind an open space fund includes a recurring funding stream, similar to a purchase of development rights (PDR) program; however, the goal of the program is to purchase and acquire land (not rights). A major consideration in the pursuit of an open space initiative program is the level of resources required to accept ownership and maintenance responsibilities that come along with acquiring land.

   Metro Parks could be a formidable partner in the establishment of an Accord-wide open space fund program. Metro Parks and the Accord could work together to structure an agreement whereby local jurisdictions would contribute funding to strategic Metro Park acquisition efforts in the planning area, based on the Darby Accord general land use plan. Local jurisdictions may be able to successfully target state and federal grant resources as matching funds in acquisition efforts. Accord jurisdictions and residents would need to work together to identify an agreeable contribution level for local funding in establishing an open space initiative and consult with potential partners. Local businesses, organizations and other non-profit groups could also provide monetary support to acquisition efforts and raise awareness for the program. An open space initiative could become a major initiative for the Accord and lead to a brand identity for the Big Darby and more public awareness campaigns for educational and outreach purposes.

Each community within the Accord should continue to evaluate their ability to issue general revenue bonds that would support conservation efforts.

2. **Land Stewardship Program**.
With a dedicated funding stream, it is recommended that the Accord establish a program to purchase Tier 1, 2 and 3 lands from willing property owners. This program could be called Darby Greenspace Initiative, Darby Land Stewardship Program, Darby Open Space Initiative, or some other agreed-upon title. In addition to acquiring land by purchase, this program should be used to facilitate a charitable contribution of land through a gift, testamentary gifts, charitable remainder trusts, land conservation easements and other types of transfers that would benefit both the landowners and the local jurisdiction. This new program should be established to acquire, by purchase and/or charitable donation, land in the watershed that will be used for open space or parks that is consistent with Plan priorities.

   The Accord should focus efforts for purchase on priority conservation lands in Tier 1. The Accord could assume ownership and maintenance of land, or the land could remain under private ownership with restrictions placed on it through a conservation easement in perpetuity. Restrictions may include public access rights if the area is determined to provide a special linkage or opportunity for future greenway or trail alignment.

   To enhance and implement the objectives of this program, the Accord should make arrangements to have financial/tax professionals available for consultation with residents who desire to sell or donate their land and to assist with the transfer of land for green space and conservation purposes. In addition to land transfers, this program could accept asset contributions other than real estate, which could be used solely for the acquisition or preservation of conservation areas or parkland. Establishing a flexible program for donation could encourage property owners to donate entire parcels, or portions of their land (i.e. along stream corridors) for conservation purposes.

3. **Parkland Dedication Ordinance**
All residential subdivisions (major and minor) of land should contribute to the overall parkland and open space system of the Accord planning area. New development will result in increased demand for recreational resources and create opportunities to proactively plan for future demand and recreational trends. A parkland dedication ordinance, adopted among all jurisdictions is recommended to help build a park system that includes different scales of parks such as neighborhood, community and regional parks.

   The parkland dedication ordinance should offer developers a range of options in meeting the parkland dedication requirement including a dedication of land that becomes deeded to the respective jurisdiction, a transferred dedication of land, or fee-in-lieu-of one of these options. Jurisdictions should work with developers during the early stages of plan development to determine which option would best meet the needs of all parties. Parties should be flexible in negotiating requirements to meet this obligation. Not all land is suitable parkland.

   Parkland dedication requirements should be linked to development patterns in the Accord area; a single standard for parkland dedication encompassing the entire Accord area is not practical. Other communities, such as Dublin and Columbus maintain parkland requirements that can be referenced in determining requirements for Accord jurisdictions. Emphasis on parklands should be geared towards creating neighborhood parks, contributing to the regional Metro Parks system, or providing new parks to meet increased demand for recreational uses. In all cases, parks should incorporate low impact development techniques and innovative materials that reduce the amount of impervious surface for parking areas. Retention/detention ponds and other stormwater facilities should not count toward parkland dedication requirements

   Town Center
   The Town Center Zone should accommodate a number of neighborhood oriented parks that are within close walking proximity to residents. The amount of land dedicated should focus on the amount of people it would be serving because of the greater density development pattern. It is recommended that there be at least 6-10 acres of parkland per 1,000 people provided within the Town Center. Neighborhood parks should be located within at least ½ mile radius of all residential properties. A Master Plan for the Town Center should identify appropriate parkland that can provide a range of activities. The location of park land should be oriented toward protecting Tier 1 and 2 elements.

   Outside Town Center (including Conservation Development overlay)
   The conservation developments already require that 50% of the land be dedicated for open space. Portions of this open space, which are not preserved because of important environmental considerations, could be appropriate for certain appropriately designed recreational amenities, playgrounds and public spaces. The amount of land provided for public use for major and minor

subdivisions should be between 3 and 5% of the total gross open space area and include a set acres per dwelling unit amount (Dublin uses .03 acres per unit plus a minimum of 2% of the total gross site). A fee in lieu of payment could also satisfy a dedication requirement. In no case shall the open space requirement exceed 25% of total gross site area.

Land Dedicated as Parkland

If a developer chooses to dedicate land to meet the requirement, the location of the parkland should consider the Conservation Strategy of the Plan and should also be linked to any future Master Plan for the Town Center. Any land dedicated for parkland will need to be carefully evaluated to ensure that it can serve its intended use. Lands dedicated as park should not be an after thought to the development process and should be determined in consultation with the local jurisdiction. Key considerations should include:

- Preserves and protects Tier 1, 2 or 3 Conservation areas
- Proximity to other park lands (ensure even distribution)
- Roadway accessibility (for regional serving parks)
- Opportunities for pedestrian and bicycle connections (off-road)
- Vistas and scenic qualities
- Preserves and protects any woodlands and incorporates them as a park amenity
- Open to the public (private recreational facilities should not count toward parkland dedication requirements)

Subdivisions occurring adjacent to existing park lands should provide linkages to the existing park as part of the open space requirement and any dedicated parkland.

Procedures

Plat Dedication

The general arrangement of parkland and how it serves the neighborhood and greater community should be reviewed and subject to approval of the local jurisdiction. The local jurisdiction should evaluate the amount of parkland provided, the distribution of parkland, and the quality of the land provided. The local jurisdiction and the developer should meet early in the planning process to discuss options and ideas for meeting the requirements. Early discussions will facilitate approval during the preliminary plat stage.

Fee in lieu

If land dedication is inappropriate or insufficient, the local jurisdiction may request that the subdivider pay a park fee-in-lieu-of. The total fee should be based on the amount of land dedication required for final plat approval. Each jurisdiction will have to establish an average value of land per acre upon recommendation of a qualified land appraiser based on recent land transactions with a suggested price per acre for raw land within the jurisdiction. The total fee will also be based upon the average value of land. The total fee provided by the subdivider is determined by:

Total amount of land dedication X Average value of land per acre

Fees will be collected and deposited in a fund managed by the Community Authority. The funds will be used for the acquisition of recreational facility sites, parkland, and/or the maintenance and operation of publicly owned recreation sites and facilities. Monies will be issued to the Community Authority at the time of the final plat. No building permits will be issued unless and until the fee has been provided.

For residential dwelling units which are not constructed as part of a subdivision, the fee for each residential dwelling shall be ½ % of the total land and building costs of the residential or dwelling unit, with a minimum fee of $300 and maximum fee of $1000 per unit, regardless of the acreage involved. This fee will be evaluated each year by the local jurisdiction and adjusted accordingly in order to meet the parkland goals of the Accord.

Dedication Transfers

Dedicated land for parks could be transferred from one subdivision to another if providing parkland on that site is not feasible, there are no priority environmental protection areas or it is more logical to provide it in an adjacent area as a part of a larger green space. These transfers must be evaluated carefully.

4. **Purchase of Development Rights (PDR) Program**

A PDR program would allow landowners to voluntarily sell the development rights of their property, or a portion thereof, to the Accord, or similar organization. The landowner would retain ownership and maintenance of the land; however, as part of the land transaction, the property, or a portion thereof, would be placed under a conservation easement which would limit any further development. Restrictions may also stipulate public access rights if the area is determined to provide a special linkage or opportunity for future greenway or trail alignment. Ideally, this program will facilitate the conservation of land for open space and will lead to land being returned to natural, prairie or open grass lands. All conservation easements should be held jointly and in perpetuity by an individual property owner or Home Owners Association (HAO) and either the local jurisdiction or the Franklin County Soil and Water Conservation

District. Property owners of easements will be required to develop a planting plan and management plan that will guide the conversion of land from its current use to conservation.

A PDR program could also be used to help farmers retain their land as active farmland. It is recommended that any approvals for PDR for active agriculture lands be subject to the application of best management practices as part of the agreement.

To provide guidance to the Accord on how to spend available funding for purchasing rights, the PDR program should be linked to plan priorities and have an established application process for interested landowners that integrates criteria for protecting Tier 1, 2 and 3 areas. Preference should be given to properties that exhibit environmentally sensitive resources related to protecting water quality.

A PDR program would require a sufficient funding stream in order to facilitate the out-right purchase of the development rights. The Accord would also need to establish a process for severing rights from land; a review process for applications; determine which applications it will fund; hire personnel to perform appraisals and provide assistance to carry out the transaction.

A PDR program within the Darby Creek Watershed that uses public funds could be leveraged with other public agency funding, such as MetroParks, to realize significant advantages. A recurring funding source is recommended for a PDR program, similar to that suggested by a more simplified open space fund initiative. Accord jurisdictions would need to work together to identify an agreeable contribution level for establishing a PDR program.
A PDR program could be a stepping stone to a longer-term goal of a TDR program. If the development rights are held and placed into a "bank" they could be instrumental in initiating the first transactions of a TDR program because developers would not have to pursue the purchase of development rights from individual landowners.

5. **Density Transfer Charge**
Density Transfer Charges (DTC) are also designed to guide development away from sensitive areas that a community wants to protect; therefore, they could be classified as an open space program. Fees are assessed to development proposals that wish to increase density and those fees are used to protect sensitive lands or resources. To implement the use of a density transfer fee program, Accord jurisdictions would need to develop the appropriate zoning language to allow fees to be collected in areas that would be subject to increases in density, such as the town center area.

Density transfer charges are triggered with rezoning requests. They can work with minimum (base) and maximum (threshold) zoning densities or can be applied to any rezoning that involves an increase in density or intensity of use. In order to receive the increase in density, a developer is charged a transfer fee per unit of increase. For example, the base zoning for a 1 acre parcel (in a DTC zone) is 2 dwelling units per acre but the maximum density is 5 units per acre (achievable through DTC). Assume that each unit of density costs $8,000; the developer could seek an increase in density up to the maximum by paying $24,000. The money from the transaction would be used to purchase land or easements in the areas that are identified for conservation. With DTCs, conservation efforts are funded by development rather than through public sources and taxes. The Accord should consider developing a density transfer program to capture funds related to requests for increases in density. Although establishing a DTC program does not necessarily require a re-zoning of the base zoning in all areas, in the case of the town center area a rezoning would be recommended to ensure base levels of development are sufficient to support and warrant public utilities.

Big Darby Creek
Source: Metro Parks

DTC programs differ from TDRs in that they can be used almost anywhere. DTC programs do not require sending and receiving areas or the participation of sellers and buyers, although communities can include these elements and other TDR-like elements, as part of a DTC ordinance. DTC programs do not require any off-site preservation like a TDR program.

To implement DTC, the Accord jurisdictions would need to create an ordinance that spells out the purpose and procedure for the program. The ordinance will need to state the amount of the transfer fee and clarify how those funds will be used for conservation efforts. Density fees must consider the valuable increment of the additional development unit. Fees should be reasonable and set at an amount that still provides a reasonable return on investment for the developer; otherwise the program will not be used. Developer fees are calculated and typically collected when building permits are issued.

A disadvantage of using a DTC is that it potentially postpones many of the decisions that are made at the start of some classic TDR programs (Pruetz, 2003). In some TDR programs, receiving areas are not only designated, but rezoned so that developers are administratively approved to exceed the TDR threshold as long as they comply with the code and buy the necessary TDRs. In DTC, developers propose zoning changes on a parcel by parcel basis, with each proposal evaluated separately (Pruetz, 2003). This provides less certainty to developers. In many TDR programs, sending areas are clearly identified and in some cases down-zoned to reflect community preservation goals and promote conservation and the use of TDRs. This is not an approach found in DTC programs; areas identified for conservation would be pursued by the Accord using DTC funds but those areas could develop as currently zoned.

Areas approved for up-zoning through the use of DTC must be compatible with the overall plan for a community. Increasing density on a case by case basis will ultimately increase overall development and would need to be weighed against factors such as environmental impacts and adequate infrastructure and serviceability. Furthermore, up-zonings across the planning area would need to be monitored to understand the cumulative impact on overall growth and development in the watershed.

Within the Darby Watershed, DTC may be most appropriate on a limited case by case basis. However, because public sewer and water will not be made available in all areas, increases in density will most likely not be suitable for remote areas of the planning area. Any DTC program for the Accord area should be applied to each jurisdiction and coordinated among all ten jurisdictions. By pooling funds collected through the program, the Accord jurisdictions could better leverage their funds and target specific areas for preservation or conservation.

6. **Transfer of Development Rights (TDR) Program**
   As a long term goal, the Accord should consider the development of a TDR program as part of the tool box of options to achieving the conservation of Tiers 1, 2 and 3. A TDR program would allow willing property owners in Tiers 1, 2 or 3 (sending areas) to negotiate and sell their development rights to buyers that then execute them in appropriate 'receiving areas' (town center). The value of a development right is determined through negotiation between the buyer and seller and is a function of the real estate market.

   TDR requires the development of a more detailed process for the transfer of the rights, including rezoning sending and receiving areas, establishing administrative processes for the transfer of rights and extensive outreach to the public about how the program works.

   It is recommended that the Darby Accord continue to support a change in state legislation that would enable the transfer of development rights between any and all jurisdictions (incorporated and non-incorporated). The current boundaries of the Town Center should serve as a receiving area and Tiers 1, 2 and 3 would become sending areas. The informal transfer of rights could occur today within a single jurisdiction among agreeable parties. Informal transfers should be encouraged as a way to conserve land in the Tiers and help create the Town Center. A successful TDR program requires an active housing market and a supportive public that participates in the program. TDRs offer landowners another option for realizing the value of their land.

7. **Land Owners Roundtable Series**
   This planning process has revealed a need to hold a series of roundtable discussions to inform landowners about the priority conservation areas and to explain conservation options such as easements, donations, purchase of development rights and other programs. The majority of land in the watershed is within private land holdings. A pro-active approach with land owners could result in an increased willingness to contribute land into an open space network and land conservation strategy. The Accord should consider establishing a core group of landowners, representative of all Accord jurisdictions, for this effort. This group can serve as ambassadors to other landowners and interested citizens, distribute information and

provide a voice for landowners. Key partners in this effort should include Accord jurisdictions, FSWCD, ODNR, Metro Parks and key local institutions.

8. **Backyard Conservation Program.** Similar to the program established by the Friends of Olentangy Watershed (FLOW), a backyard conservation program provides guidance to homeowners in how to maintain their property in harmony with the watershed. The program could be part of an overall Healthy Streams marketing campaign designed to engender support for conservation projects and raise awareness of the role that each resident has in protecting the Darby watershed. Program components could include lawn care, pest management, suggest native tree and vegetative plantings, include instructions on how to develop and maintain a rain garden or other lot-level best management practices. This program could be expanded to school-aged children.

The Friends of Olentangyy Watershed provides signs to those members practicing backyard conservation. *http://www.olentangywatershed.org/*

Franklin SWCD assisted in the development of the FLOW program and is working to develop a central Ohio-wide Backyard Conservation program for dissemination to all residents. Franklin SWCD is a potential partner for the Accord in developing a Healthy Streams program.

Another example of a backyard conservation program can be found in the Northern Virginia Planning District Commission's "Maintaining Your BMP" handbook. The book is designed for property owners and suggests basic maintenance and planting tasks for BMPs.

9. **Nutrient Reduction Programs for Farmland.** Nutrient reduction programs for farmers are one way to encourage better site management in active agriculture areas. A program in the Stillwater watershed in Ohio led by Ohio State University Department of Agricultural, Environmental, and Development Economics is running such a program. The Ohio State University Group performance contracts tie payments farmers receive for reducing pollution loads to measurable pollution reductions downstream, using small sub-watersheds of 1000 – 2000 acres and groups of 5 – 15 farmers. (*Sohngen, March 2005).* Farmers must purchase the equipment and payment for nutrient reductions is measured collectively downstream (Taylor, Sohngen, Randall and Pushkarskaya, 2004).

5.5 Revenue

The following section addresses a key element in the implementation strategy for the Big Darby Accord: the funding opportunities. These funding opportunities are based on potential revenue that could be realized for the planning area through the implementation of a new community authority, tax increment financing and/or developer contributions. For the purposes of this plan, there has been an analysis and initial set of projections prepared for all three sources of revenue. This analysis includes a number of assumptions, noted in the following discussion, and several assumptions regarding the level of fees and assessments that would be applied. Although provided as part of this plan, these matters will require further discussion among the various jurisdictions and stakeholders that would be impacted by these costs to determine the appropriate fees and assessments. These jurisdictions and stakeholders would also be participants in the implementation of these revenue sources.

An important factor in considering the level of revenue sources that could be generated is determining how these funds could be used. This Plan identifies a number of priorities that should be pursued as implementation efforts coalesce:

- Infrastructure (utilities and roads)
- Regional stormwater management (acquisition, construction, maintenance)
- Open Space and Land Conservation (in partnership with other agencies)
- Water Quality Monitoring
- Community Facilities
- Stream Restoration
- Supporting resources to implement and update the Accord Plan (plan review, coordination)

It is also worth noting that these three revenue sources should not be viewed as the only revenues available to fund the plan. Other sources that should be considered and pursued for Plan implementation include state and federal grants and water and sewer revenues.

The revenue assessments completed as part of this effort should be regarded as preliminary in nature and indicative only of the order of magnitude of the financing capacity for each tool, but by no means definitive. This is due to the fact that these projections are based on development assumptions that are subject to change.

As possible sources for funding aspects of the plan, revenue streams and related capital evaluations of financing capacity were prepared for the following three sources:

1. A new community authority (NCA)
2. Tax increment financing (TIF)
3. Development fee contributions.

These three revenue sources were evaluated because of their proven central Ohio track records in funding public infrastructure in connection with new residential and commercial development in Hilliard, Powell, Dublin, New Albany and the City of Columbus' recently adoption of all three of these revenue sources as part of its "Pay As You Grow" policy.

5.5.1 Key Assumptions

A number of key assumptions have been used for the basis for revenue projections.

In connection with any tax increment financing, it is assumed that the tax increment financing would be for the maximum legally permitted 30 years in duration on each improved parcel, but that the overlapping school districts would be held harmless. The result is that the tax increment financing revenue stream that is the basis for these projections is limited to the "non-school" share of each real property tax dollar generated by any new development permitted in the planning area. The TIF revenues shown below include any non-school amounts that are also subject to potential sharing with overlapping townships and county agencies.

With respect to a new community authority charge, projections are based on a ten mill charge that would be imposed on each new residential unit or structure for 30 years.

Over the 30 year period, it is assumed that the allocation for the first 20 years would be one half (5 mills) to local public infrastructure improvements and community facilities, and one half (the other 5 mills) to regional improvements, with the full ten mills allocated entirely to regional improvements for years 21 through 30.

It was also assumed in the case of both tax increment financings and the new community authority that each would apply to both residential and commercial development.

For both tax increment financing and new community authority charges -- which are applied to the assessed value of each new structure or unit -- a growth factor of 3% of that value with every triennial update or sexennial reappraisal was assumed. It was assumed that the true value of each unit as determined by the county auditor would be approximately 90% of the sale or per square foot value, with that true value then reduced to tax value of 35% of true value.

With respect to any development fee contribution, a $2,500 per unit fee was assumed that would be paid at the time a building permit is drawn for each residential unit. If a development fee is already imposed by a local jurisdiction, that jurisdiction could receive the balance of the proposed $2500 per unit fee to be applied to items consistent with the Plan. In addition, jurisdictions could discount developer contributions by allowing credit for extraordinary costs incurred by a development associated with regional best management practices, regional stream restoration efforts, sewer extension to the Town Center area, and/or community-based wastewater treatment systems in the rural conservation areas.

5.5.2 Projections

The above assumptions were applied to build-out assumptions in connection with each of the identified development areas of the Town Center, Hilliard growth area and the areas identified for rural conservation development.
In the figures that follow, the projected revenues are expressed in terms of both the actual amount to be collected over a described period of years, as well as the "PV" or "present value" of that long term stream of revenues. Present Value is the value of that future cash flow discounted (in this case at the rate of 5%) into its value in today's dollars. Present Value is also a very rough measure of the financing capacity of that long term revenue stream.

