Watershed Management Plan

for

Busseron Creek Watershed

ARN # 7-187

Final
March 2010

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Section I. Executive Summary

The Busseron Creek Watershed (BCW) is 252 square miles in size and is located in Clay, Greene, Sullivan, and Vigo Counties in West-Central Indiana. The Busseron Creek flows in a southwesterly direction to a confluence with the Wabash River. Approximately 83% of the watershed is located in Sullivan County. The BCW retains a rural, agrarian heritage with land use that is overwhelmingly agricultural (58%) or forested (30%). Surface coal mining operations have significantly altered the watershed landscape. Only 7% of the area is developed.

Over 16,000 acres of lands managed by the Indiana Department of Natural Resources provide habitat for a growing number of threatened and endangered species as well as large tracts of state-significant and rare wet-mesic floodplain forests. The watershed's close proximity to Goose Pond Fish & Wildlife Area has served to increase the incidence of rare and unusual migrating bird species.

The BCW Advisory and Steering Committee collaboratively identified water quality source concerns as they related to various land uses. Goals, objectives and tasks were identified to address these resource concerns.

Water quality monitoring, habitat assessments, and geo-statistical modeling were performed to identify physical areas of concern and strategic areas in which to implement tasks to reduce pollutant loads. These tasks / areas were prioritized based upon critical concern and projected impact on water quality.

The Busseron Creek Watershed Management Plan is intended as a guide for the protection and enhancement of the environment and quality of the Busseron Creek Watershed while balancing the different uses and demands of the community on this natural resource. Goals address items such as:

- Education and outreach;
- Reducing the amount of pollutants and sediment entering surface waters;
- Increasing and targeting conservation efforts;
- Increasing cooperation, coordination, and collaboration among all stakeholders;
- Building and maintaining a solid organization to further the improvement of environmental and economic health of the Busseron Creek Watershed.

Section II. Introduction

2.01 Mission & Vision Statements

(a) Mission Statement

The Busseron Creek Watershed Partnership (BCWP) is a coalition of interested parties dedicated to promoting and implementing best management practices in the Busseron Creek Watershed while educating the general public about environmental stewardship. The BCWP is committed to improve the water quality in the watershed and the regions downstream from Busseron Creek.

(b) Vision Statement

The BCWP envisions a balanced ecosystem that supports a healthy watershed, where quality of life and economic vitality are fostered by

- improving current conditions of the water resources;
- having a dynamic mix of land uses and development types;
- a continued push for improved land management strategies;
- development of public/private partnerships for implementation of local and region-wide plans and projects.

2.02 Partnership Structure

(a) Sponsor

The Sullivan County Soil & Water Conservation District (SWCD) serves as the fiscal and administrative arm of the Busseron Creek Watershed Partnership. Funds received from all sources, including EPA Section 319 grant, other grants and cash donations are controlled by the SWCD. Legal and financial administration of BCWP – Landowner contracts are part of the SWCD responsibilities

(b) Advisory and Steering Committee

The BCWP Advisory and Steering Committee is a group of engaged stakeholders representing local growers, the coal industry, town government, SWCD, Indiana DNR, wildlife & natural resources concerns, economic development, education, river heritage, and conservancy districts. This core group of individuals actively directs the work of the partnership, including development of this watershed management plan, and work performed and administrated by individual committees.

(c) Watershed Coordinator

The BCWP Watershed Coordinator reports directly to the Steering Committee and is contractually obligated to the SWCD. The coordinator is responsible for oversight of all BCWP activities, coordinating resources and manpower to complete work, and cooperating with other organizations to develop cohesive and focused work in order to use available resources in the most effective and efficient means possible.

(d) Committees

A dynamic group of committees will continue to evolve and subside as the needs of the Busseron Creek Watershed Partnership change. As of the most recent publication of this watershed management plan, the following committees are actively engaged:

(i) Advisory and Steering Committee

This core group of individuals actively directs the work of the partnership, including development of this watershed management plan, and work performed and administrated by individual committees.

(ii) Monitoring

The Monitoring Committee is responsible for oversight of water quality sampling & procedures, habitat assessment, macroinvertebrate sampling, and other on-site monitoring activities that may evolve.

(iii) Education and Outreach

The Education and Outreach Committee is responsible for framing a cohesive, yet dynamic education program for school-aged residents and instructors, educator workshops, and adult (non-education-related) workshops.

(iv) Data Analysis & Modeling

The Data Analysis Committee is responsible for organization of collected information into a useable, functional format. This includes:

- **Databases –** Input of existing and new data into a database structure easily joined to a geo-referenced dataset. This data includes water quality test results, macroinvertebrate sampling scores, and habitat assessment scores.
- **Habitat Assessment** – Because of their complex and subjective nature, Qualitative Habitat Assessments will be further reviewed in relation to land uses, critical habitat areas and needs, and economic impact.
- **GIS / Modeling**
  Statistical analysis and modeling provide a visible representation of possible priority areas, aiding in ranking and classification of needs.

(v) Project Development and Planning

As with Data Analysis, a divide and conquer method has been adopted by the Project Development and Planning Committee. Its main areas of concern are the *Watershed Management Plan* and *Annual Work Plans*.

As an expansion of the Advisory and Planning Committee, individuals with area expertise provided leadership and review for the body of this work. Working meetings have been conducted to direct the content of this document and will be similarly conducted in development of Annual Work Plans. This committee will also be responsible for promoting and overseeing implementation of projects outline in the Annual Work Plans.