			NCA Charge	
	TIF	Fees	Local Share	Regional Share
Amount (millions)	$213.6	$12.5	$36.6	$79.1
PV (million)	$71.3	$7.8	$14.0	$21.4
Per Unit	$1,500.00/yr	$2,500.00	$630.00/yr	
Length per Parcel	30 years	One time	30 years	

Figure 5.7 Town Center - Minimum Build-out Scenario
Approximate Revenues – 5,000 Total Units (Build-out Complete 2021)

			NCA Charge	
	TIF	Fees	Local Share	Regional Share
Amount (millions)	$89.4	$5.0	$14.3	$30.9
PV (millions)	$32.2	$3.5	$6.1	$9.3
Per Unit	$1,500.00/yr	$2,500.00	$630.00/yr	
Length per Parcel	30 years	One time	30 years	

Figure 5.8 Hilliard Growth Area
Approximate Revenues – 2,000 Total Units (Build-out Complete 2017)

			NCA Charge	
	TIF	Fees	Local Share	Regional Share
Amount (millions)	$534.1	$12.5	$99.4	$214.5
PV (millions)	$178.2	$7.0	$34.1	$52.0
Per Unit	$3,920.00/yr	$2,500.00	$1,575.00/yr	
Length per Parcel	30 years	One time	30 years	

Figure 5.9 Low Density Development (Conservation Development Areas)
Minimum Build-out Scenario Approximate Revenues – 5,000 Total Units
(Build-out Complete 2023)

			NCA Charge	
	TIF	Fees	Local Share	Regional Share
Amount (millions)	$837.1	$30.0	$150.3	$324.5
PV (millions)	$281.7	$18.3	$54.2	$82.7
Length per Parcel	30 years	One time	30 years	

Figure 5.10 Aggregate Projections - Minimum Build-out Scenario
Approximate Revenues– 12,000 Total Units

Town Center Residential
Residential development in the town center assumes a build-out of 400 residential units built per year commencing in 2009 with an average sales price of $200,000. Based on a minimum build-out scenario of 5,000 total units with build-out complete in 2021, the approximate revenues and financing capacity for a non-school TIF, a $2,500 developer contribution fee and a ten mill new community authority charge in this area are identified in Figure 5.7.

Town Center Commercial
For Town Center commercial, the revenue and financing projections assume a build-out of 850,000 square feet (SF) of office space costing $100 per square foot over ten years. Projections also assume a build-out of 900,000 SF of large commercial space at $75 per square foot of construction cost over ten years and another 500,000 SF of small commercial space at construction cost of $75 per SF over the same ten year period. Finally, it assumes that build-out begins in 2009.

Based on these assumptions, a non-school TIF would generate approximately $51.4 million of revenue over 30 years, yielding a financing capacity at a 5% borrowing rate of approximately $17.5 million.

Hilliard Residential
For the Hilliard growth area, the following projections are based on 200 residential units per year, commencing in 2008, for a total of 2,000 units, with an average sales price of $200,000.

Low-Density
For low-density residential development outside of the higher growth areas, assumptions include 200 built residential units each of the first five years and 400 units built in each year thereafter, commencing in 2009. All units are assumed to have an average sales price of $500,000. Given the long term nature of this build-out, the build-out assumption is based on 5,000 total units as reflected in Figure 5.9.

Aggregate Revenue Projections
The aggregated revenue projections from all three revenue sources for the Town Center, Hilliard and low-density development assumptions set forth above, are presented Figure 5.10.

5.5.3 Summary Revenue Considerations (with Respect to Build-out Assumptions and Revenue Projections)

All of these revenue tools are assumed to reflect an agreed upon consensus among the members of the Accord and the development community that would be active in the Accord area, as was the case with Columbus Pay As You Grow. This consensus is important because these tools are only revenue-producing to the extent they are agreeable to the development community. If the combination of tools is overly burdensome to development in these areas, development will not occur resulting in reduced revenues.

5.5.4 Uses of Revenues

Based on their legally permitted uses, the nature (one time or sustaining over time) of each, the source of payment and other considerations, likely priority "uses" for the three revenue streams evaluated might be as follows:

1. **Tax Increment Financing Revenues**
   These revenues are generally limited to capital financing of "public infrastructure improvements" and therefore would be used to pay or finance capital costs of the following in connection with the Plan:
   - Public roads and highways;
   - Water and sewerlines;
   - Stormwater and flood remediation projects, including stream remediation; and
   - Land acquisition.

   Although regional improvements called for by the Big Darby Accord may be the first priority for these resources, they may also be allocated to public infrastructure improvements in each jurisdiction. The jurisdictions may also determine that a portion of the TIF revenues should also be allocated to the public agencies that normally benefit from real property taxes.

2. **New Community Authority Community Development Charge**
   This charge may be applied to pay costs of:
   - Land acquisition as part of the Big Darby Accord development program;
   - Land development including water distribution systems, sewers, sewage collection systems, roads, streets, curbs, gutters, sidewalks, storm drainage facilities and other installations or work, whether within or without the new community district area; and
   - Community facilities.

   The charge may also be applied to operation and maintenance costs of those facilities, and thus is more flexible than TIF revenues. It may also be possible to fashion a "prepayment credit" against this revenue stream for developer conservation expenditures in support of the Big Darby Plan.

3. **Developer Contributions**
   Developer contributions might most logically be segregated into a fund for the acquisition of land and development rights to implement the Big Darby Accord and Plan. It may also be possible to establish credits against these contributions based on the value of development rights or land acquisition and donation that is made by a developer.

In addition to the revenue sources named above, other possible traditional public finance revenue sources for various public infrastructure improvements exist. These include, for example, the use of utility revenues in support of sewer and waterline extensions into developing areas. In light of the extensive infrastructure and Big Darby Plan conservation needs identified for the area, all revenue sources will likely be needed to fund development and the plan.

Any tax increment financings which would need to be authorized by the relevant overlapping township or county or municipal jurisdictions, while any community authority would need to be approved by the City of Columbus and the Franklin County Commissioners.

5.6 Early Actions

Accord jurisdictions should work together to establish the necessary processes and programs that are vital for plan implementation. The following early action items identify priority steps for plan implementation. The emerging Memorandum of Understanding (MOU) provides further refinement of these actions.

Timeframe: 1-4 months

Facilitate Accord Plan Adoption
Each jurisdiction should submit the Accord Plan to elected officials and approving bodies for review and approval. Each jurisdiction should follow their established public review processes for plan adoption.

Complete a Memorandum of Understanding
The participating jurisdictions should agree to a memorandum of understanding which outlines the relationship and obligations of the jurisdictions within the Darby Accord Plan framework.

Timeframe: 2-6 months

Update Local Regulations
Each jurisdiction should update land use policies and documents including comprehensive plans, zoning and subdivision regulations to ensure consistency with the Accord Plan. Jurisdictions should work together on this task.

Timeframe: 4-6 months

Establish the Big Darby Accord Advisory Panel
This panel should include members of the Accord. This panel should provide non-binding review of development-related proposals for consistency with the overall Mission Statement of the Accord and the Big Darby Accord Plan.

Update Development Review Processes
The participating jurisdictions should update their development review processes to integrate the Big Darby Accord Advisory Panel, as described in Section 5.1.

Update Submission Requirements
Each jurisdiction should review and make changes to their development application submission requirements to reflect the priorities of the Big Darby Accord Plan. This process should include the agreement to use a development review checklist.

Update Utility and Service Permits
The jurisdictions should examine and modify, if necessary, their utility and service permit process in order to adhere to recommendations outlined in the Big Darby Accord Plan.

Timeframe: 6-9 months

Identify Staff Resources to Carry Out Plan Implementation
To ensure that plan implementation is occurring, and that efforts are moving forward, it is recommended that the Accord jurisdictions appoint at least one staff person to coordinate implementation efforts, including the Big Darby Accord Advisory Panel. Accord jurisdictions should jointly fund this position. This person should be charged with coordinating activities in the immediate months after plan completion, pursuing funding and creating partnerships. Outreach and advocacy to other communities in the watershed should also be pursued and could be coordinated by staff.

Timeframe: 6-12 months

Perform Facilities Planning for Services
Accord jurisdictions should perform facilities planning for the provision of water and central and non-centralized wastewater services according to the Accord Plan. Accord jurisdictions should continue to work together with technical experts to address issues concerning the treatment of waste water for areas that will not be serviced by central sewer and water. This will include identifying appropriate technologies, management, regulation and enforcement. Strong consideration should be given to establishing an inspection and enforcement program for HSTS to ensure proper function. Appendix F offers draft recommendations put forth by the Darby Alternative Wastewater Treatment Technical Advisory Committee related to options for alternative wastewater treatment systems.

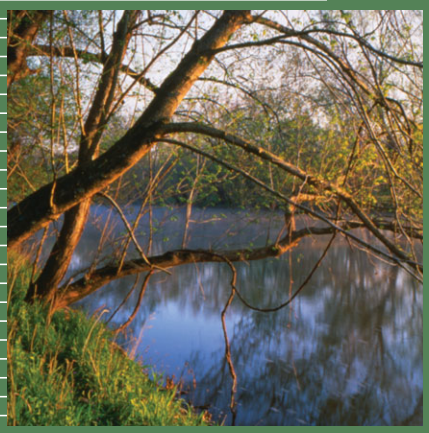
Initiate a Town Center Master Plan
A Master Plan for the proposed Town Center should be developed to adhere to recommendations made in the Big Darby Accord Plan.

Timeframe: 6-18 months
Establish a New Community Authority (NCA) and Non-school Tax Increment Financing (TIF) Revenue Mechanisms
The participating jurisdictions should create a new community authority and adopt appropriate legislation for the creation of such an entity. The creation of the Authority will require the establishment of by-laws among other procedural requirements including funding priorities. Participating jurisdictions should also establish a non-school TIF.

Designate an Environmental Monitoring Group and Open Space Advisory Council.
The Darby Accord jurisdictions should establish an Environmental Monitoring Group to lead and facilitate development of a water quality monitoring program (and procedures) and an Open Space Advisory Council to coordinate land conservation efforts.

Timeframe: Ongoing

Education and Outreach
The Big Darby Accord Advisory Panel and supporting partners should continue education and outreach to inform property owners, developers and elected officials of the goals and objectives of the Accord Plan, as well as the means being employed to implement the Plan. Efforts should be made to reach out to other watershed communities to encourage regional collaboration and adoption of Accord standards.



Big Darby Accord
Watershed Master Plan

Appendix

Prepared for

City of Columbus
City of Hilliard
Grove City
Brown Township
Norwich Township
Pleasant Township
Prairie Township
Washington Township
Village of Harrisburg
Franklin County

EDAW

FINAL / JUNE 2006

Prepared by
EDAW Inc

In Collaboration With:
MSI Design
EMH&T
Ohio State University Extension
Squire, Sanders & Dempsey LLP
Schottenstein Zox & Dunn
Trans Associates

Appendix A

- Final Modeling Study
- Final Pilot Study Model

Appendix B

- Funding Sources

Appendix C

- Reference Information
- Inventory of GIS Data

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- Development Review Checklist

Appendix E

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Appendix F

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Big Darby Accord
Water Quality Modeling Summary Report

EMH&T, Inc.
June 2006

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A. Purpose

The purpose of the water quality modeling was to determine the impact on water quality, measured in terms of pollutant loading, related to projected land use changes within the Big Darby Accord planning area. Using the Soil and Water Assessment Tool (SWAT) software, a baseline condition model was created similar to the Generalized Watershed Loading Functions (GWLF) model established by the Ohio EPA for the Big Darby Creek TMDL analysis and draft report. The SWAT baseline model was calibrated for flow to the USGS gage along Hellbranch Run; the model was then calibrated to the EPA's GWLF model results for Total Nitrogen (TN), Total Phosphorous (TP), and Total Suspended Solids (TSS). Although the Ohio EPA did not publish calculated TN loadings in the TMDL report, we were provided detailed and summary model results by the Ohio EPA that included those values for the Hellbranch Run watershed and the 14-digit HUC's that are at least partially within the Big Darby Accord planning area.

The final calibration model's parameters were then used to analyze the effects of the final land use plan, comparing the resultant pollutant loadings predicted by the SWAT model to the target water quality goals published in the OEPA draft TMDL report. The model results were also used to evaluate the requirements for stormwater best management practices (BMPs), in an effort to mitigate the impact of development on pollutant loadings.

B. Pollutant Loading Considerations

The pollutant constituents chosen for this analysis, Total Nitrogen (TN), Total Phosphorous (TP), and Total Suspended Solids (TSS), are those that are commonly considered and are most likely to be affected by changing land use conditions. Heavy metals, especially within the Big Darby Accord planning area, did not appear to be a significant consideration in the Big Darby Creek TMDL. Furthermore, there are no anticipated future industrial land uses within the Big Darby Accord area that would be a significant contributor of those pollutants.

C. Initial Model Set-Up

1. Digital Elevation Model (DEM)

The first step in the modeling process was to create a Digital Elevation Model (DEM). Using the Arc/INFO "TOPOGRID" command, a 15-ft DEM was created from the following data inputs:

- Franklin County Auditor's spot elevation data
- Franklin County Auditor's 2-ft contours
- Madison County Auditor's 5-ft contours
- 1:24,000 scale USGS Digital Line Graph (DLG) contours (for Pickaway County)
- Blue line streams from Franklin County Soil and Water Conservation District's (FSWCD) hydrography layer
- Blue line streams from USGS Digital Line Graph (DLG) hydrography, manually edited to include only stream centerlines and to better correspond to contour data (for areas outside of Franklin County)

2. Spatial Extent

The Big Darby Accord planning area consists of the portion of the Big Darby Creek watershed located within Franklin County. To restrict the automated sub-basin delineation to Franklin

County, a mask was used. However, instead of simply using a mask equivalent to the Franklin County boundary, small portions of Madison County and Pickaway County were also required for SWAT to correctly delineate the portion of Big Darby Creek that forms the Madison County/Franklin County boundary and the stream network at the southern part of the Big Darby Accord planning area.

Therefore the mask used during the sub-basin delineation only limited the extent of the sub-basins along the eastern, western, and northern sides. Along the eastern and western sides, the mask extent was for the most part identical to the initial boundary of the Big Darby Accord planning area, which consisted of the Madison County/Franklin County boundary on the west and the HUC 14 Big Darby Creek watershed boundary on the east. (Note: the Accord planning area's eastern boundary was later revised; this is discussed below in the section "Revision of Sub-basin Areas".) However, for Big Darby Creek to be correctly delineated along the Madison County/Franklin County boundary, the mask actually extended 100 feet west of the Big Darby Creek centerline into Madison County. Along the northern side, the mask extent was equivalent to the Franklin County boundary and the Hellbranch Watershed Forum (HWF) boundary for the Hellbranch sub-watershed.

3. Delineation of Sub-basins, Hydrologic Response Units (HRUs)

Sub-basin outlets were selected according to the following criteria:

- Within the Hellbranch Run sub-watershed, sub-basin outlets corresponded to those utilized by the Hellbranch Watershed Forum (HWF) to maintain general agreement with the HWF for potential comparison of model results. The SWAT sub-basin boundaries delineated using the DEM were in general agreement with the HWF sub-basin boundaries.

- For areas outside of the Hellbranch Run sub-watershed, a sub-basin outlet was placed at each blue line stream's confluence with Big Darby Creek. Additional sub-basin outlets along Big Darby Creek were selected such that an average sub-basin size of approximately 1,000 acres was maintained.

- Sub-basin outlets were created at the outlets of each of the 14-digit HUC's contained or at least partially contained within the study area, to allow for potential pollutant calibration with EPA data. However, with the exception of the Hellbranch sub-watershed outlet, these outlets were not used as calibration points since the majority of the area within each 14-digit HUC was actually located outside of the modeling study area and would therefore not provide for an accurate calibration.

- A watershed inlet was created at the confluence of Little Darby Creek with Big Darby Creek, which corresponds to a 14-digit HUC outlet, to better allow for OEPA/GWLF point source pollutant loadings for areas outside of Franklin County to be added to the model. After the establishment and calibration of the baseline SWAT model, however, a decision was made not to include point source loadings for areas outside of Franklin County since these values were unable to be accurately projected for the time period corresponding to the final land use scenario. The resultant exclusion of the Little Darby Creek tributary area from the SWAT model was determined to have little to no impact on the model results, since the majority of the land in this region is currently

MetroPark forested land and continues to be designated as forested land in the future land use scenario.

The result of the SWAT sub-basin delineation process was a 53,068-acre watershed comprised of 51 sub-basins (average of 1,041 acres per sub-basin). The SWAT sub-basins along with the Big Darby Accord planning area can be seen in Figure 1. The modeling study area is essentially comprised of two large sub-watersheds: the Hellbranch Run sub-watershed (25,154 acres) and all other areas within Franklin County that are directly tributary to Big Darby Creek. It should be noted that a small area in the southwest corner and the very northernmost tip of the Big Darby Accord planning area are actually located outside of the Big Darby watershed boundary, so these regions were not included in the modeling efforts. The 51 sub-basins initially created for the SWAT calibration model were also utilized for the final land use scenario model so results from the two models could be readily compared.

To adequately capture the diversity of land uses and soils present within each sub-basin, the SWAT model then divides each sub-basin into even smaller units, referring to unique combinations of land use and soil type as Hydrologic Response Units (HRUs). HRUs allow for increased accuracy in the model since loadings from each HRU are calculated independently, based on specific parameters that correspond to land use/management operations and soil type (i.e., percent impervious, plant species, fertilizer application rates, soil hydrologic group, etc.). Although the sub-basin boundaries were consistent for the baseline/calibration model and the final land use scenario model, since the land use coverages for the two models varied significantly, the total number of Hydrologic Response Units (HRUs) analyzed in each model differed. On average each SWAT model contained at least 10 HRUs per sub-basin; a further discussion of the HRU delineation process for each model is included in the "Land Use Data" section below.

4. Revision of Sub-basin Areas

For some sub-basins along the eastern boundary of the study area, the sub-basin areas were manually revised in SWAT to include additional drainage area. This revision was due to a change in the eastern boundary of the Big Darby Accord planning area that occurred after the sub-basin delineation process had already been completed and work on the calibration model was underway. The revised boundary corresponds to either the Hellbranch Watershed Forum boundary or the HUC 14 Big Darby Creek watershed boundary, whichever is "greatest". Where the boundary was changed, a larger total drainage area is reflected in the SWAT model. For the majority of the sub-basins with revised areas, the additional drainage area was simply distributed proportionally amongst the various HRUs already established. However, where significant differences were observed in terms of land use percentages within a sub-basin, HRUs were added, revised or deleted as necessary to maintain accuracy in the model.

5. Revision of Main Channel Widths/Depths, Channel Lengths

The default SWAT values for main channel widths and depths were overwritten; instead, the main channel widths and depths were calculated using the following regional curve equations provided by The Ohio State University (OSU):

$$\text{Width (meters)} = 0.477 \times (\text{Drainage area in ha})^{0.4032}$$

$$\text{Depth (meters)} = 0.0474 \times (\text{Drainage area in ha})^{0.3167}$$

Based on a GIS analysis of the river shapefile delineated by SWAT, some main and tributary channel lengths were also manually revised, since the SWAT program had incorrectly clipped or merged some river segments.

6. Study Period

The designated modeling study period was selected to match that used by the OEPA in its TMDL analysis: April 1, 1994 through March 31, 2004.

D. Data Inputs

A summary of the data inputs used in the SWAT water quality modeling process is shown as Table 1. This data (with the exception of the baseline land use data) was used for both the baseline/calibration model and the future land use scenario model.

1. Weather/Climate Data

Precipitation and temperature data for April 1994 through March 2004 were provided by the OEPA from its Big Darby Creek TMDL efforts. This data was collected from eight gages, none of which were located within the Big Darby Accord planning area. Of these, the Columbus, London, Marysville, and Delaware gages were in closest proximity to the planning area; however, when comparing the relative magnitude and timing of precipitation events to the observed flows at the U.S. Geological Survey's (USGS) Hellbranch Run gage, none of the gages had data that was consistent with the Hellbranch sub-watershed over the entire span of the study period.

Various combinations of gages and individual gages were then tested in the model: the average of the nearest four gages, the average of all eight gages, and individual data from the Columbus and London gages. However, all yielded poor calibration results. As a result, additional precipitation data sources were explored. Data from the three nearest City of Columbus gages were incomplete and inaccurate for large portions of the ten-year study period. Finally, after evaluating precipitation data from a variety of sources, the National Weather Service (NWS) gage at the Port Columbus International Airport was determined to most accurately represent the conditions within the Hellbranch Run sub-watershed. The precipitation events recorded at the NWS gage best corresponded to the flow data from the USGS Hellbranch Run gage in terms of both relative magnitude and the timing of events.

For consistency, temperature data from the same NWS gage was then also selected for use in the SWAT model. However, NWS precipitation and temperature data were only available for the duration July 1996 through March 2004, which does not include the beginning of the designated ten-year study period (April 1994 through March 2004). Therefore, for the time period ranging from April 1994 through June 1996, precipitation data from the Ohio Agricultural Research and Development Center (OARDC) Columbus Station gage and temperature data from the OARDC Delaware Station gage were utilized. This substitution did not have a significant effect on the accuracy of the SWAT model or the interpretation of its results, since these gages are located in close proximity to the study area and are also considered to be adequately representative of the weather/climate in this region. Also, since the SWAT model requires one to two years for initial conditions to equilibrate, the calibration period was set as study years three through 10 (April 1996 through March 2004), during which the majority of the precipitation and temperature data consisted of the NWS gage data.

All other weather/climate data (solar radiation, wind speed, relative humidity, and potential evapotranspiration) were simulated by SWAT, which uses a database of national weather information to create approximations customized to a specific geographical area.

Table 1
SWAT Data Input Summary

Data Input	Applies to SWAT Land Use(s)	Data Source(s)
Precipitation data	All land uses	OARDC Columbus Station gage (Apr 1994-Jun 1996); NWS Port Columbus Airport gage (Jul 1996-Mar 2004)
Temperature data	All land uses	OARDC Delaware Station gage (Apr 1994-Jun 1996); NWS Port Columbus Airport gage (Jul 1996-Mar 2004)
All other weather/climate data	All land uses	Approximated within SWAT using national weather/climate database
Soil data	All land uses	NRCS Soil Survey Geographic Database (SSURGO)
Baseline land use data	NA	OEPA Hybrid Land Use Coverage
Initial groundwater concentrations of nitrate and soluble phosphorus	All land uses	OEPA
Agricultural operations including crop types/rotations, tillage practices, fertilizer application rates	Agricultural Land - Row Crops (AGRR)	NRCS, research conducted by OSU, OSU Extension Bulletin E-2567 (http://ohioline.osu.edu/e2567)
Manure application from livestock	Pasture (PAST)	OEPA
Lawn fertilizer application	Pervious portions of all urban land uses	OSU Extension FactSheet HYG-4006 (http://ohioline.osu.edu/hyg-fact/4000/4006.html)
Recreational field fertilizer application	Parks (PARK)	OSU Extension FactSheet SRT-2-05 (http://ohioline.osu.edu/srt-fact/0002.html), Purdue University's Turfgrass Science report AY-325-W (http://www.agry.purdue.edu/turf/pubs/AY-325-W.pdf)
Golf course fertilizer application	Golf Courses (GOLF)	Virginia Cooperative Extension Publication Number 430-399 (http://www.ext.vt.edu/pubs/turf/430-399/430-399.html), Delaware Department of Natural Resources and Environmental Control "Turf Nutrient Management" report (http://www.dnrec.state.de.us/water2000/Sections/Watershed/WS/fact_appo_turf_nutrient.pdf)
Build-up/wash-off parameters	Impervious portions of all urban land uses	SWAT, OEPA
Runoff curve numbers and percent impervious values	All urban land uses	SWAT, NRCS TR-55 documentation

2. Soil Data

NRCS SSURGO data was utilized due to its more detailed determination of the soil types. Additionally, this soil data was utilized by the OEPA for the TMDL. To minimize the number of HRUs created while still maintaining the distinct data attributes used by SWAT, the SSURGO soil types were reclassified into soil series. Figure 2 displays the predominant soil series within the modeling study area (those soil series comprising at least 1% of the overall watershed area).

3. Land Use Data

a) Baseline Conditions

The land use coverage used to represent baseline conditions in the calibration model was provided by the OEPA and is identical to that used in the OEPA's TMDL analysis. This hybrid land use dataset includes data from the USGS National Land Cover Dataset (NLCD - 1992), OEPA's analysis of forested land cover using 1997 Landsat 5 satellite imagery, an OEPA-funded land use study based on 2000-2001 Landsat 7 satellite imagery conducted by the University of Cincinnati, and land use data based on 1997 Landsat Thematic Mapper data provided by Dr. Steve Gordon at The Ohio State University (OSU). To verify that this hybrid land use information reflected the most current land use within the Accord planning area, a parcel-based MORPC land use coverage representing 2003 conditions was revised using 2005 Franklin County Auditor's land use codes, taking into account any changes from agricultural land or open space to other land uses. This revised MORPC dataset (showing urban land uses/zoning type categories only) was then merged with the natural land cover data from the hybrid land use coverage to create an updated 2005 existing land use layer.

After comparing the updated 2005 existing land use dataset to the original OEPA hybrid land use dataset, it was determined that the differences between the two land use coverages would likely have very little impact on the SWAT modeling results. Therefore, for consistency with the OEPA TMDL analysis, the hybrid land use dataset was selected to represent baseline conditions in the baseline/calibration model.

Based on the land use descriptions for each category, a "look-up" table (Table 2) was created to convert the hybrid land use categories to the appropriate SWAT land use categories. Since a significant part of the hybrid land use dataset was from the USGS 1992 National Land Cover Dataset (NLCD), the majority of this lookup table was derived from a lookup table that had previously been created to convert NLCD classes to SWAT land use classes, based on research and trial runs in SWAT. A map showing the hybrid land use coverage (converted to SWAT land use categories/codes is included as Figure 3.

The SWAT land use data was then used in conjunction with SSURGO soil data from the NRCS to create HRUs. A 10% threshold value for land use and a 10% threshold value for soil type were utilized to limit the total number of HRUs created, so that in subsequent modeling steps the HRUs could be effectively managed. This meant that if a particular land use or soil type was not did not comprise at least 10% of a sub-basin, an HRU was not created. Many of the land uses in the hybrid land use coverage represented only a very small portion of the entire modeling area (less than 1% in most cases) and less than 10% of each sub-basin; thus, only the following SWAT land use categories remained in the calibration model after the HRU delineation: AGRR, FRSD, PAST, URLD, and URMD.

After the initial creation of 464 HRUs, some additional HRUs were then manually added to the model to assure the accurate representation of parks and golf courses in the study area and to account for the land uses outside of the sub-basin boundaries but yet still inside the Accord planning area (due to the revision in the eastern boundary of the Accord planning area), for a total of 505 HRUs. The management files for park and golf course HRUs were created by starting with the default PAST management file (no grazing operations or manure application), and adding fertilizer application rates appropriate for the land use type based on various research. See section "Fertilizer Application Data" below for more detail.

Table 2
Hybrid Land Use to SWAT Land Use Look-up Table

Hybrid Land Use Value	Hybrid Land Use Description	SWAT Code	SWAT Description
1	20% - 39% (pct forest canopy)	RNGB	Range-brush
2	40% - 59% (pct forest canopy)	FRSD	Forest-deciduous
3	60% - 79% (pct forest canopy)	FRSD	Forest-deciduous
4	80% - 100% (pct forest canopy)	FRSD	Forest-deciduous
5	Residential (2000)	URMD	Residential-Medium Density
11	Open Water	WATR	Water
21	Low Intensity Residential	URLD	Residential-Low Density
22	High Intensity Residential	URHD	Residential-High Density
23	Commercial / Industrial / Transportation	UCOM	Commercial
32	Quarries / Strip Mines / Gravel Pits	RNGE	Range-grasses
41	Deciduous Forest	FRSD	Forest-deciduous
42	Evergreen Forest	FRSE	Forest-evergreen
43	Mixed Forest	FRST	Forest-mixed
81	Pasture / Hay	PAST	Pasture
82	Row Crops	AGRR	Agricultural Land - Row Crops
85	Urban / Recreational Grasses	URLD	Residential-Low Density
91	Woody Wetlands	WETF	Wetlands-forested
92	Emergent Herbaceous Wetlands	WETL	Wetlands

b) Final Land Use Scenario

A map showing the final land use scenario for the Big Darby Accord Planning area is included as Figure 4. Based on the land use descriptions for each category, a "look-up" table (Table 3) was created to convert the final land use scenario categories to the appropriate SWAT land use categories. To account for conservation development areas in SWAT, instead of creating entirely new SWAT land use categories, a revised GIS land use coverage was created to divide these conservation development areas into separate areas of range-brush and the appropriate residential land use category. The areas for the new range-brush regions were calculated cumulatively by sub-basin. Since the exact location of the open space (range-brush land use) within each conservation development area was unknown, the location of the open space areas were randomly selected within the conservation development areas and were simply drawn as circles of the correct size. A map showing this revised final land use scenario (converted to SWAT land use categories/codes) is included as Figure 5.

The addition of the following land use codes/categories in SWAT was required to accurately model the final land use scenario: URR2, URM2, PARK, and GOLF. The two new urban land use codes were created by copying existing land use categories in the urban.dat SWAT database and making revisions to the urban land use parameters as necessary (see section "Urban Land Use Parameters"). The PARK and GOLF categories were simply created by copying and renaming the PAST category from the crop.dat SWAT database.

Table 3
Final Land Use to SWAT Land Use Look-up Table

Final Land Use Scenario Land Use Description	SWAT Code	SWAT Description
Agricultural Use	AGRR	Agricultural Land - Row Crops
Riparian Corridor	FRSD	Forest-deciduous
Forest/Wooded Land	FRSD	Forest-deciduous
Active Recreation Park Land	PARK[1]	Park
Open Space	RNGB	Range-brush
Golf Course	GOLF[1]	Golf Course
Public/Institutional	URM2*	Suburban High Density
Commercial	UCOM	Commercial
Mixed Use	UCOM	Commercial
Industrial	UIDU[2]	Industrial
Transportation	UTRN	Transportation
Water Body	WATR	Water
Rural Estate (< 0.2 DU/ac)	PAST	Pasture
Rural (0.2-0.5 DU/ac)	URR2[1]	Rural residential
Residential Conservation Development 50% (0.2-0.4 DU/ac)	URR2[1] (+RNGB)	Rural residential
Residential Conservation Development 50% (1 DU/ac)	URLD (+RNGB)	Residential-Low Density
Suburban Low Density (0.5-3 DUs/ac)	URLD	Residential-Low Density
Suburban Medium Density (3 DUs/ac)	URMD	Residential-Medium Density
Suburban Medium-High Density (5 DUs/ac)	URM2[1]	Suburban High Density
Urban Medium Density (8 DUs/ac)	URM2[1]	Suburban High Density
Urban High Density (>8 DU/ac)	URHD	Residential-High Density
Special Residential LEEDS	URMD	Residential-Medium Density

[1] New SWAT land use category created

[2] UIDU land use code was not actually used in the final land use scenario model, due to the very small area of UIDU included in the final land use coverage and the land use thresholds used during the HRU delineation process

After the final land use scenario had been converted to the correct SWAT land use codes, the data was then used in conjunction with SSURGO soil data from the NRCS to create HRUs. A 3% threshold value for land use and a 12% threshold value for soil type were utilized to ensure that the land use scenario was represented effectively in the model while still limiting the total number of HRUs created. These threshold values resulted in a total of 684 HRUs being delineated for the entire modeling area.

4. Initial Groundwater Pollutant Concentrations

Initial concentrations of nitrate and soluble phosphorus in the shallow aquifer for each 14-digit HUC were entered into SWAT using data provided by the OEPA from the Big Darby Creek TMDL study. A summary of these values is shown in Table 4.

Table 4
SWAT Initial Groundwater Pollutant Concentrations

14-digit HUC	Nitrate (mg N/L or ppm)	Soluble Phosphorus (mg P/L or ppm)
Hellbranch Run (220-010)	0.5351	0.0574
BDC 4 (200-010)	0.5537	0.0601
BDC 5 (200-020)	0.4635	0.0467
BDC 6 (220-020)	0.4451	0.0440
BDC 7 (220-030)	0.4888	0.0505

5. Agricultural Data

Input parameters regarding agricultural operations were generated in collaboration with OSU and the local NRCS office. Ten different agricultural management scenarios were created within the SWAT model, consisting of various three-year crop rotations of corn, soybeans, and/or winter wheat. For each of the three years in the rotation, approximately 30% to 40% of the crops grown are corn, 50% to 60% are soybeans, and 10% are winter wheat. The total number of heat units for each plant type to reach maturity was either the SWAT default value of 1,800 heat units or that recommended by the SWAT Potential Heat Unit Program, which estimates the heat units for crops based on local weather/climate conditions:

- Corn – 1,800 heat units
- Soybeans – 1,360 heat units
- Winter wheat – 1,506 heat units

The selected values were chosen based on the ability of the calibrated model to predict crop yields that were relatively close to historical crop yield statistics for Ohio (see Table 15).

The SWAT agricultural management scenarios also included tillage practices appropriate for the modeling area, based on information provided by the NRCS. For each of the three years in the rotation, approximately 30% of the crops grown utilize fall tillage, while about 70% use conservation tillage. The ten agricultural management scenarios were applied randomly to agricultural HRUs, such that each scenario was applied to a total of approximately 10% of the area within each 14-digit HUC (or partial HUC).

6. Fertilizer Application Data

a) Crops

The fertilizer application rates for agricultural lands were based on guidelines from the report "Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa" (OSU Extension Bulletin E-2567). Values were then adjusted by about +/- 20% during the calibration process, to

better correlate with the results from the OEPA GWLF model. The final values used in the model are still within an acceptable range and generally correspond to the range of application rates observed within the local area. All fertilizer was applied as elemental nitrogen and phosphorus; Application dates were selected to correspond to the dates used by OSU in its Olentangy TMDL agricultural management files/scenarios A summary of the annual fertilizer application rates is shown in Table 5.

Table 5
SWAT Annual Fertilizer Application Rates - Crops

Crop Type	Elemental Nitrogen (kg/ha)	Elemental Phosphorus (kg/ha)
Corn	185	22
Soybean	20	15
Winter wheat	99	22

b) Livestock Manure Application

Using data provided from the OEPA for each 14-digit HUC, manure application from livestock was applied to pasture lands via both grazing operations and direct fertilizer application (manure collected from non-grazing animals year-round and from grazing animals during non-grazing seasons). All manure was applied to pasture/PAST land (versus agricultural/AGRR land), so that the amount of manure applied per unit area of pasture could remain constant for the final land use scenario model, according to the assumption that the number of livestock would increase/decrease in proportion to any increases/decreases in pasture. Grazing operation data is summarized in Table 6, while livestock manure application data is summarized in Table 7.

Table 6
Grazing Operations Data

14-digit HUC (portion within Franklin County)	Livestock Type	Number of Livestock[1]	Number of Grazing Days (Start Date)[1]	Animal Weight (kg) [1]	Dry Mass Intake/Day (% of body weight)	Total Dry Mass Intake (kg/ha/day)[5]
Hellbranch Run (220-010)	Cattle	142	244 (Apr 1)	363	2.25% [2]	1.096
	Horses	172	232 (Apr 1)	454	1.75% [3]	1.291
	Sheep	976	365 (Jan 1)	27	2.00% [4]	0.502
BDC 4 (200-010)	Cattle	40	244 (Apr 1)	363	2.25% [2]	0.920
	Horses	35	232 (Apr 1)	454	1.75% [3]	0.782
	Sheep	282	365 (Jan 1)	27	2.00% [4]	0.432
BDC 5 (200-020)	Cattle	34	244 (Apr 1)	363	2.25% [2]	0.648
	Horses	30	232 (Apr 1)	454	1.75% [3]	0.556
	Sheep	241	365 (Jan 1)	27	2.00% [4]	0.306
BDC 6 (220-020)	Cattle	68	244 (Apr 1)	363	2.25% [2]	1.717
	Horses	59	232 (Apr 1)	454	1.75% [3]	1.448
	Sheep	479	365 (Jan 1)	27	2.00% [4]	0.806
BDC 7 (220-030)	Cattle	19	244 (Apr 1)	363	2.25% [2]	0.751
	Horses	16	232 (Apr 1)	454	1.75% [3]	0.615
	Sheep	133	365 (Jan 1)	27	2.00% [4]	0.350

[1] Source: OEPA (from TMDL analysis)
[2] Source: http://ohioline.osu.edu/anr-fact/0002.html
[3] Source: http://ohioline.osu.edu/b762/b762_12.html
[4] Estimated value
[5] Calculated value: Total Dry Mass Intake = (Number of Livestock x Animal Weight x Dry Mass Intake/Day) / Total Pasture area within 14-digit HUC

Table 7
Livestock Manure Application Data

14-digit HUC (portion within Franklin County)	Livestock Type	Number of Livestock[1]	Dry Weight of Manure Produced (kg/animal/day)[2]	Total Manure Produced (kg/ha/day)[3]	Non-grazing Days/Yr[1]	Annual Non-grazing Loading (kg/ha)[4]
Hellbranch Run (220-010)	Cattle	142	6.27	0.840	121	101.7
	Horses	172	4.75	0.771	121	93.3
	Sheep	976	0.27	0.251	0	0
	Hogs	312	1.25	0.368	365	134.3
BDC 4 (200-010)	Cattle	40	6.27	0.705	121	85.3
	Horses	35	4.75	0.467	121	56.5
	Sheep	282	0.27	0.216	0	0
	Hogs	88	1.25	0.309	365	112.8
BDC 5 (200-020)	Cattle	34	6.27	0.497	121	60.1
	Horses	30	4.75	0.332	121	40.2
	Sheep	241	0.27	0.153	0	0
	Hogs	76	1.25	0.221	365	80.8
BDC 6 (220-020)	Cattle	68	6.27	1.316	121	159.3
	Horses	59	4.75	0.865	121	104.7
	Sheep	479	0.27	0.403	0	0
	Hogs	150	1.25	0.579	365	211.2
BDC 7 (220-030)	Cattle	19	6.27	0.576	121	69.7
	Horses	16	4.75	0.367	121	44.4
	Sheep	133	0.27	0.175	0	0
	Hogs	42	1.25	0.254	365	92.6

[1] Source: OEPA (from TMDL analysis)
[2] Source: Wet weights (lb/animal/day) from OEPA TMDL analysis; Converted to dry weights using conversion rates from http://www.metrokc.gov/dchs/csd/wsu-ce/agriculture/PDFs/ManureGuide.pdf
[3] Calculated value: Total Manure Produced = (Number of livestock x Dry Weight of Manure Produced) / Total Pasture area within 14-digit HUC; These values were used for the SWAT grazing operations as required; they were also then used to calculate the annual non-grazing loadings.
[4] Calculated value: Annual Non-grazing Loading = (Total Manure Produced x Non-grazing Days/Yr); These annual loadings were then separated into four separate manure application dates according to the dates and percentages used in the OEPA TMDL analysis. These dates (and corresponding percent of annual loadings) were: for cattle, Apr 1 (20%), May 1(20%), Oct 1(30%), and Nov 1(30%); for hogs, 1 (10%), May 1(10%), Oct 1(40%), and Nov 1(40%); and for horses, Jan 1 (25%), Feb 1 (25%), Mar 1 (25%), Dec 1 (25%).

c) Lawns

For the pervious parts of all urban land uses, fertilizer type, application dates, and amounts were set according to an OSU Extension Fact Sheet discussing recommended lawn fertilizer application specific to the state of Ohio. Selecting a fertilizer with an approximate 5:1:2 ratio, the 25-5-0 fertilizer from the default SWAT fertilizer database was chosen (disregarding K, since this pollutant was not specifically studied in the model). The application recommendations for similar fertilizers (24-4-8 and 24-4-12) were then utilized. The final lawn fertilizer application information used in the SWAT model is summarized in Table 8.

Table 8
SWAT Fertilizer Application Rates - Lawns

Date	25-5-0 Application (kg/ha)
May 1	98
July 1	146
Sept 1	195
Nov 1	293

d) Recreational Fields/Parks

For active recreational park lands, the fertilizer type, application dates, and amounts were based on recommendations for recreational/sports fields published by the OSU Extension and by Purdue University. First, the 24-6-0 fertilizer was selected from the SWAT database, since this most closely matched the 4:1:2 and 4:1:3 ratios recommended by the OSU Extension (disregarding K, since this pollutant was not specifically studied in the model). The dates and application rates used in the SWAT model are shown in Table 9.

Table 9
SWAT Fertilizer Application Rates - Recreational Fields/Parks

Date	24-6-0 Application (kg/ha)
Jun 1	203
Aug 20	203
Sept 20	203
Nov 20	305

e) Golf Courses

For active golf courses, the fertilizer type, application dates, and amounts were based on recommendations published by the Virginia Cooperative Extension and by the Delaware Department of Natural Resources and Environmental Control. First, the 28-10-10 fertilizer was selected from the SWAT database, since this is between the recommended 4:1:2 and 4:2:4 ratios from the Virginia report (disregarding K, since this pollutant was not specifically studied in the model). The recommended total nitrogen application rates for greens, tees, fairways, and rough areas are summarized in Table 10.

Using estimated percentages of these areas within each golf course (derived using Franklin County orthophotos), a composite annual fertilizer application rate for golf courses was then estimated as: Total Annual 28-10-10 Loading (lb/1000 sq ft/yr) = (0.05)(35) + (0.03)(14.29) + (0.70)(10.71) + (0.22)(3.57) = 10.46. Converted to kg/ha, this composite value was then divided into five equal applications of 102.1 kg/ha on May 1, May 15, June 1, June 15, and July 1.

Table 10
Recommended Annual Fertilizer Application Rates - Golf Courses

Golf Course Area	Recommended Total N (lb/1000 sq ft/yr)	Annual 28-10-10 Application (lb/1000 sq ft/yr)[1]	Estimated Percentage of Total Golf Course Area[2]
Greens	9.8	35.00	5%
Tees	4	14.29	3%
Fairways	3	10.71	70%
Rough	1	3.57	22%

[1] Calculated as Total N/0.28
[2] Estimated using Franklin County orthophotos

7. Urban Land Use Parameters

a) Build-up/Wash-off Parameters

For the impervious portions of urban lands, the build-up/wash-off algorithms within SWAT were used; however, the default values for nutrient concentrations and time to reach one-half of the maximum build-up were adjusted in order to better correspond with values used by the GWLF model. Thus, the build-up/wash-off calculations from the SWAT model more closely matched those predicted in the Big Darby TMDL analysis. Table 11 summarizes the build-up/wash-off parameters from the SWAT urban.dat file that were revised.

Table 11
Revised SWAT Build-up/Wash-off Parameters

SWAT Land Use Code	TN (ppm)	TP (ppm)	Time to Reach 1/2 Maximum Build-up (days)
URR2	1,076	136	5
URLD	2,466	312	5
URMD	3,408	431	5
URM2	4,664	590	5
URHD	5,830	738	5
UCOM	12,944	1,443	5
UTRN	14,793	1,650	5

b) Runoff Curve Numbers and Percent Impervious Values

Curve numbers and percent impervious values for various land uses within SWAT were determined based on documentation for the Natural Resources Conservation Service (NRCS) TR-55 program, which performs hydrologic calculations for small, urban watersheds. The revised

percent impervious values were implemented within SWAT by actually overwriting the CN2 values in the management files for each HRU. The revised percent impervious values were implemented by editing the default values in the urban.dat file. The CN2 and percent impervious values used are shown in Table 12.

Table 12
Revised SWAT Runoff Curve Numbers and Percent Impervious Values

SWAT Land Use Code	Description	Runoff Curve Number (CN2) by Soil Hydrologic Group				Total Impervious (%)	Directly Connected Impervious (%)
		A	B	C	D		
AGRR	Agricultural Land-Row Crops	62	71	78	81	NA	NA
FRSD	Forest-deciduous	36	60	73	79	NA	NA
PAST	Pasture	39	61	74	80	NA	NA
GOLF	Golf Course	39	61	74	80	NA	NA
PARK	Park	39	61	74	80	NA	NA
RNGB	Range-brush	35	56	70	77	NA	NA
URR2	Rural Residential	47	66	77	81	12	10
URLD	Residential-Low Density	56	71	80	85	27.5	24
URMD	Residential-Medium Density	61	75	83	87	38	30
URM2	Suburban High Density	69	80	87	90	52	48
URHD	Residential-High Density	77	85	90	92	65	49
UCOM	Commercial	89	92	94	95	85	80
UTRN	Transportation	98	98	98	98	98	95

E. Calibration/Baseline Model

The SWAT baseline model was first calibrated for flow to the USGS gage along Hellbranch Run. The calibrated model flow volumes were within 1.5 % of the USGS Hellbranch gage's values and produced R^2 values of approximately 0.7 and 0.6 for average annual and average monthly flows, respectively. The R^2 values can, in part, be attributed to several instances in the dataset where measured precipitation did not coincide with observed flow at the HB gage and vice versa.

Pollutant loads in the stream (phosphorous, nitrogen, and total suspended solids) were calculated in SWAT based on the volume of runoff and groundwater flow entering the stream in conjunction with the following inputs: fertilizer application on agricultural land, parks, golf courses and pervious portions of urban land; manure application on pasture; build-up/wash-off pollutants from impervious portions of urban land; and initial concentrations of nitrates and soluble phosphorus in the shallow aquifer. Point source pollutant loadings from OEPA's TMDL model were not entered into the model. The model was then calibrated to the EPA's GWLF model results for Total Nitrogen (TN), Total Phosphorous (TP), and Total Suspended Solids (TSS). All calibration operations were performed using data for the Hellbranch Run sub-watershed.

The parameters and values used to calibrate the baseline model are summarized in Table 13. Results of the calibration are presented in Table 14 (pollutant values are average annual loadings for the calibration period).

Table 13
Calibration Parameters

Category	Variable Name	Input File	Description	Value Used	SWAT Default Value	Minimum	Maximum	Comments	Reference for Value Used
Water Balance									
	ESCO	.bsn	Soil evaporation compensation factor	0.95	0.95	0.01	1.0	As ESCO is reduced, more evaporation occurs due to effect of capillary action, crusting and cracks in soil	SWAT ET for entire modeling area (study yrs 1-10) was compared to GWLF results for Hellbranch subwatershed (study yrs 2-10); SWAT = 52.47 cm, GWLF = 52.94 cm
	IPET	.bsn	Potential evapotranspiration method (PET)	Priestley-Taylor	NA	NA	NA	Available methods: - Priestley-Taylor method (uses solar radiation, air temperature, relative humidity) - Penman/Monteith method (uses solar radiation, air temperature, relative humidity, wind speed) - Hargreaves method (uses air temperature only)	
	SFTMP	.bsn	Snowfall temperature (degrees C)	2.5	1.0	-5	5	Mean temperature at which precipitation is equally likely to be rain as snow/freezing rain	Value used was determined by comparing annual snowfall predicted by SWAT to ODOT average annual snowfall map, which shows 30 to 40 in/yr for Franklin County (using a 1:10 rain to snow depth ratio, SWAT model yielded 34.9 in of equivalent snowfall); See http://www.dot.state.oh.us/snomap.htm
	SMFMX	.bsn	Melt factor for snow on June 21 (mm H2O/degree C - day)	3.0	4.5	NA	NA	Varies depending on land use; for rural areas, can vary from 1.4 to 6.9; for urban areas, 3.0 to 8.0; for asphalt, 1.7 to 6.5 (from SWAT manual)	
	SMFMN	.bsn	Melt factor for snow on Dec 21 (mm H2O/degree C - day)	3.0	4.5	NA	NA	Varies depending on land use; for rural areas, can vary from 1.4 to 6.9; for urban areas, 3.0 to 8.0; for asphalt, 1.7 to 6.5 (from SWAT manual)	
Surface Runoff									
	CN2	.mgt	Initial SCS runoff curve number for moisture condition II	Varies by land use type, soil hydrologic group (see Table 12)					Values used are within SWAT recommended ranges for specific land use types and soil hydrologic groups; Also utilized TR-55 as reference to set urban CNs
	SURLAG	.bsn	Surface runoff lag coefficient	1.0	4.0	NA	NA	Allows for surface runoff storage, to lag a portion of the surface runoff release to the main channel; as SURLAG decreases in value, more water is held in storage	
Baseflow/Groundwater Flow									
	ALPHA_BF	.gw	Baseflow alpha factor (days)	0.1	0.048	NA	NA	Baseflow recession constant; is a direct index of groundwater flow response to changes in recharge; Values vary from 0.1-0.3 for land with slow response to recharge to 0.9-1.0 for land with rapid response	Value obtained from SWAT baseflow separation program was 0.0335, but value calculated from equation in SWAT manual using baseflow days (BFD) was equal to 2.3/BFD = 2.3/29.88 = 0.077
	GWQMN	.gw	Threshold depth of water in the shallow aquifer required for return flow to occur (mm H2O)	150	0	NA	No maximum value	Groundwater flow to the reach is allowed only if the depth of water in the shallow aquifer is equal to or greater than GWQMN	
	GW_REVAP	.gw	Groundwater "revap" coefficient	0.175	0.02	0.02	0.2	As GW_REVAP increases, increased transfer of water from shallow aquifer to root zone occurs, allowing more water loss due to plant uptake and evaporation	
	RCHRG_DP	.gw	Deep aquifer percolation fraction	0.05	0.05	0.0	1.0	Fraction of percolation from the root zone that recharges the deep aquifer	
	REVAPMN	.gw	Threshold depth of water in shallow aquifer for "revap" or percolation to the deep aquifer to occur (mm H2O)	0.0	1.0	NA	NA		

Table 13 (continued)
Calibration Parameters

Category	Variable Name	Input File	Description	Value Used	SWAT Default Value	Minimum	Maximum	Comments	Reference for Value Used
Nutrients									
	FRT_KG	.mgt	Amount of fertilizer applied to agricultural HRUs (kg/ha)	Varies by crop type, feralizer type	0.00	NA	NA	All fertilizer applied as elemental N, P; Recommended fertilizer application rates were altered +/- 20% to calibrate to GWLF (see Table 5 for final values used)	Fertilizer application dates based on Olentangy TMDL management files/scenarios; Application rates based on "Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa" (http://ohioline.osu.edu/e2567)
	GW_NO3	.gw	Initial concentration of nirate in shallow aquifer (mg N/L or ppm)	Varies by HUC14	0.00	NA	NA		Values from TMDL study used for each HUC14 subwatershed
	GWSOLP	.gw	Initial concentration of soluble phosphorus in shallow aquifer (mg P/L or ppm)	Varies by HUC14	0.00	NA	NA		Values from TMDL study used for each HUC14 subwatershed
	NPERCO	.bsn	Nitrate percolation coefficient	1.0	0.20	0.01	1.0	Controls amount of nitrate removed from surface layer in runoff relative to amount removed via percolation; as NPERCO approaches 1.0, surface runoff has the same concentration of nitrate as the percolate	
	PPERCO	.bsn	Phosphorus percolation coefficient (10 m3/Mg)	10.0	10.0	10.0	17.5	Ratio of solution phosphorus concentration in the surface 10 mm of soil to the concentration of phosphorus in percolate	
	PHOSKD	.bsn	Phosphorus soil partitioning coefficient (m3/Mg)	175	175	NA	NA	Controls amount of phosphorus removed from surface layer in runoff via diffusion; is the ratio of soluble phosphorus concentration in the surface 10 mm of soil to that in surface runoff	
	HRU_SLP	.hru	Average slope steepness (m/m)	0.8 * SWAT default value	Varies by sub-basin	NA	NA	This value is calculated automatically by SWAT during the sub-basin delineation process, using the DEM. Since a relatively small DEM grid cell size of 15 ft was utilized, based on other research studies, the slope calculated for each sub-basin is likely greater than that actually observed.	SWAT recommendations for a calibration range for sediment indicate +/- 20% of the default slope value.
Reaches									
	ALFHA_BNK	.rte	Baseflow alpha factor for bank storage (days)	0.1	ALPHA_BF	0.0	1.0	Recession constant that characterizes bank storage recession curve; Value approaches 1.0 for flat recessions; value approaches 0.0 for steep recessions	
	CH_K1	.sub	Effective hydraulic conductivity in tributary channel alluvium (mm/hr)	11.3	0.00	NA	NA	Controls transmission losses from surface runoff as it flows to the main channel in the subbasin	Value set at 11.3 mm/hr, which is equivalent to the predominant hydraulic conductivity within the modeling area as shown in the DRASTIC dataset
	CH_K2	.rte	Effective hydraulic conductivity in main channel alluvium (mm/hr)	11.3	0.00	NA	NA	Perennial streams that simultaneously receive and lose groundwater have an effective hydraulic conductivity of zero.	For all subbasins with Big Darby Creek as the main channel, CH_K2 was set to zero; For all other subbasins (tributaries of Big Darby Creek), CH_K2 was set to 11.3 mm/hr, which is equivalent to the predominant hydraulic conductivity within the modeling area as shown in the DRASTIC dataset
	CH_N1	.sub	Manning's "n" value for tributary channels	0.05	0.014	NA	NA		
	CH_N2	.rte	Manning's "n" value for main channels	0.045	0.014	NA	NA		

Table 14
Calibration Model Results

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	TSS (kg)
USGS Hellbranch Run gage	348.7	39.8	52/48 to 70/30[1]	NA	NA	NA
OEPA's GWLF model	NA	NA	59/41[2]	212,320[3]	15,297[3]	3,085,230[3]
SWAT Baseline model	344.4	39.3	54/46	190,200	14,706	3,439,721
Percent Error	-1.2%[4]	-1.3%[4]	NA	-10.4%[5]	-3.9%[5]	11.5%[5]

mm – millimeters cfs – cubic feet per second SF/BF – surface flow/baseflow

[1] Range derived using SWAT Baseflow Separation program

[2] Published value in draft Big Darby Creek TMDL report for Hellbranch Run sub-watershed (220-010)

[3] Does not include point source data that was added outside of GWLF to yield published TMDL "Existing" pollutant loadings; GWLF data corresponds to the SWAT model's calibration period (study years 3-10, Apr 1996 through Mar 2004)

[4] Compared to USGS Hellbranch Run gage data

[5] Compared to OEPA GWLF values

In addition to the calibration results shown in Table 14, as a check to determine the relative accuracy of the parameters associated with agricultural row crops, crop yields predicted by the model were compared to crop yield statistics for Franklin County. Table 15 demonstrates that crop yields, and therefore crop parameters, are relatively accurate since the SWAT yields are generally within 10% of the historical yields for each crop type.

Table 15
SWAT Crop Yields Compared to Historical Data

Crop	Average Crop Yields for Ohio, 1997-2003 (bu/ac)[1]	Average Crop Yields for Ohio, 1997-2003 (kg/ha)[2]	SWAT Crop Yields (kg/ha), Calibrated Model
Corn	125	7,822	6,892
Soybeans	39	2,587	2,308
Winter Wheat	69	4,668	3,299

[1] Source: USDA National Agricultural Statistics Service (http://www.nass.usda.gov/Statistics_by_State/Ohio/index.asp)

[2] Conversion from bu/ac to kg/ha, assuming 56 lb/bu for corn, 60 lb/bu for soybeans and winter wheat

The results of the calibration modeling serve as the basis for comparison with the results of the final land use scenario modeling, described below. This comparison allows for a determination of the changes in pollutant loading within the study area corresponding with only the changes in land use associated with the final land use plan associated with the Big Darby Accord.

F. Final Land Use Scenario Model

The final land use scenario model was established from the baseline (calibration) model by changing the land use coverage to reflect projected build-out conditions within the Accord planning area, considering various development types and housing densities along with their location. The fundamental changes related to the final land use scenario are described below.

1. Converting existing agricultural land uses to a variety of urbanized land uses, varying from a low density (rural) residential to a commercial level of development.
2. Converting existing agricultural land uses to preserved open space (conservation areas).

For areas outside of the Accord planning area, the baseline land use data was used, since build-out conditions were not projected for these regions.

The results of the final land use scenario model along with results from the calibration model are summarized in Table 16. Data is categorized by each 14-digit HUC (or portion of) within the modeling study area. For the Hellbranch sub-watershed only, published values from the Big Darby Creek draft TMDL report are also included. To be able to compare the SWAT results to these TMDL values, additional TN and TP point source loadings that were added to the GWLF results to yield the published "Existing" pollutant loadings in the TMDL report were also added to the SWAT results. The TSS values reported in the TMDL are cumulative values that account for both sediment yield from overland runoff (predicted by the GWLF model) and a larger amount of sediment from channel degradation and construction activities (estimated by the OEPA outside of GWLF). The SWAT model, similar to GWLF, accounts only for sediment related to overland runoff. The parameters that dictate bank erosion are site specific, and this information did not exist at the time of calibration. Therefore, sediment produced by channel degradation and construction runoff was not estimated as a part of these water quality modeling efforts. TSS from construction/channel erosion is assumed to be the same as that estimated for the TMDL analysis.

TMDL allowable values for the other 14-digit sub-watersheds are not provided in the table below because the Accord planning area and, therefore, the area modeled within the SWAT analysis, does not include the entire extent of those 14-digit HUCs. As such, it is not logical to report the allowable values from the TMDL report for those areas, nor is it feasible to estimate the proportion of the published allowable values that are attributed to only a portion of the 14-digit HUC.

Table 16
Comparison of Pollutant Loading Values

Hellbranch Run (220-010)

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	Overland Runoff TSS (kg)	Construction/ Channel Erosion TSS (kg)
TMDL Existing	NA	NA	59/41	NA	16,359	3,051,200	17,594,074
TMDL Allowable	NA	NA	NA	NA	3,175	1,086,249	
SWAT Baseline model + PS	344.4	39.3	54/46	190,885	15,944	3,439,721	17,594,074
SWAT Future Land Use Scenario model + PS	369.8	42.2	62/38	113,617	4,517	1,023,087	17,594,074

PS – Point Source Loading (additional TN and TP loadings calculated by OEPA that were added to GWLF results to yield TMDL Existing values)

BDC 4 (200-010)

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	Overland Runoff TSS (kg)
SWAT Baseline model	351.7	11.0	46/54	47,985	3,938	454,960
SWAT Future Land Use Scenario model	346.6	10.8	44/56	20,019	582	184,825

BDC 5 (200-020)

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	Overland Runoff TSS (kg)
SWAT Baseline model	341.6	20.0	48/52	83,537	7,038	1,903,448
SWAT Future Land Use Scenario model	344.5	20.1	49/51	36,393	1,175	427,247

BDC 6 (220-020)

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	Overland Runoff TSS (kg)
SWAT Baseline model	331.1	37.1	50/50	163,813	16,230	8,548,723
SWAT Future Land Use Scenario model	335.1	37.6	50/50	93,456	6,840	6,858,007

Entire SWAT Modeling Area

Description	Volume (mm)	Q (cfs)	SF/BF (%)	TN (kg)	TP (kg)	Overland Runoff TSS (kg)
SWAT Baseline model	338.2	81.3	64/36	382,681	34,148	18,462,134
SWAT Future Land Use Scenario model	354.6	85.3	68/32	228,523	11,882	10,283,179

G. Conclusions

The modeling provided has been successful in duplicating the results from the TMDL study, at least for the Hellbranch Run sub-watershed. With that modeling serving as a baseline for comparison, it has been determined that the proposed land use plan for the Big Darby Accord will ultimately reduce the level of pollutants that are contained in stormwater runoff and discharged to Hellbranch Run or directly to the Big Darby Creek main stem. The percent reduction in the various pollutants for Hellbranch Run and for the larger study area is contained in Table 17, below. As expected, the increase in impervious area associated with the urbanizing land uses contained within the final land use plan will increase the calculated average annual flow rate and cause a re-distribution of the surface flow/baseflow relationship within the study area.

Table 17
Comparison of Baseline Condition to Final Land Use Plan

Pollutant	Percent Loading Reduction[1]	
	Hellbranch Run Watershed	Entire Study Area[2]
TSS[3]	70%	44%
TP	72%	65%
TN	41%	40%

[1]Compared to SWAT Baseline model
[2]Includes areas directly tributary to Big Darby Creek
[3]Pertains only to the overland runoff component of TSS

The percent reductions noted in Table 17 for the Hellbranch Run watershed are less than those specified in the TMDL to obtain the target levels for those pollutants. [Note: TN is not presented in the TMDL.] Furthermore, the comparison of TSS only pertains to the overland runoff component of that pollutant. Table 16 contains additional information relating the additional loading associated with construction activities and channel bank erosion. Considerations to reduce these individual components include comprehensive erosion and sediment control criteria and incentives to promote stream bank stabilization and/or restoration activities within the watershed.

It is important to note that the results represented by the SWAT modeling and summarized within this document represent only an analysis of land use changes within the Accord planning area and do not account for stormwater best management practices or specific site planning practices, such as low-impact design, that would further reduce pollutant loading or increase infiltration from urbanizing land uses. Other important observations regarding the modeling and the accompanying results are described below.

- The significant reduction in pollutants when comparing the final land use plan to the baseline condition can be attributed not only to the replacement of agriculture with

urbanizing land uses, but also the representation of conservation open space that is part of the plan and also replaces a considerable amount of land currently being used for agriculture.

- The analysis performed for this study did not represent the presence of field tile that exists in conjunction with agricultural land uses throughout the study area. Eliminating field tile in conjunction with changing land uses would likely reduce the change in flow rate and the surface flow/baseflow relationship.
- Stream restoration activities can have a beneficial impact on multiple facets of the modeling provided for this study. Stream restoration to add floodplain storage can mitigate the impact of increased flow associated with urbanizing areas. It can also increase the assimilative capacity of pollutants conveyed within the stream channel, particularly TSS.

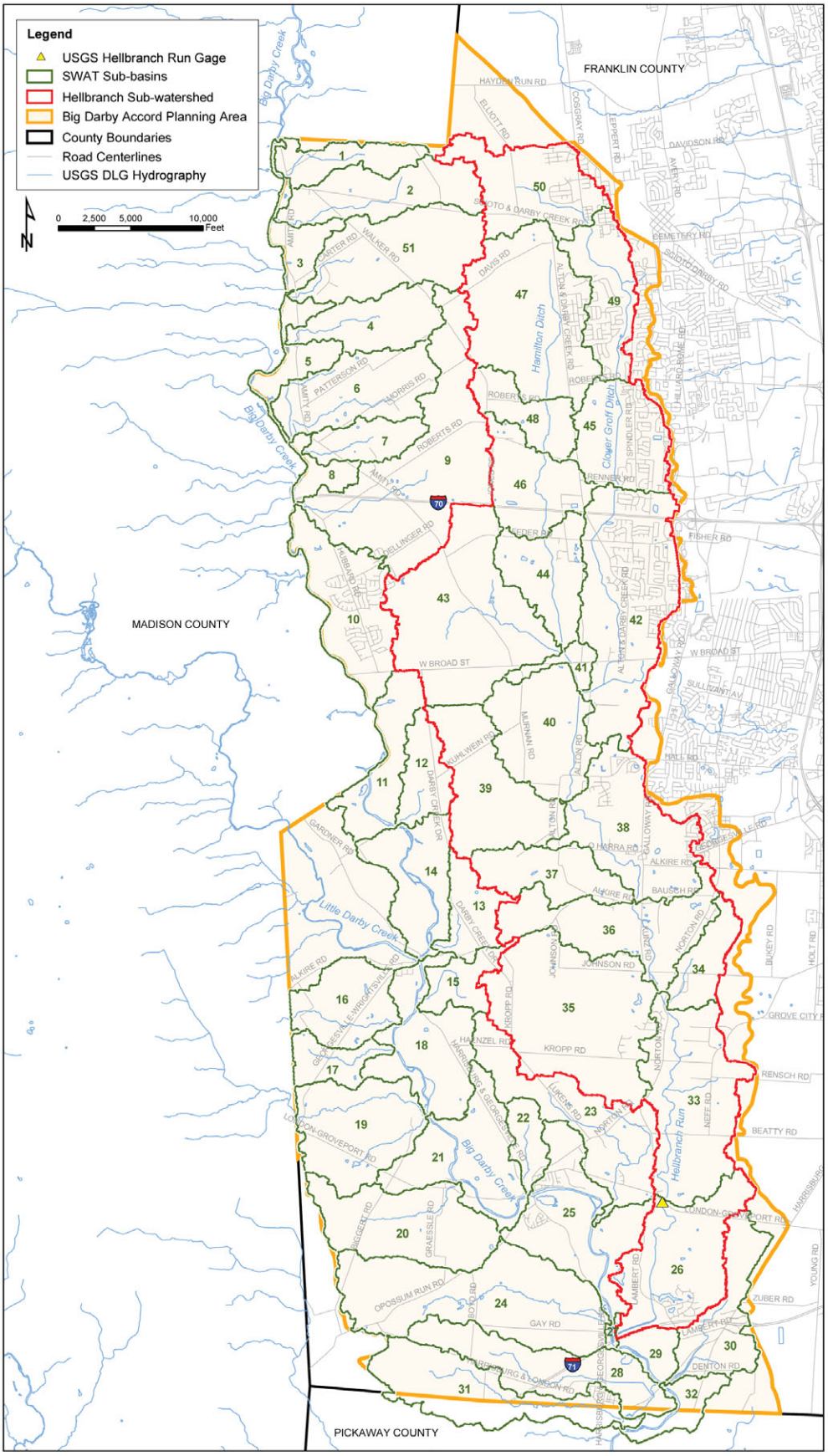


Figure 1: Modeling Study Area

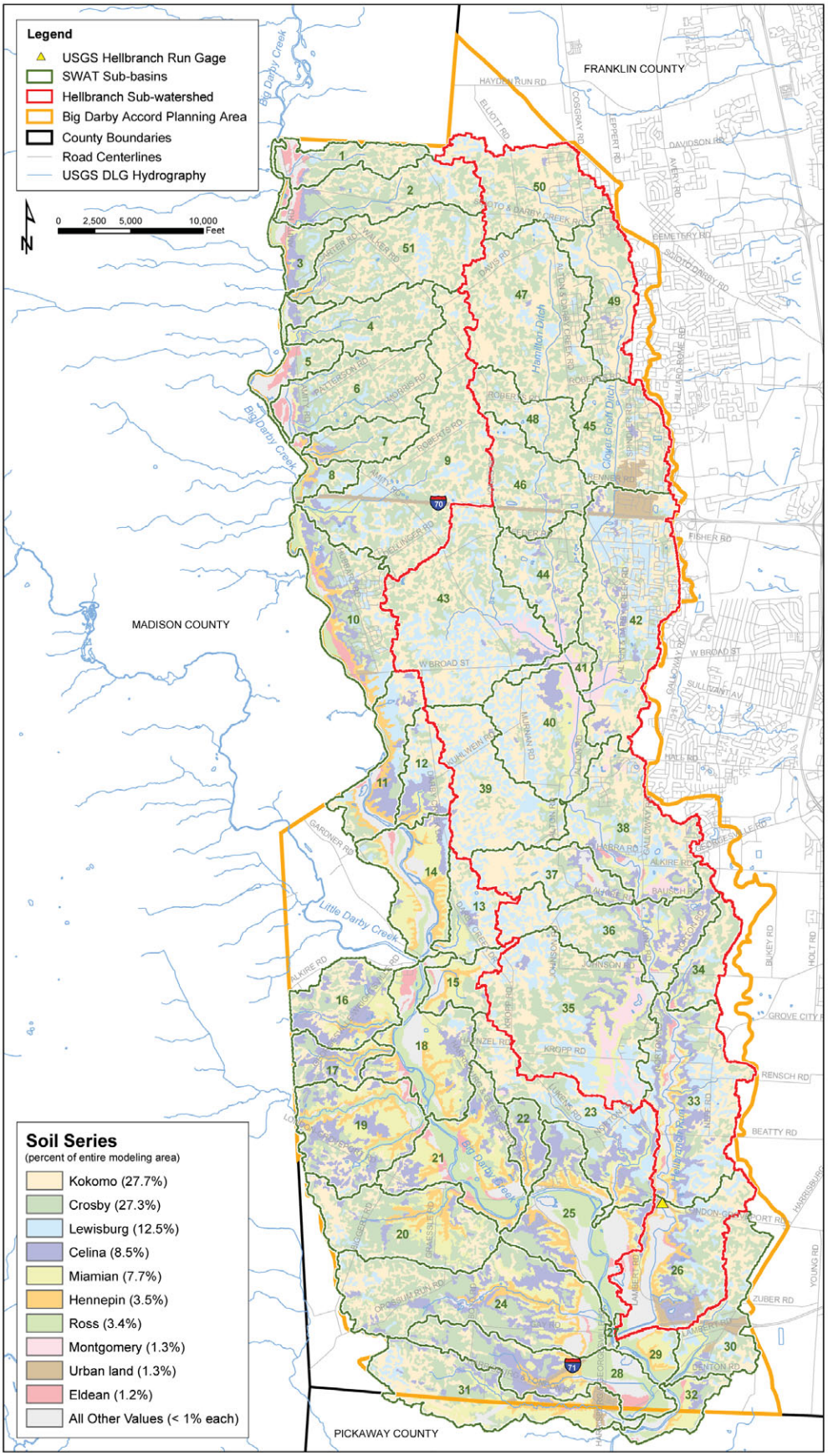


Figure 2: Soils Series (NRCS SSURGO Data)

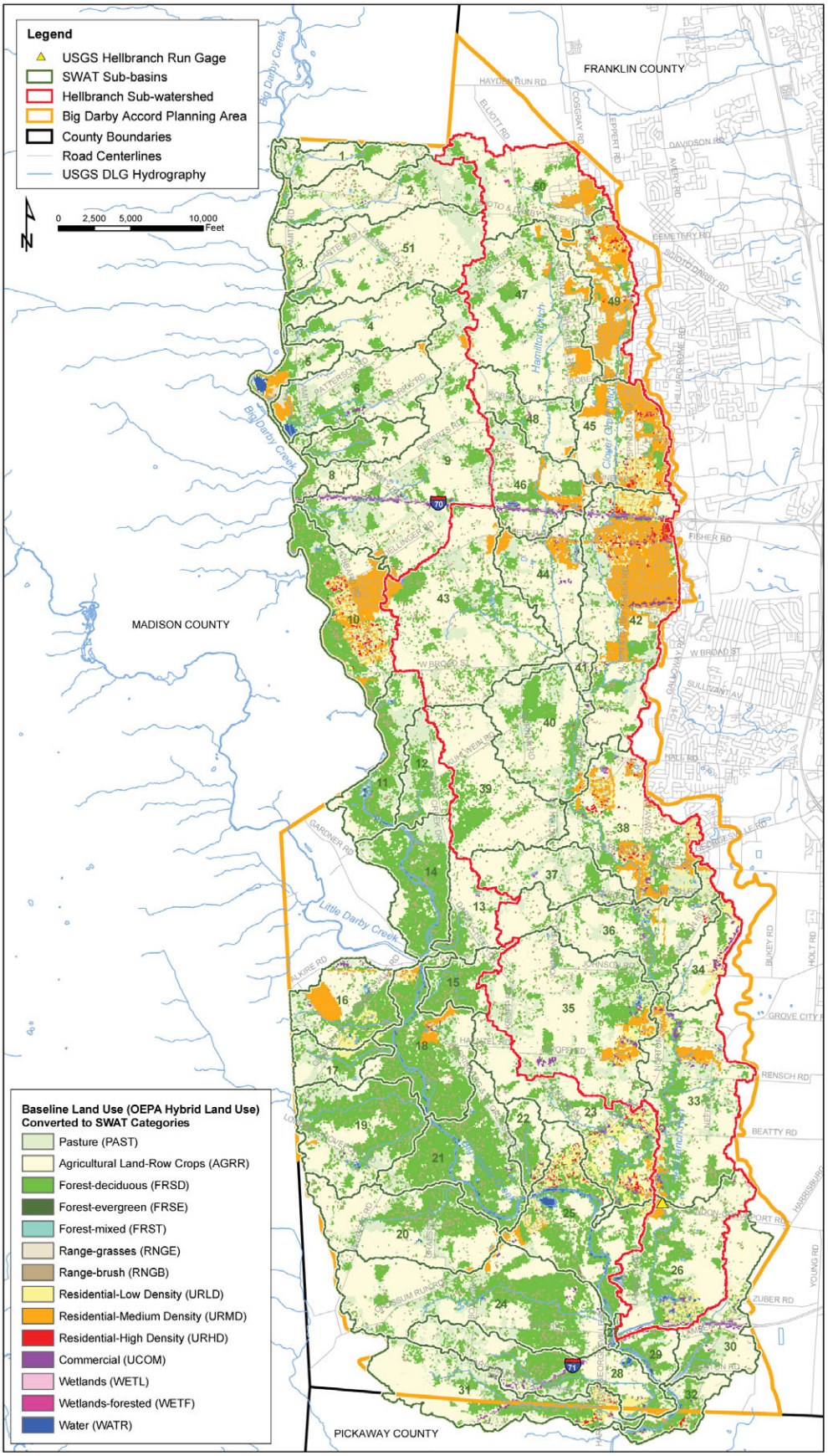


Figure 3: Baseline Land Use (OEPA Hybrid Land Use) Converted to SWAT Categories

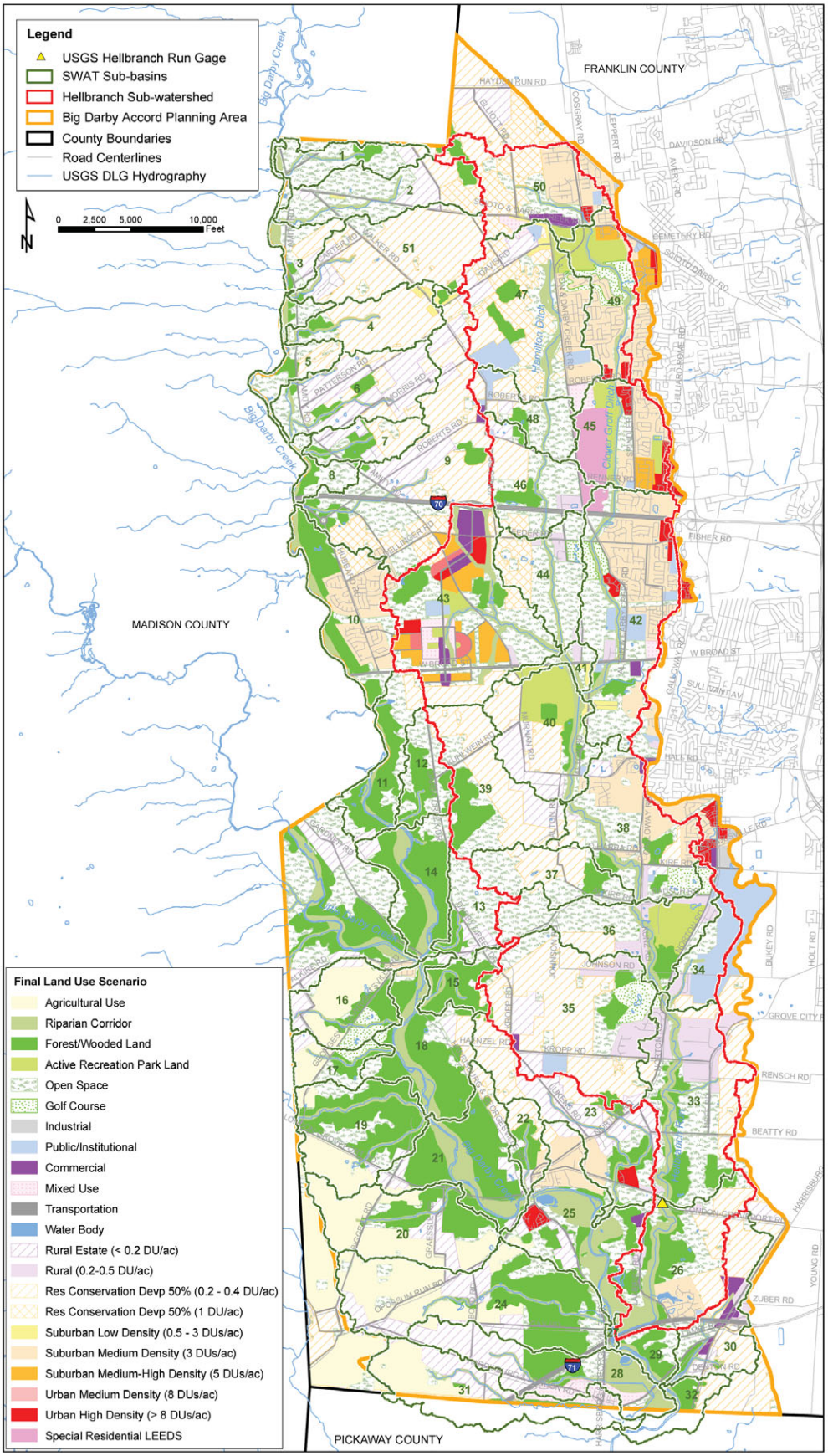


Figure 4: Final Land Use Scenario

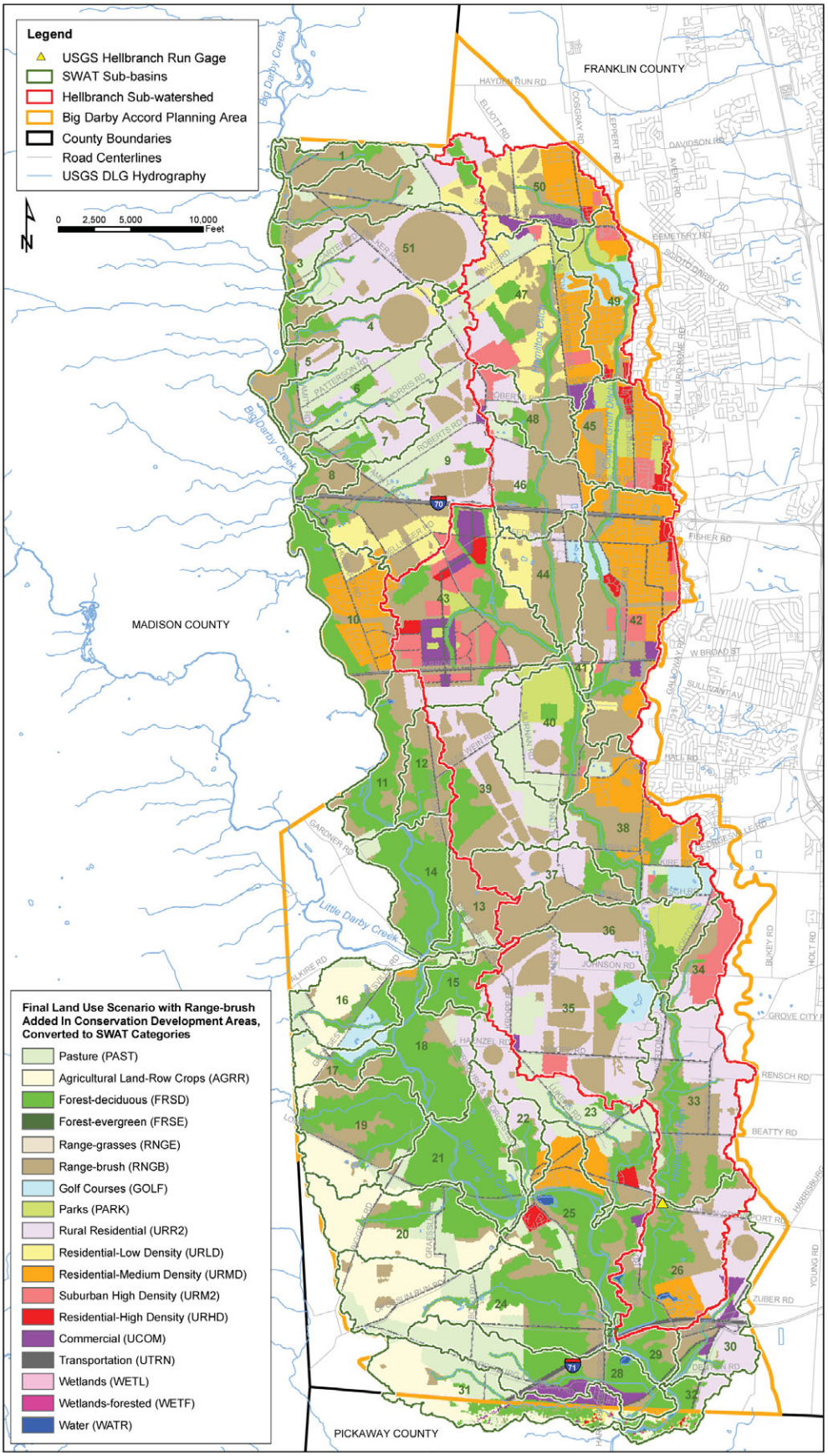


Figure 5: Final Land Use Scenario With Range-brush Added In Conservation Development Areas, Converted to SWAT Categories

Big Darby Accord
Best Management Practice Pilot Study Report

EMH&T, Inc.
June 2006

Table of Contents

A. Introduction

The SWAT model that was prepared for the final land-use plan did not include a representation of any stormwater BMPs, and the results of the modeling were compared to similar locations within the OEPA Total Maximum Daily Load (TMDL) report. For example, SWAT model results were compared to the TMDL results for the entire Hellbranch Run watershed. A pilot study was undertaken in an effort to more closely review the results of the SWAT modeling of one sub-watershed within the Hellbranch Run watershed and to provide an analysis of stormwater BMPs for the pilot study area, in this way, the pilot study analysis would examine a possible template for meeting the proposed water quality performance goals for the planning area.

The BMP pilot study was focused on the Town Center area of the most recent Darby Accord land use plan. The Town Center is located within sub-basin 43 of the overall SWAT model and is tributary to McCoy Ditch, within the Hellbranch Run watershed. Refer to Figure 1 for a representation of the pilot study area.

B. SWAT Analysis of Pilot Study Development Area

The structural BMPs that are part of the BMP Toolkit in the land use plan cannot be modeled within the SWAT model platform. Two of the non-structural BMPs that are part of the Low Impact Development parameters can be directly analyzed within SWAT: 1) a reduction in directly connected impervious area (DCIA), and 2) the use of filter strips (vegetated buffers along streams). A reduction of DCIA is indicative of a development that has less downspout to gutter to storm sewer connections and the filter strips are representative of a storm water conveyance system discharging into a dedicated stream side riparian area prior to entering a stream channel.

DCIA is represented by a percentage of the total impervious surface that is considered directly connected, for example, if a site is 20% impervious cover and the DCIA is 90%, then 90% of the 20% impervious cover is directly connected and is defined within the “urban.dat” file of the SWAT program. The SWAT manual includes information on a range of values for DCIA for different land use types based on research done on several sites in Wisconsin and Michigan (page 477 of the Input/Output File Documentation manual). The calibrated model utilizes numbers for DCIA that are close to the averages listed in the SWAT manual. For the purposes of the pilot study, the DCIA percentage was lowered to the lowest value listed in the SWAT manual for each of the urban land-use types in the pilot study area. The lowest limit for DCIA takes into account practical limitations on disconnecting impervious surfaces, for example, it is not practical to disconnect sidewalk runoff from driveway runoff, and to disconnect driveway runoff from street runoff.

The results of the reduction in DCIA, and the impact on each of the pollutants of concern, are summarized in Table No. 1. In comparing the results of the DCIA reduction modeling to the final land use plan modeling, an increase in TSS, phosphorous, and nitrogen is present. Upon further study of the modeling output, this increase is present only from the commercial areas, which is likely due to the manner in which pollutants buildup on paved surfaces before being washed off during a rain event. In general, a decrease in pollutants is realized by disconnecting impervious surfaces on all land uses except for commercial development, however, it is not enough to eliminate the need for other BMPs on the site that would have a larger impact on pollutant removal rates.

In addition to DCIA, the impact of filter strips on the pollutant loads was analyzed in SWAT. Within SWAT, a filter strip width is defined within the management file for each HRU. SWAT utilizes a simple

equation to determine the pollutant removal efficiency for a filter strip which it applies equally to total suspended solids (TSS) and nutrients (phosphorous and nitrogen). The equation is:

$$trap_{ef} = 0.367*(width_{filstrip})^{0.2967}$$

Where $trap_{ef}$ is the fraction of the pollutant loading trapped by the filter strip, and $width_{filstrip}$ is the width of the filter strip in meters

Two different widths were analyzed, 10 meters and 20 meters, and the results of this analysis are also summarized in Table No. 1 below. It should be noted that by utilizing the equation in the SWAT theory manual (pg. 325) for the removal efficiency of filter strips, a 25 meter (82 feet) wide filter strip would meet the 95% removal target for TSS, with no other BMP application. After reviewing the results of the filter strip modeling it is possible that the model is over-simplifying the processes that occur within a filter strip and, therefore, over-estimating the removal efficiency that can be achieved through their use.

Table No. 1
Summary of SWAT Modeling for Pilot Study

Scenario	TSS (kg)	% Reduction from Existing	Total P (kg)	% Reduction from Existing	Total N (kg)	% Reduction from Existing
Existing	2,302,169.14	NA	1,602.19	NA	18,260.50	NA
Final Plan	301,310.34	86.9	483.66	69.8	9,641.87	47.2
10 Meter Filter Strip	116,091.96	95.0	239.22	85.1	5,791.58	68.3
20 Meter Filter Strip	73,798.50	96.8	183.45	88.6	4,703.69	74.2
Reduced DCIA	310,159.67	86.5	516.07	67.8	9,897.37	45.8
Reduced DCIA & 20 meter filter strip	74,763.70	96.8	187.72	88.3	4,839.30	73.5

The analysis of the SWAT model output from the pilot study area is based on pollutant loading numbers from each individual HRU before they are routed and transported downstream, and should not be compared to the Hellbranch Run output that was used for calibration purposes. As runoff is routed downstream in the SWAT model attenuation of pollutant loads and runoff peak flows are accounted for, the results summarized above are prior to any of that attenuation occurring. The results presented above are useful for comparative purposes for the pilot study area, and specifically for the BMPs analyzed within the SWAT model.

C. Post-SWAT Analysis of BMPs

In order to determine which BMPs will be necessary to meet the target pollutant removal rates from the TMDL report, analysis outside of the SWAT model was performed. In 2004 the State of Georgia developed the *Georgia Stormwater Management Manual Stormwater Quality Site Development Review Tool* as a method for both designers and reviewers to determine whether or not a proposed BMP or combination of BMPs would meet the requirements for removal of TSS that the State of Georgia requires. The State of Georgia has an 80% TSS removal as their primary pollutant removal goal, and other pollutants are secondary. As part of this tool, it is possible to link multiple BMPs in sequence and determine the cumulative benefit of the "treatment train" of BMPs. As part of the tool, Georgia includes an instruction manual which includes the equations used to determine the diminishing benefit of BMPs in series. For example, if two BMPs are in series, and individually they can remove 80% of the TSS load, when placed in series the first will remove 80% of the TSS, but the second will not remove 80% of the final 20% of the TSS, which would be a total removal efficiency of 96%. The calculator determines that

two combined BMPs will remove approximately 88% of the total TSS load. The diminishing affect of the treatment train concept is attributed mostly to the finer (smaller) particles that are not captured in the initial BMP and less likely to be captured by the second. Information contained within the Georgia tool references previously determined removal efficiencies of the various BMPs, and the removal efficiencies have no correlation to land use. For example, if a Stormwater Wetland is the selected BMP, an 80% removal of TSS can be achieved regardless of the land use type that provides runoff to that feature. TSS and phosphorus (P) removal efficiencies for certain individual BMPs used within the tool are summarized in Table No. 2, below.

Table No. 2
BMP Removal Efficiencies

Structural Control	TSS Removal (%)	Total P Removal (%)
Stormwater Pond	80	50
Stormwater Wetland	80	40
Bioretention Area	80	60
Infiltration Trench	80	60
Enhanced Swales	80	50
Filter Strip	50	20
Grass Channel	50	25

The Georgia tool was used to determine which BMPs used in conjunction with one another would be able to reach the Big Darby Creek TMDL target goal of 95% removal of TSS. TSS removal was the focus for the pilot study analysis as it is the primary pollutant targeted by the design tool being used, and has the highest standard for removal in the TMDL.

Two different scenarios were considered, one utilizing BMPs that would be more likely within a residential development, and one that would be more typical of a commercial development. Both scenarios are built on the concept of a treatment train, assessing multiple BMPs applied in combination. The scenarios below are shown with multiple different removal efficiencies, starting at 80% (which is a common goal in other stormwater management guidelines), and proceeding up to the 95% goal of the TMDL. These different efficiencies require different numbers of BMPs to meet the goal, and are therefore listed in order of which BMPs are the most likely to be implemented to meet a specific goal. For example, on a residential development, if the goal were to meet 80% removal of TSS only a stormwater wetland would be needed, but if 85% were required a stormwater wetland and an enhanced swale would be necessary. This method was utilized due to ongoing discussion regarding the target for water quality protection. There is a possibility that due to the large conservation areas required in the final land use plan that a 95% removal of TSS would not be required, and that a different removal rate would become the goal for the BMPs to achieve. It is recommended that a minimum removal efficiency of 80% be used on all development sites.

The results of the treatment train analysis are presented below.

Residential Land Use Area:

- To meet 80% removal: Stormwater Wetland
- To meet 85% removal: 80% + Enhanced Swale (which reaches 88%)
- To meet 90% removal: 85% + Enhanced Swale
- To meet 95% removal: 90% + either Bioretention or an Infiltration Trench

This listing above does not take the order of the BMPs into account, which would likely be:

Bioretention to Enhanced Swale to Stormwater Wetland to Enhanced Swale

Commercial Land Use Area:

- To meet 80% removal: Bioretention
- To meet 85% removal: 80% + Infiltration Trench (which reaches 88%)
- To meet 90% removal: 85% + Filter Strip
- To meet 95% removal: 90% + Stormwater Wetland *and* an Enhanced Swale (which reaches 96%)

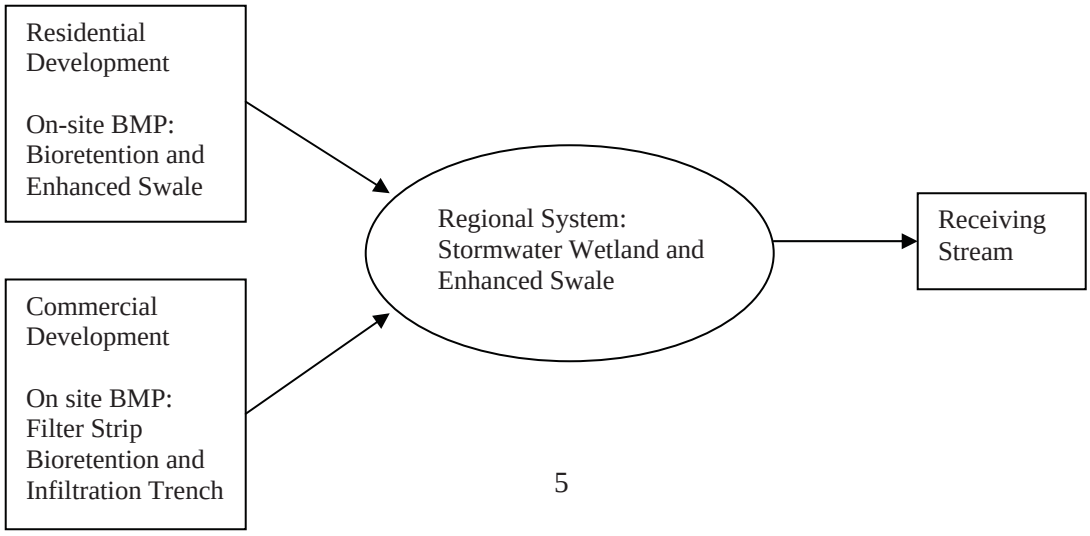
The more likely order would be:
Filter Strip to Bioretention to Infiltration Trench to Stormwater Wetland to Enhanced Swale.

D. Application of Results

As part of the final land use plan, the Town Center area is expected to be an area of high population density and a mix of different housing types and commercial uses. Projections were made about the composition and arrangement of development within the Town Center area in order to facilitate the modeling of the area for both the final land use plan model and the pilot study modeling. Figure 1 has been prepared to show the configuration of proposed land use within the Town Center area that has been used to perform the SWAT analysis of that condition. Figure 2 has been prepared to show a more detailed depiction of that proposed land use with a conceptual representation of stormwater management applications.

After comparing the results of the analysis to determine which BMPs would be necessary to meet the TMDL goal of 95% removal of TSS and the proposed conceptual configuration of the Town Center, it became apparent that it may be impractical for certain development types to incorporate all of the BMPs that would be necessary to meet the TMDL target. For example, a small commercial development site would be unlikely to have enough space to incorporate 5 separate BMPs without compromising the ability to feasibly develop the site. Furthermore, the proliferation of numerous smaller BMP applications presents a concern regarding long term maintenance and viability. These realizations, coupled with the projected development composition of the Town Center area led to the development of a more regionalized BMP implementation process. In the regional system, the stormwater BMPs that are physically larger and occupy more land area would be considered the regional BMPs that would provide for a portion of the water quality control, and much of the quantity control for a development area.

Using the BMP treatment train concept outlined above for commercial and residential development, the regional system would likely be the last two or three BMPs in the train, while the initial BMPs would be included within individual development sites, as illustrated in the diagram below.



In an effort to determine what some of these BMPs could potentially change in the appearance of different types of development, Figures 3 through 6 were created using existing developed areas within Franklin County. None of these developments is located within the planning area, nor are any retrofit projects expected from these Figures. The Figures were created for illustrative purposes only to show how development would have to be altered to incorporate a treatment train of stormwater BMPs. As development density increases it requires more creativity on the part of the site designer to incorporate some of the required BMPs, but as shown on the Figures is possible. Figures 3 through 6 show BMPs that are not primary BMPs for a site, like pervious pavement, that have the possibility to reduce the overall size of required runoff quantity control by increasing the portion of the post development runoff that is allowed to infiltrate into the soil. These secondary BMPs are shown for illustrative purposes only and will not be required, but may be encouraged, for any development.

E. Conclusions

The pilot study was undertaken to allow for a greater understanding of the impact of stormwater BMPs on the pollutant loads that are produced by urban runoff. This was done through two different methods, by analyzing results from the SWAT modeling performed for the final land use plan, and through the use of a tool developed for use in the State of Georgia to determine the BMPs necessary on a site to meet a TSS removal requirement. Based on the analysis performed, a treatment train of BMPs will likely be required to meet the current pollutant targets for the Darby Accord planning area. The information gathered regarding this treatment train method of controlling water quality led to the realization that regional stormwater BMPs have the ability to allow for a higher density development in the area tributary to the BMPs by minimizing the area required for BMPs on individual development sites.

The final land use plan indicated, and the pilot study model reinforces, that by enabling land use change, a significant reduction in pollutant loads can be achieved. This would indicate that any post-development stormwater BMPs implemented in the developed condition may not have to meet the removal efficiency shown in the TMDL. The pollutant removal requirements (for TSS and phosphorous) listed in the TMDL are from the existing condition for the planning area, and the implementation of the land use plan will likely account for a portion of the removal requirement for those pollutants. Certain land use types reduce TSS, but may increase phosphorous, and other land use types may do the opposite. The final removal efficiency required for post-development BMPs will likely vary somewhat by land use type, with sites that have a higher pollutant loading potential requiring a removal efficiency closer to the 95% required by the TMDL.

Based on the pilot study analysis, minimizing directly connected impervious areas does provide a benefit to water quality and should be encouraged, it does not eliminate the necessity for other BMPs for a site. While filter strips were shown to provide a marked decrease in the pollutant load to the streams, the results may exaggerate the actual benefit provided. So, like minimizing DCIA, it is a practice that should be encouraged, but will not eliminate the need for additional BMPs as part of the development.

Details regarding the implementation of a regional stormwater system and the related BMP treatment train must be resolved, including who constructs the regional portions of the system and the timing of the construction of the regional system in relation to the rest of the development that will be tributary to it. These issues and others will need to be addressed before any regional stormwater system is implemented within the planning area. Furthermore, more specific allowable pollutant load rates are being developed at this time to provide additional design guidance for site-specific or regional-based stormwater BMPs. .

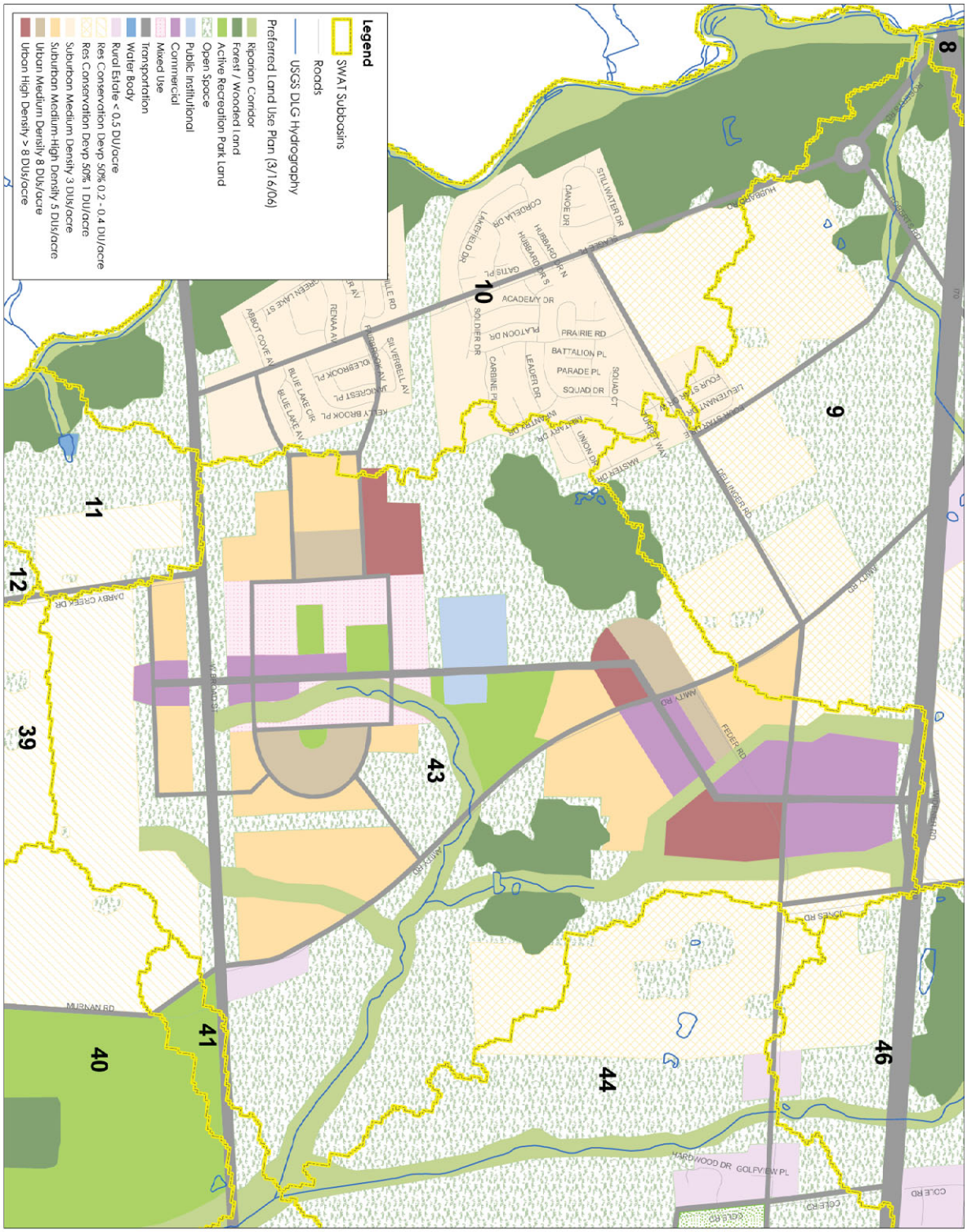


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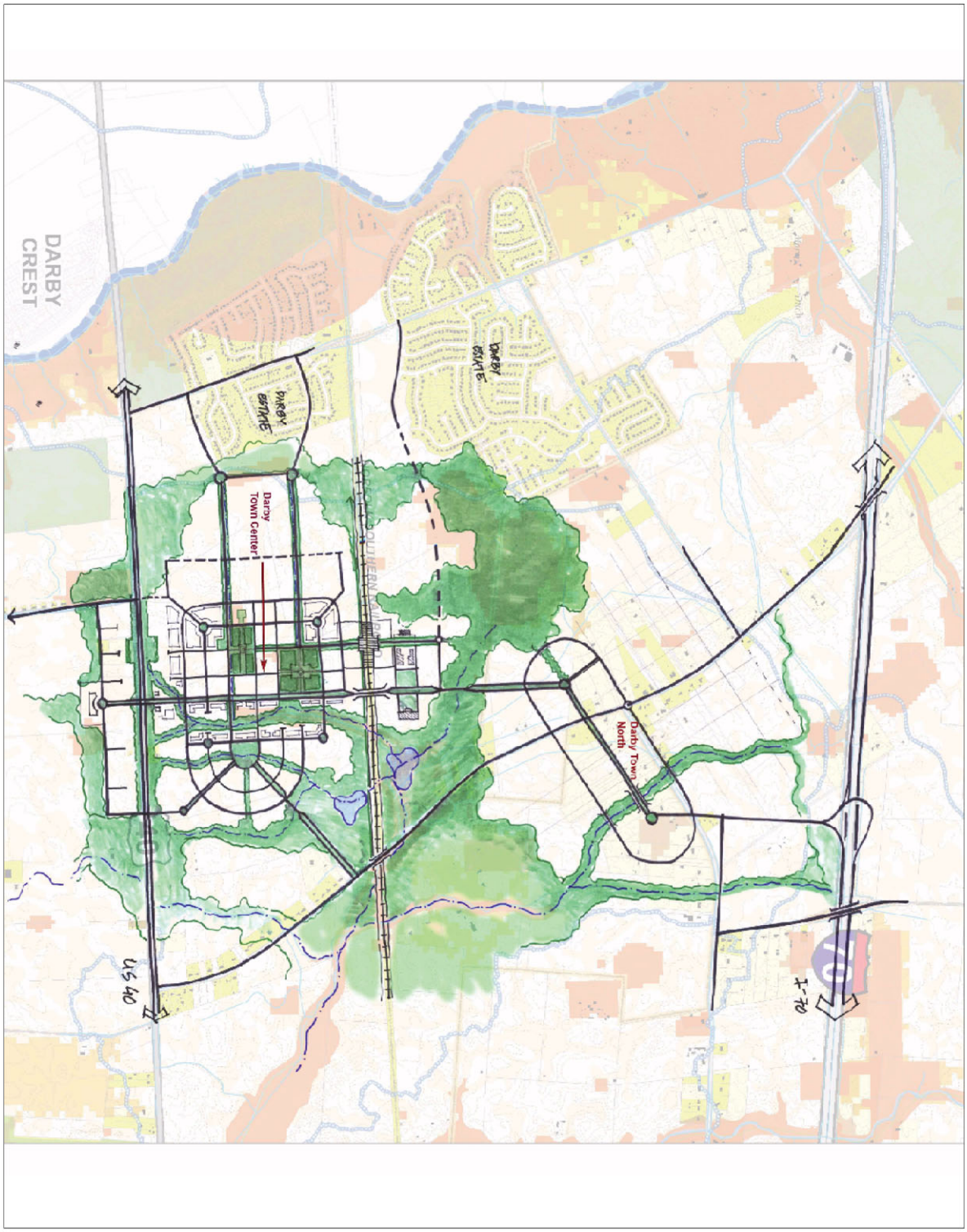
FIGURE 1
PILOT STUDY AREA
SWAT LAND USE



EDAW

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FIGURE 2
TOWN CENTER DESIGN

MEDIUM DENSITY AND MULTI-FAMILY HOUSING

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Figure 3

LOW DENSITY SINGLE FAMILY RESIDENTIAL

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Figure 4

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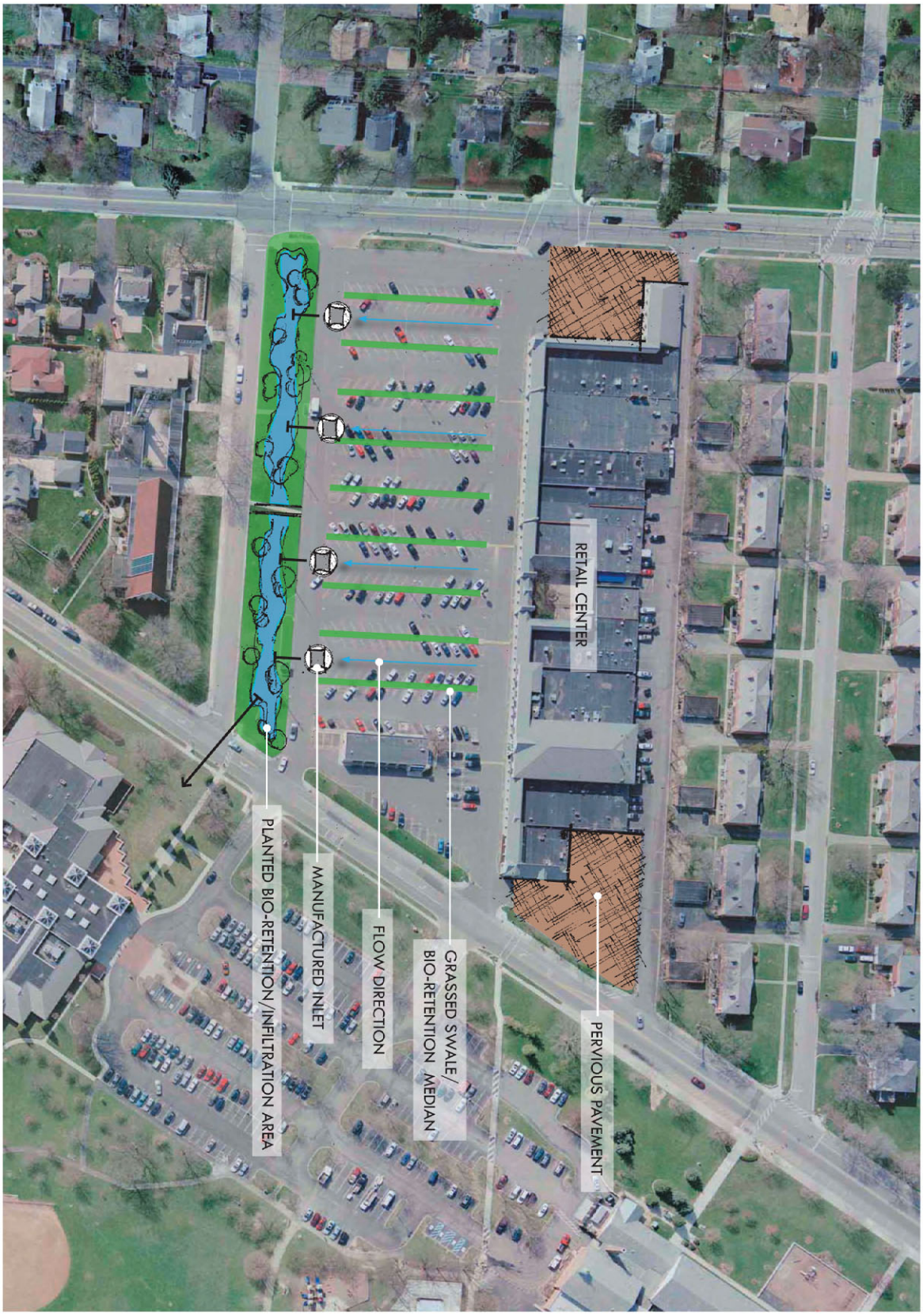
HIGH DENSITY SINGLE FAMILY RESIDENTIAL AND BIG BOX RETAIL

Figure 5



NEIGHBORHOOD RETAIL

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Figure 6

		Resource Management					Development					Recreation						Other	
Organization / Agency and Grant or Program	**Website/Contact**	Land Acquisition/Open Space/Resource Protection	Conservation Corridors	Wildlife Habitat (Rehabilitation/ Restoration)	Pollution Control/ Water Quality/Stormwater/Flood Prevention	Farmland Protection	Community and Economic Development	Facility and Service Improvements	Streetscaping	Neighborhood Revitilization / Rehabilitation	Future Planning and Ordinances	Trails	Recreational Areas or Fields	Facilities/ Amenities	Management and Maintenance	Restoration and Rehabilitation of Existing Sites	Future Planning	Education / Interpretation	General Operating Budget
Federal Agencies and Programs																			
Federal Emergency Management Agency	http://www.fema.gov/fima/planning.shtm	✓	✓	✓	✓														
National Park Service																			
Rivers, Trails, and Conservation Assistance Program	http://www.ncrc.nps.gov/rtca/	✓	✓																
North American Wetlands Conservation Act Grants Program	http://www.nature.nps.gov/water/NorthAmWetlandsConsActGrantsProgram.doc	✓	✓	✓		✓													
US Army Corp of Engineers	http://www.usace.army.mil/public.html	✓		✓	✓	✓													
US Department of Agriculture/Natural Resources Conservation Service																			
Conservation Reserve Program	http://www.fsa.usda.gov/dafp/cepd/crp.htm	✓	✓	✓	✓	✓													
Conservation Security Program	http://www.oh.nrcs.usda.gov/programs/csp_06/csp_home_2006.html		✓	✓															
Conservation Innovation Grants (CIG)	http://www.oh.nrcs.usda.gov/programs/CIG/cig2006.html																		
Emergency Conservation Program	http://www.fsa.usda.gov/pas/publications/facts/html/ecp04.htm	✓				✓													
Farmland Protection Program	http://www.info.usda.gov/nrcs/fpcp/fpp.htm	✓	✓			✓													
Grassland Reserve Program	http://www.oh.nrcs.usda.gov/programs/grp/grassland_res_2003.html	✓	✓	✓		✓													
Wetlands Reserve Program and Wetlands Reserve Enhancement Program	http://www.nrcs.usda.gov/programs/wrp	✓	✓	✓															
Wildlife Habitat Incentives Program (WHIP)	http://www.oh.nrcs.usda.gov/programs/whip/whip_2006.html	✓		✓															
Cooperative Conservation Partnership Initiative (CCPI)	http://www.oh.nrcs.usda.gov/programs/eqip/eqip2006.html																		
Environmental Quality Incentives Program (EQIP) - National	http://www.oh.nrcs.usda.gov/programs/eqip/eqip2006.html		✓		✓														
Resource Conservation and Development (RC&D) Program	http://www.oh.nrcs.usda.gov/programs/RCD/index.html	✓	✓	✓	✓														
US Department of Housing and Urban Development	http://www.hud.gov/offices/adm/grants/fundsavail.cfm#grants						✓	✓	✓	✓	✓								
US Department of the Interior	http://www.nbc.gov/cci/matrix.cfm	✓		✓						✓	✓	✓	✓	✓		✓	✓		
US Department of Transportation	http://www.fhwa.dot.gov/reauthorization/safetea.htm	✓										✓		✓	✓	✓	✓		
US Environmental Protection Agency	http://www.epa.gov/epahome/grants.htm	✓	✓	✓	✓						✓								
Water Resource Restoration Sponsor Program	www.epa.state.oh.us/defa	✓	✓	✓	✓														
Non source Program and Grants	http://www.epa.gov/owow/nps/cwact.html				✓														
US Fish and Wildlife	http://www.fws.gov/grants																		
Private Stewardship Grants	http://endangered.fws.gov/grants/private_stewardship.html	✓		✓															
State Agencies and Programs																			
Ohio Department of Natural Resources (ODNR)	http://www.dnr.state.oh.us/grants.htm																		
Division of Real Estate and Land Management																			
Natureworks	614-265-6646	✓										✓	✓			✓	✓		
Land and Water Conservation Fund	614-265-6646	✓	✓									✓	✓	✓	✓	✓	✓		
Clean Ohio Trails Fund	614-265-6477	✓										✓							
Recreational Trails Program	614-265-6477	✓	✓									✓	✓	✓	✓	✓	✓		
Division of Forestry																			
Greenworks	614-265-6657	✓	✓			✓												✓	
Recycle Ohio	614-265-6333				✓														
Division of Soil and Water Conservation																			
Agriculture Pollution Abatement Cost Sharing	Local Soil and Water Conservation District Office				✓	✓													
Pollution Abatement Toolbox	614-265-6684				✓	✓													
Non Point Source Pollution Grants	614-265-6682																	✓	
Conservation Reserve Enhancement Program (CREP)	(614) 255-2441		✓		✓														
Watershed Coordinators	614-265-6647		✓		✓														✓
Urban Streams Program	614-265-6685	✓			✓			✓			✓								✓
Division of Wildlife																			
Grassland Restoration: Pastures to Prairies	614-265-6907			✓										✓					
Wetland Restoration	614-265-6907	✓	✓		✓														
Ohio Department of Development																			
DoD website	http://www.odod.state.oh.us/																		
Community Services Block Grant	http://www.odod.state.oh.us/cdd/ocs/csbg.htm						✓	✓	✓	✓	✓								

		Resource Management					Development					Recreation						Other	
Organization / Agency and Grant or Program	**Website/Contact**	Land Acquisition/Open Space/Resource Protection	Conservation Corridors	Wildlife Habitat (Rehabilitation/ Restoration)	Pollution Control/ Water Quality/Stormwater/Flood Prevention	Farmland Protection	Community and Economic Development	Facility and Service Improvements	Streetscaping	Neighborhood Revitilization / Rehabilitation	Future Planning and Ordinances	Trails	Recreational Areas or Fields	Facilities/ Amenities	Management and Maintenance	Restoration and Rehabilitation of Existing Sites	Future Planning	Education / Interpretation	General Operating Budget
Office of Housing and Community Partnerships (grants and loans)	http://www.odod.state.oh.us/cdd/ohcp/	✔	✔	✔	✔		✔	✔	✔	✔	✔								
Ohio Environmental Protection Agency	http://www.epa.state.oh.us/cleanohio.html	✔	✔	✔	✔	✔													
Clean Ohio Fund	http://www.epa.state.oh.us/cleanohio.html	✔	✔	✔	✔	✔													
Clean Ohio Green Space Conservation Program	http://www.pwc.state.oh.us/clean_ohio.htm	✔	✔		✔		✔	✔	✔	✔	✔								
Clean Ohio Agricultural Easement Purchase Program	http://www.ohioagriculture.gov/pubs/divs/farm/farm-index.stm	✔				✔													
Clean Ohio Trails Fund	http://www.dnr.state.oh.us/cleanohiofund/admin.htm											✔	✔	✔	✔	✔	✔		
Clean Ohio Revitilization Fund	http://www.odod.state.oh.us/ud/CORF.htm	✔	✔	✔	✔		✔	✔				✔	✔	✔	✔	✔	✔		
Ohio Department of Transportation (Ohio DOT)	http://www.dot.state.oh.us/programresource/	✔	✔		✔		✔	✔	✔	✔	✔	✔			✔		✔	✔	
Ohio Emergency Management Agency (PEMA)	http://www.ema.ohio.gov/ema.asp																		
Ohio Water Development Authority	http://www.owda.org/																		
Research and Development Grant Program	http://www.owda.org/ProgramInfo/rdgrants/rdgrants.asp				✔			✔											
Private Sources and Programs/Foundations																			
Altria Group, Inc.	http://www.altria.com/responsibility/4_9_1_1_whatwefund.asp																	✔	
Balance Bar	http://mountainbike.about.com/od/bikenewsevents/a/Bgrants_comm.htm																		
Kraft Food	http://www.kraft.com/profile/cares.html#Anchor-Focus-49575																		
Captain Planet Foundation	http://www.captainplanetfdn.org/aboutUs.html																		✔
Cherokee Investment Partners	http://www.cherokeefund.com						✔	✔		✔	✔								
Doris Duke Charitable Foundation	http://www.ddcf.org/page.asp?pageId=1	✔	✔	✔	✔													✔	
Local Initiatives Support Corporation (LISC)	http://www.lisc.org										✔								
North American Association for Environmental Education	http://eelink.net/pages/Grants+-+General+Information																		
The George Gund Foundation	http://www.gundfdn.org/	✔	✔	✔	✔		✔											✔	
The Joyce Foundation	http://www.joycefdn.org/seekingagrant/seekingmain-fs.html				✔														
The John Merck Fund	http://www.jmfund.org/	✔	✔	✔	✔													✔	
Surdna Foundation	http://www.surdna.org/	✔	✔	✔	✔		✔			✔									
The Kenneth A. Scott Charitable Trust	http://www.vetmed.wsu.edu/depts-pppp/Scott.asp			✔															
The Columbus Foundation	http://www.columbusfoundation.org																		
Clean Air Task Force	http://www.catf.us/																		
The Energy Foundation	http://www.ef.org/home.cfm																		
Kodak American Greenways Awards Program	http://www.conservationfund.org						✔					✔						✔	
Environmental Support Center	http://www.envsc.org/														✔			✔	
Great Lakes Aquatic Habitat Fund	http://www.glhabitat.org/grants.html																		
Project Grants	http://www.glhabitat.org/grant1.html	✔	✔																
Technical Assistance Grants	http://www.glhabitat.org/grant1.html																		
Special Opportunity Grants	http://www.glhabitat.org/Special.html																		
Theme Grants	http://www.glhabitat.org/grant2.html																		
Invasive Species Grants	http://www.glhabitat.org/nuisance.html			✔															
Great Lakes National Program Office of the National Fish and Wildlife Foundation	http://www.epa.gov/glnpo/fund/glf.html																		
Institute for Conservation Leadership	http://www.icl.org/																		
National Wildlife Federation	http://www.nwf.org/																		
River Network	http://www.rivernetwork.org/library/index.cfm?doc_id=114	✔	✔																
State Environmental Leadership Program (SELP)	http://www.selp.org/	✔	✔																
The Wege Foundation	http://www.healingourwaters.org/																		
Rural Action	http://www.ruralaction.org/																		
Smart Growth America (SGA)	http://www.smartgrowthamerica.org	✔									✔								

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Columbus Comprehensive Plan, 1993

The Darby Accord recognizes the following organizations for contributing photos for the Big Darby Accord Plan:
The Darby Creek Association
The Nature Conservancy
Metro Parks

Inventory of GIS Data for Darby Creek Watershed

Category	Data Layer	Spatial Extent	Data Type	Feature Type	Date of Material	Data Source
Aerial photography	Orthophotos (b/w)	Western part of Franklin County	.sid image	N/A	2000	Franklin County Auditor
	USGS Orthophotos (color)	Darby watershed	GeoTIFF	N/A	May 2002	USGS website
Base Map	Address ranges	Franklin County	shapefile	Line	2005	Franklin County Auditor
	Addresses of parcel owners	Franklin County	shapefile	Point	2005	Franklin County Auditor
	Buildings (only roofed structures)	Franklin County	shapefile	Line	2005	Franklin County Auditor
	Parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Airport parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Cemetery parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Condo parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Golf course parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Health services parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Hopsital parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Misc. parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Notable building parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Parks and recreation center parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Police and fire departments parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Service-related parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Retirement center parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	School parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Shopping center parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Subdivision parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Tall building parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Venue parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Worship center parcels	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Railroads	Franklin County	shapefile	Line	2005	Franklin County Auditor
	Road centerlines	Franklin County	shapefile	Line	2005	Franklin County Auditor
	Roads	Franklin County	shapefile	Line	2005	Franklin County Auditor
	School districts	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Structures (all man-made feaures/structures as seen in orthophotos)	Franklin County	shapefile	Line	2005	Franklin County Auditor
	Subdivisions (points)	Franklin County	shapefile	Point	2005	Franklin County Auditor
	Tax districts	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Zipcodes	Franklin County	shapefile	Polygon	2005	Franklin County Auditor

Inventory of GIS Data for Darby Creek Watershed

Category	Data Layer	Spatial Extent	Data Type	Feature Type	Date of Material	Data Source
	Bikeways	MORPC	shapefile	Line	Unknown	MORPC
	Parks, Golf Courses, Cemeteries	MORPC	shapefile	Polygon	Unknown	MORPC
	School districts	MORPC	shapefile	Polygon	Unknown	MORPC
	ODOT Road centerlines - interstates, US highways, state routes	Ohio	shapefile	Line	2004	ODOT
	ODOT Road centerlines - county & township roads	Ohio	shapefile	Line	2004	ODOT
	ODOT Road centerlines - municipal roads	Ohio	shapefile	Line	2004	ODOT
	City of Columbus parks	City of Columbus	shapefile	Polygon	Unknown	City of Columbus, Parks & Recreation
	City of Columbus recreation centers	City of Columbus	shapefile	Point	Unknown	City of Columbus, Parks & Recreation
	City of Columbus senior centers	City of Columbus	shapefile	Point	Unknown	City of Columbus, Parks & Recreation
	City of Columbus hospitals	City of Columbus	shapefile	Point	2005	City of Columbus
	City of Columbus neighborhood health centers	City of Columbus	shapefile	Point	2005	City of Columbus
	City of Columbus urgent care centers	City of Columbus	shapefile	Point	2005	City of Columbus
	City of Columbus police stations	City of Columbus	shapefile	Point	2005	City of Columbus
	City of Columbus fire stations	City of Columbus	shapefile	Point	2005	City of Columbus
	Parcels (DUPLICATE DATA)	Townships within Franklin County	shapefile	Polygon	Unknown	Franklin County
Cultural Resources	National Register sites	Study area	shapefile	Point	2005	Ohio Historical Preservation Office (OHPO)
	Ohio Archaeological Inventory (OAI) sites	Study area	shapefile	Point	2005	Ohio Historical Preservation Office (OHPO)
	Ohio Historical Inventory (OHI) sites	Study area	shapefile	Point	2005	Ohio Historical Preservation Office (OHPO)
	Previously Surveyed Areas (PSA)	Study area	shapefile	Polygon	2005	Ohio Historical Preservation Office (OHPO)
Demographics	Population change - 1990 to 2000	Darby watershed	shapefile	Polygon	2000	Benjamin Webb, Darby Creek Watershed Coordinator
	US Census 2000 Data	Franklin (39049), Madison (39097), and Pickaway (39129) Counties	shapefiles, tables	Polygon	2000	ESRI Geography Network
Environmental Resources	Agency & non-profit preserved land	Darby watershed	shapefile	Polygon	2004	ODNR, Division of Natural Areas and Preserves
	Franklin County easements	Franklin County	shapefile	Polygon	Unknown	MORPC
	Environmental Conservation District (ECD) grid	N/A	shapefile	Polygon	Unknown	MORPC
	Environmentally Sensitive Development Area (ESDA) boundary	N/A	shapefile	Polygon	Unknown	OEPA
	Environmentally Sensitive Development Area (ESDA) boundary	N/A	shapefile	Polygon	Unknown	City of Columbus
	Environmentally Sensitive Development Area (ESDA) grid	N/A	shapefile	Polygon	Unknown	MORPC
	Historic vegetation	Darby watershed	.jpg image	N/A	Unknown	ODNR

Inventory of GIS Data for Darby Creek Watershed

Category	Data Layer	Spatial Extent	Data Type	Feature Type	Date of Material	Data Source
	Biological Water Quality Indices - Bugs	Darby watershed	shapefile	Point	2004	Benjamin Webb, Darby Creek Watershed Coordinator (created using OEPA Sampling Data, 1977-2002)
	Biological Water Quality Indices - Fish	Darby watershed	shapefile	Point	2004	Benjamin Webb, Darby Creek Watershed Coordinator (created using OEPA Sampling Data, 1979-2003)
	Biological Water Quality Indices - Sampling Trends	Darby watershed	shapefile	Point	2004	Benjamin Webb, Darby Creek Watershed Coordinator (created using OEPA Sampling Data, 1979-2003)
	Water quality attainment, Aquatic life use designations	Darby watershed	shapefile	Line	2004	Benjamin Webb, Darby Creek Watershed Coordinator (created using OEPA Sampling Data, 2001-2002)
	Public water supplies	Franklin County portion of Darby	shapefile	Point	2004	OEPA
	National Wetland Inventory (NWI)	Study area	scanned images (.tif)	N/A	1985	US Fish & Wildlife Service
	Ohio Wetland Inventory (OWI)	Franklin County	shapefile	Polygon	1987	ODNR website
	NPDES Point Sources	Darby watershed	shapefile	Point	2004	OEPA
	Riparian cover	Darby watershed	shapefile	Line	2004	Benjamin Webb, Darby Creek Watershed Coordinator
	Natural Heritage Database	Study area	shapefile	Polygon	2005	ODNR, Division of Natural Areas and Preserves
	Managed Areas	Study area	shapefile	Polygon	2005	ODNR, Division of Natural Areas and Preserves
	Scenic Rivers	Study area	shapefile	Line	2005	ODNR, Division of Natural Areas and Preserves
	Metro Parks land holdings	Western part of Franklin County	shapefiles (derived from AutoCAD)	Polygon, Line	2005	Metro Parks
Floodplains	FEMA 100-yr boundary	Franklin County	shapefile	Polygon	1978	ODNR website
	FEMA floodway	Franklin County	shapefile	Polygon	1978	ODNR website
	FEMA other flood hazard areas	Franklin County	shapefile	Polygon	1978	ODNR website
	Flooding potential (USGS & NRCS)	Franklin County	shapefile	Polygon	1978-79	ODNR website
	Inventory of structures at risk of flooding	Franklin County	shapefile	Point	1995	ODNR website
	USGS flood prone areas	Franklin County	shapefile	Polygon	1978	ODNR website
Geology	Bedrock geology	Franklin County	shapefile	Polygon	1958	ODNR website
	Depth to bedrock	Franklin County	shapefile	Polygon	1979	ODNR website
	Glacial geology	Franklin County	shapefile	Polygon	1958	ODNR website
	Ground water pollution potential	Franklin County	shapefile	Polygon	1995	ODNR website
	Ground water resources	Franklin County	shapefile	Polygon	1993	ODNR website
	Limitations for large scale development	Franklin County	shapefile	Polygon	1958-79	ODNR website
	Oil and gas well location database	Franklin County	.dbf	N/A	2004-05	ODNR website

Inventory of GIS Data for Darby Creek Watershed

Category	Data Layer	Spatial Extent	Data Type	Feature Type	Date of Material	Data Source
Hydrography	Lakes	Ohio	shapefile	Polygon	Unknown	ODOT
	Rivers	Ohio	shapefile	Line	Unknown	ODOT
	Lakes, rivers, streams	Franklin County	shapefile	Line	2005	Franklin County Auditor
	National Hydrography Dataset (NHD)	Scioto River watershed	GDB	N/A	2005	USGS NHD website
	USGS Digital Line Graphs (DLGs)	Franklin County	shapefile	N/A	(as per USGS topo maps)	USGS
Land Use	1976 Land Use/Land Cover	Franklin County	shapefile	Polygon	1976	ODNR website
	1992 National Land Cover Dataset (NLCD) - USGS	Darby watershed	grid	N/A	1992	USGS NLCD website
	1994 Land Cover	Franklin County	shapefile	Polygon	1994	ODNR website
	1998 Land Use/Land Cover	Franklin County	shapefile	Polygon	1998	ODNR website
	2005 Existing Land Use (auditor's parcel data)	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Hybrid Land Use Data	Darby watershed	ARC/INFO Coverage, Raster (with corresponding layer file)	N/A	Various	Benjamin Webb, Darby Creek Watershed Coordinator
	Existing and Future land use	Franklin County	shapefile	Polygon	Unknown	MORPC
	Existing and Future land use	Madison County	shapefile	Polygon	Unknown	MORPC
	Existing land use	Pickaway County	shapefile	Polygon	Unknown	MORPC
	Future land use	Pickaway County	shapefile	Polygon	Unknown	MORPC
	Existing and Future land use	Union County	shapefile	Polygon	Unknown	MORPC
	Prime farmland	Franklin County	shapefile	Polygon	1979	ODNR website
	Development - Commercial (through May 2005)	Franklin & Delaware Counties	shapefile	Point	2005	MORPC
	Development - Residential (through May 2005)	Franklin & Delaware Counties	shapefile	Point	2005	MORPC
Planning Data	Airport noise levels	City of Columbus	shapefile	Polygon	2005	City of Columbus
	Hellbranch planning overlay	City of Columbus	shapefile	Polygon	2005	City of Columbus
	Hellbranch planning overlay (DUPLICATE DATA)	City of Columbus	shapefile	Polygon	2005	City of Columbus
	Northwest corridor boundary	City of Columbus	shapefile	Polygon	2005	City of Columbus
	Westland area plan - adopted 1994	City of Columbus	shapefile	Polygon	2005	City of Columbus
	West Columbus Interim Development Concept - adopted 1991	City of Columbus	shapefile	Polygon	2005	City of Columbus
Political Boundaries	City boundaries	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Township boundaries	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
	Corporate Boundaries	Franklin County	shapefile	Polygon	Unknown	Franklin County
	County boundaries	Ohio	shapefile	Polygon	Unknown	ODOT
	Historical township boundaries	Franklin County	shapefile	Polygon	2005	Franklin County Auditor

Inventory of GIS Data for Darby Creek Watershed

Category	Data Layer	Spatial Extent	Data Type	Feature Type	Date of Material	Data Source
	Neighborhood boundaries	Franklin County	shapefile	Polygon	2005	Franklin County Auditor
Soils Data	SSURGO	Franklin County	shapefile	Polygon	1980	NRCS website
	Hydric soils	Study area	shapefile	Polygon	1980	EMHT created from SSURGO data
Topography	2-ft contours - Franklin County	Study area	shapefile	Line	2005	Franklin County Auditor
	5-ft contours - Madison County	Madison County	shapefile	Line	Unknown	Madison County GIS website
	National Elevation Dataset (NED) 1-arc second resolution	Darby watershed	grid	N/A	Created 1999	USGS website
	National Elevation Dataset (NED) 1/3-arc second resolution	Western part of Franklin County	grid	N/A	Created Oct 2003	USGS website
	Spot elevations	Franklin County	shapefile	Point	2005	Franklin County Auditor
Transportation	Franklin County 2020 Thoroughfare Plan - Draft	Franklin & Delaware Counties +	shapefile	Line	2005	MORPC
	City of Columbus Thoroughfare Plan	City of Columbus	shapefile	Line	2005	City of Columbus
	Transportation Improvement Plan (TIP), FY 2006-2009 (July 1, 2005 to June 30, 2009)	Franklin & Delaware Counties +	shapefiles	Various	Unknown	MORPC
	Transportation Plan - 2030 (TPLAN)	Franklin & Delaware Counties +	shapefiles	Various	Unknown	MORPC
	ODOT Road centerlines - interstates, US highways, state routes (contains some ADT data)	Ohio	shapefile	Line	2004	ODOT
	Traffic Analysis Zones (TAZ) with incremental 30-yr forecast data	Franklin County +	shapefile	Polygon	2000	MORPC
Utilities	Sewer service areas	Darby watershed	shapefile	Polygon	2004	Benjamin Webb, Darby Creek Watershed Coordinator
	Proposed Facility Planning Area (FPA) for City of Columbus	N/A	shapefile	Polygon	Unknown	MORPC
	Community Planning Areas	Franklin County +	shapefile	Polygon	Unknown	City of Columbus
	Marysville existing sewer area	N/A	shapefile	Polygon	Unknown	MORPC
	Pickaway future sewer area	N/A	shapefile	Polygon	Unknown	MORPC
	Union sewer service area	N/A	shapefile	Polygon	Unknown	MORPC
	Water and Wastewater Treatment Plants - DATA INCORRECT	MORPC	shapefile	Point	Unknown	MORPC
	City of Columbus Sewer Lines (DOSD)	Study area	shapefile	Line	Unknown	City of Columbus
	City of Columbus Sewer Nodes (DOSD)	Study area	shapefile	Point	Unknown	City of Columbus
	City of Columbus utility data (SECAP project) - sewer lines (sanitary, storm, combined)	City of Columbus	shapefiles	Line	2005	EMHT
	SECAP - sanitary sewers (including combined) 18" and larger	City of Columbus	shapefile	Line	2005	EMHT
	SECAP - sanitary sewers (including combined) main trunk lines only	City of Columbus	shapefile	Line	2005	EMHT
	SECAP - service boundary area	City of Columbus	shapefile	Polygon	2005	EMHT
	SECAP - sewersheds	City of Columbus	shapefile	Polygon	2005	EMHT
	SECAP - pump stations	City of Columbus	shapefile	Point	2005	EMHT

Inventory of GIS Data for Darby Creek Watershed

Category	Data Layer	Spatial Extent	Data Type	Feature Type	Date of Material	Data Source
	SECAP - contract entities	City of Columbus	shapefile	Polygon	2005	EMHT
	City of Hilliard water lines	City of Hilliard	shapefile	Line	2005	City of Hilliard
	City of Hilliard sanitary sewer lines	City of Hilliard	shapefile	Line	2005	City of Hilliard
	City of Hilliard storm sewer lines	City of Hilliard	shapefile	Line	2005	City of Hilliard
Watersheds	8-digit watersheds, USGS	Ohio	shapefile	Polygon	1996	Created from Detailed Ohio watersheds file
	11-digit watersheds, NRCS	Ohio	shapefile	Polygon	2005	Ohio NRCS website
	14-digit watersheds, NRCS	Ohio	shapefile	Polygon	2005	Ohio NRCS website
	Detailed Ohio watersheds, USGS	Ohio	shapefile	Polygon	1996	ODNR website
	Darby Creek watershed	Darby watershed	shapefile	Polygon	1997-99	Created by Ben Webb using NRCS 14-digit watersheds
	Darby Creek watershed (DUPLICATE DATA)	Darby watershed	shapefile	Polygon	1997-99?	Unknown - created using NRCS 14-digit watersheds
	Darby Creek watershed, with 14-digit subwatersheds	Darby watershed	shapefile	Polygon	1997-99?	Unknown - created using NRCS 14-digit watersheds
Zoning	Township zoning map	Townships within Franklin County	shapefile	Polygon	2005	Franklin County
	Prairie Township zoning map	Prairie Twp	shapefile	Polygon	2005	Franklin County
	Washington Township zoning map	Washington Twp	shapefile	Polygon	2005	Franklin County
	City of Columbus zoning map	City of Columbus	shapefile	Polygon	2005	City of Columbus
	City of Hilliard zoning map	City of Hilliard	shapefile	Polygon	2005	City of Hilliard

Big Darby Accord Advisory Panel
Development Review Checklist - Concept

Project Information

Location	(Requested) Zoning	Use(s)	Acreage	Sq Ft or Number of Units	Proposed Density	Permitted Density	Open Space Required	Public Parkland Provided	Public Parkland Required

Water Quality / Conservation	yes	no		Details / Comments
Incorporates BMPs in Site Plan to achieve TMDL Requirements				
Protects Tier 1 Land				
Protects Tier 2 Land				
Protects Tier 3 Land				
Protects Stream Corridor Protection Zone				
Incorporates Stream Restoration				
Incorporates Site Monitoring of Water Quality				
Incorporates Low Impact Development Techniques				
Provides Open Space that Links with Adjacent Open Space Areas				
Incorportes Permanent Easements to Protect Open Space Land				
Meets and Complies with all Ohio EPA Requirements				
Meets Sewage System requirements				
Provides Necessary Performance Bond for Monitoring and Open Space Areas				
Provides Necessary Measures for Site-level Monitoring				

Development	yes	no		Details / Comments
Incorporates Principles of Conservation Development				
Incorporates Principles of Town Center Development				
Incorporates Principles of LEED ND				
Land use is Consisitent with Darby Accord Plan				
Proposed Density is Consistent with Darby Accord Plan				
Incorporates Required Public Facilities				
Provides Trail Linkages				
Provides Revenue Toward achieving the Darby Accord Plan				
Provides Required Transportation Improvements				

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Stormwater Utility

A stormwater utility is a special assessment set up to generate funding specifically for stormwater management. Users within the utility pay a stormwater fee and the revenue generated from the fee is used to support maintenance and upgrades to the existing storm drain system, the development of drainage plans, water quality programs, and to cover administrative costs. Communities in Ohio are increasingly examining the option of stormwater utilities for use in funding stormwater management and water quality programs in order to keep up with the requirements of the NPDES Phase II program. The shift towards stormwater utility funding addresses the need for a consistent source of revenue. The Accord should consider a stormwater utility as another funding option for implementing the Plan.

Stormwater utilities are often a preferred funding method due to limited resources available to cities and counties to meet the general government needs related to implementation of the NPDES Phase II program. The utility generates additional funds directly targeted to address the increasing requirements of stormwater management programs. The revenues generated by the utility are constant, gradually increasing with the community's growth and rate structure. The constant income directed toward the stormwater program allows for programmatic stability, supports the stormwater staff, and provides for continued maintenance and monitoring operations. Bonds for capital improvements can also be issued to facilitate construction of stormwater management infrastructure, using the revenues generated by the utility to pay back those bonds.

Establishing the Utility Fee Structure

The utility fee is related to the amount of runoff that a parcel of land contributes to the overall stormwater condition. The fee structure includes an option for credits through stormwater quantity reduction or water quality improvement, providing an incentive for developers of commercial (and industrial) properties to consider methods for reducing pervious area.

Most stormwater utilities base the user fees at least in part on the percentage of impervious cover of the parcels of developed land within the community. For simplicity, many utilities charge a flat rate for residential properties and then assess commercial and industrial properties based upon the actual impervious area within their parcel. The stormwater fee is frequently included as a line item within the water and sewer bill.

The revenue that could be generated by a stormwater utility would be dependant upon the number of parcels and the stormwater rate fee. Residential users are typically charged a base rate per equivalent residential unit (ERU), representing an "average" amount of imperviousness for a residential lot. This base fee typically ranges from $2 to $5 per month, per ERU. Non-residential users are typically charged per square footage of impervious area. A rate of 2.5 ERU per commercial parcel is an average that can be used for revenue approximation.

The first step in creating a stormwater utility is the evaluation of the number of equivalent residential units and the delineation of the impervious area. A comprehensive rate study may be completed to determine the revenue needs to support the community's stormwater programs and initiatives and justify the amount of the utility fee assessed on an ERU basis. The study should account for costs related to the items listed below.

- Operation and maintenance of stormwater infrastructure, including personnel and equipment costs.
- Development and promulgation of stormwater programs, including ordinances, policies and regulations, and initiatives related to public outreach and education.
- Compilation of technical documentation related to the public stormwater infrastructure, including mapping and capacity analysis (where appropriate).
- Development and implementation of a Capital Improvement Program (CIP) to replace or upgrade components of the stormwater infrastructure.

Once the stormwater utility rate is established, the community must prepare an ordinance that will adopt the utility, establish its rules and regulations and also stipulate the system of rates and charges. It is important to note that even with a user fee system in place the cost of a comprehensive stormwater program, especially related to large capital projects, will often exceed the revenues that a utility can generate. A utility is part of the revenue stream but it is not all of it.

Application to the Accord Planning Area

The City of Columbus already has an established stormwater utility program that funds a comprehensive program related to maintenance of and improvements to their public stormwater infrastructure. The City of Hilliard has considered implementing a similar program. Within the remainder of the Accord planning area, a stormwater utility could be established and implemented by the Franklin County Drainage Engineer. The authority for such a program outside of an incorporated community is provided within the Ohio Revised Code, Chapter 6117. This utility would then be administered through the office of the County Drainage Engineer or other governmental body, such as the Franklin County Soil and Water Conservation District.

The mechanism for billing the stormwater utility within the unincorporated areas may have to be examined in consideration of the fact that there would not be a consistent system of sanitary and/or water utility billing throughout the county.

Darby Alternative Wastewater Treatment Technical Advisory Committee

Date: Friday, June 23, 2006

Committee Members:
Paul Rosile, FCBH
Karen Mancl, OSU Extension
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Cathy Alexander, OEPA
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Mike Rowan, OSU FABE
Timothy Lawrence, Ohio NEMO (Chair)
Gary Young, FCBH

Ex-Officio:
Dave Parkinson, EMH&T
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Draft Recommendations:

This committee was formed independent of the Darby Accord to provide guidance and recommendations for landowners and jurisdictions within Franklin County portion of the Darby regarding their options for wastewater treatment. The Franklin County portion of the Darby Watershed is likely to experience major development within the next 20 to 30 years as outlined in the Darby Accord Plan (DAP), developed by the 10 political jurisdictions involved. Currently there are approximately 12,500 units in the area, the majority being on non-centralized sewer. The DAP calls for that number to grow to 32,500 units, with approximately 7,000 of the new units on centralized sewer. This leaves approximately 13,000 new units, within the Accord planning area needing to find onsite or an acceptable regional approach to wastewater treatment. The Ohio Legislature has recently enacted new legislation for household sewage treatment systems (HSTS). Scheduled to go into effect January 1st, 2007. These new regulations were crafted to assure the highest level of wastewater treatment and the protection of public health and environmental quality from individual households and other similar and ancillary uses. The regulations also require local boards of health to establish nutrient reduction standards in areas "when there is a significant risk of nutrient contamination to surface or ground water…or risk due to proximity to local, state, or federally recognized nutrient sensitive environments." Residents and jurisdictions are encouraged to review those regulations and consult with the Franklin County Board of Health for restrictions that apply to property within this area.

The committee's recommendations, presented in this document, are limited to land application (drip, spray, or other timed and pressure dosed effluent distribution) systems for household (one home connected to its own system), and community (a group of homes on one treatment system, but not connected to the main sewer trunk from Columbus, i.e., centralized sewer). The use of community type systems supports the application of "conservation" developments, or developments with significant open space. The committee recognizes that household sewage treatment systems, such as the Wisconsin mound system and a drip distribution system (possibly with nutrient reduction components) may be necessary to overcome specific site conditions and to meet new

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state regulations. This document contains general concerns, limitations, and recommendations to protect human health and the biological and ecological integrity of the Darby Creek system.

The two areas targeted for non-centralized sewer in the DAP are Brown and Pleasant Township. There is also a smaller area within Prairie Township that may have some units not on centralized sewer. The single biggest limiting factor to non-centralized alternative wastewater treatment in this area is the soil types. Brown Township is predominately a Kokomo-Crosby-Lewisburg (KCL) soil association that is great for farming but has conditions that limit the use of household sewage treatment systems such as leach fields, Wisconsin mounds, or other land application systems. Pleasant Township also has a large percentage of KCL soil association. However, they also have some areas of Miamian and Celina intermixed with Lewisburg and Crosby, all of which may support HSTS. The committee stressed the importance of site specificity and cautioned about making blanket statements regarding Crosby or Lewisburg in regard to their suitability for household sewage treatment systems. There is consensus among the members of the committee that HSTS should continue to not be permitted on Kokomo soils. Kokomo soils are not permitted for HSTS for new development in any part of Franklin County.

Another important limiting factor is the depth to the seasonally high water table or other limiting conditions. The KCL soil association is seasonally saturated with a water table that will need to be professionally evaluated on each site being considered for development. In addition to the depth to seasonal water table, the type of water table – apparent or perched – is also an area of concern. An apparent water table is connected with the ground water system. The new state rules places additional restrictions on the use of apparent seasonal high water tables for HSTS. Perched water tables may have fewer restrictions, but still have significant limitations. Thus the committee recommends that HSTS only be permitted in areas where the perched water table is at least 12 inches below the surface where the treated effluent is being applied. This recommendation would ensure a strict application of the new sewage rules with no variances to accommodate more severe soil limitations, and no gradient drainage around the HSTS to remove excess groundwater from around the system.

Seasonal application of drip or spray community (see above definition) land application systems on Kokomo is an option that the committee does support. However, this would require the onsite storage of large amounts of wastewater during times when the soil is saturated (generally the winter months but can begin in the fall and extend well into the spring). Other soil types found in the area are also suitable for land application systems, but they too are limited during saturated conditions. Land application should not be made strictly by the calendar and the operator of any system should carefully monitor the soil water conditions to ensure there is at least 12 inches of soil above the water table before making application.

The placement of any community land application system must first contain a component of a documented investigation into the tiling structure on the proposed spray field. If a tile does exist in the spray field, then efforts to collect and divert the tile away from the

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spray field must be done. This effort will include interception of the tile before it reaches the spray field, collection of all subterranean streams prior to the proposed spray field, and diversion into a new tile or existing tiling system which must show evidence of the continuum of the streams downstream. The committee recommends adherence to the Franklin County Sanitary Engineer's "Rules and Regulations for the Construction & Operation of Land Application Wastewater Treatment Systems," for spray field placement which is referenced under "Hydrogeologic Site Investigation/Soils Report of the Application Site." The hydrogolgic site investigation/soils report includes the location of the tiles and the feasibility of rerouting the drainage system from the spray field. This report should be presented to both the Franklin County Sanitary and Drainage Engineer for approval.

The committee recommends that the multi-unit community or "cluster development" permitted in the DAP which is not on a centralized sewer system be serviced by either a regional (more than one small community) or one community system for each group of homes, be managed under the direct supervision and maintenance of the Franklin County Sanitary Engineer. Where feasible, regional treatment systems are strongly encouraged. However, the committee also recognizes that there may be developments where it is cost prohibitive to run sewer lines to a regional facility. The committee supports the idea of using sewage treatment technology other than the traditional aeration treatment plant for community systems prior to land application, such as fixed film bio-reactors (re-circulating sand filters and synthetic or peat filter systems) however, these systems should also be under the direct supervision and maintenance of the Franklin County Sanitary Engineer. The committee is also aware that properties with existing HSTS will be in close proximity to new regional or community developments; therefore it will be necessary to connect all of those properties that are contiguous (i.e., accessible/available) into the community or regional treatment system.

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The committee supports the Ohio EPA Draft Rules for Land Application of Treated Sewage dated Oct 2003 monitoring frequency requirements. In addition it is recommended that monitoring wells in all land application fields be installed to ensure the depth to water table is at least 12 inches before effluent is applied. The committee also supports the requirement for obtaining an NPDES permit on any system that discharges directly into the Darby or any of it tributaries regardless of their size. There was also support for Land Application Management Plans for any system that is a non-discharging and the requirement for a five year renewal of those plans. The committee made these recommendations prior to the release of a more current version of the draft rules that will eventually be adopted by the state of Ohio after comment and further review. Thus the recommendations put forth in this document may change to reflect these new rules, which will set the standard for governance.

When there is less than 12 inches of unsaturated soil above the water table the treated effluent should be diverted to a holding pond which has a minimum storage capacity of 6 months based on 300 gal/unit/day. These ponds are for storage only and should not be a part of the treatment process, however the committee does not object to the use of aeration if deemed appropriate by the operator to minimize algae growth. These ponds

should not be placed within the “streamway” as defined in the DAP or within the 100-year flood plain, however, they should be permitted within designated open space areas. Similar restrictions should also apply to aeration treatment plants or bio-reactor systems.

In all areas under consideration, with exception to the spray fields outline above, the existing field tile system should be maintained to ensure adequate drainage of the water table from areas that have or may have a HSTS, single community or regional wastewater treatment system. It is suggested that these existing field tile systems be placed under the ditch petition process or other maintenance assessment programs through Franklin County.

These recommends are intended for the protection of both human health and the Darby ecological system from pathogens and pollutants. The committee recognizes that it will need to continue to meet with regulators and other interested parties to further refine and implement a final set of recommendations.

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