(vi) Financial

The financial committee provides fiduciary guidance to insure the long-term viability of the Busseron Creek Watershed Partnership. Their responsibility includes development and maintenance of a Financial Plan (“Business” Plan) and guidance in economic impact of watershed projects.

(e) Stakeholders

All work completed by the Busseron Creek Watershed Partnership is done on behalf of our stakeholders: anyone who lives in, works in, hunts in, fishes in, banks in, shops in, plays in, goes to school in, owns property in, rents property in, or is otherwise affected by the Busseron Creek Watershed.

Public meetings were held to gather stakeholder concerns. In addition, a combination of on-line surveys and newsletter-distributed surveys were conducted to further define those concerns. A list of concerns may be found in Section V of this document.

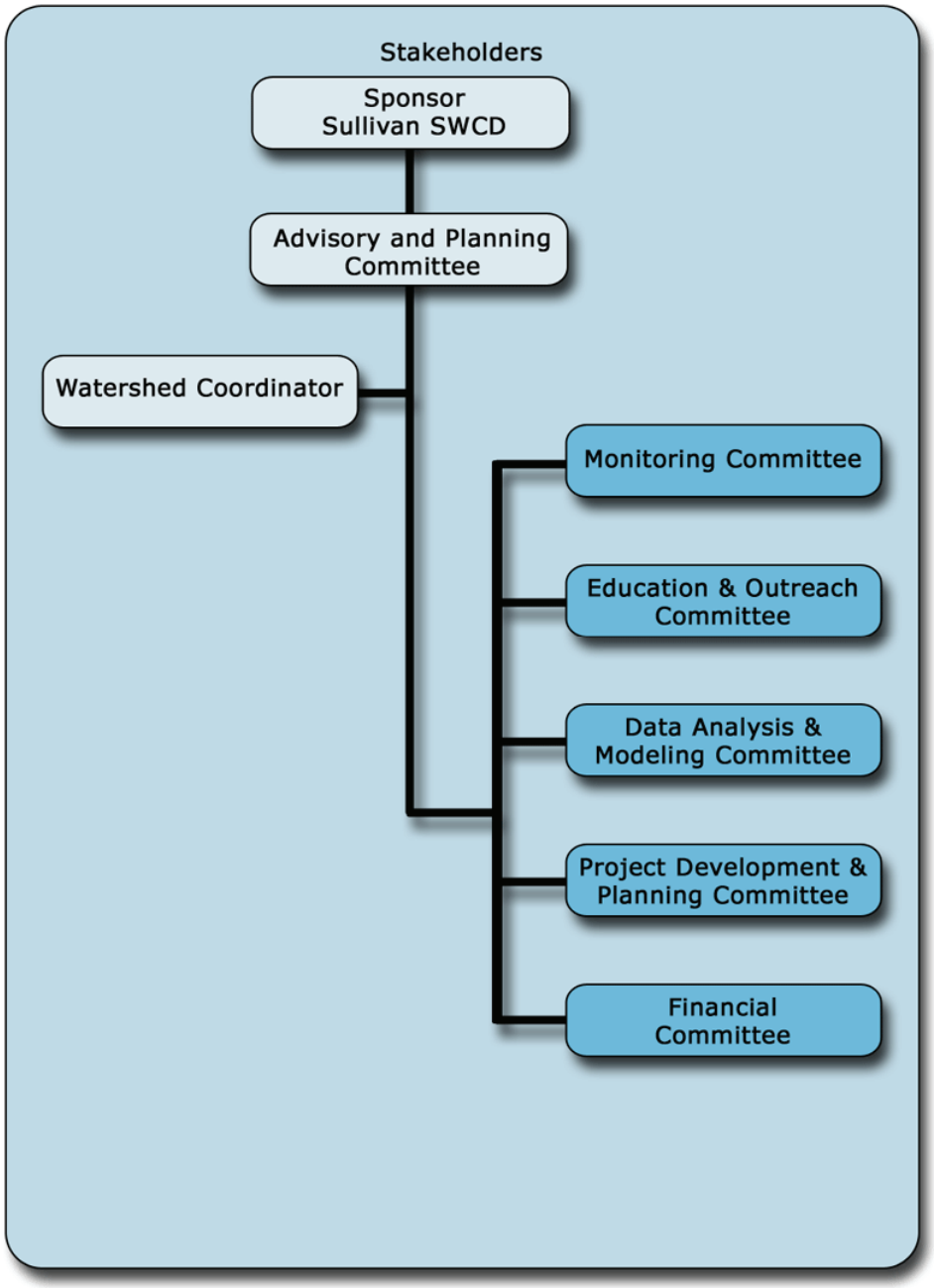

Figure II-1 Organization Tree

Section III. Watershed Description

3.01 Physical Characteristics

(a) Location

The Busseron Creek Watershed (BCW) lies within the Lower Wabash watershed and flows southwest for approximately 30 miles before discharging into the Wabash River west of Carlisle. It crosses the political boundaries of Clay, Greene, Sullivan, and Vigo counties of Indiana. *(Figure III-1 – BCW Location, Table III-1 – County Acres)*

Classified by the EPA as part of the Glaciated Wabash Lowlands ecoregion (72b), the area is *"often mantled by till or windblown silt and sand. The loamy to sandy till deposits are pre-Wisconsinan in age and are older and more leached than the glacial drift of Ecoregions 54a and 55b. The original vegetation included beech forest and oak-hickory forest; relict sand dunes sometimes supported prairies. Today, the productive soils support corn, soybean, wheat, and vegetable farming; scattered woodlands and surface coal mines also occur. Many streams have gravel bottoms, riffles, and associated fauna; they are less sluggish than the streams of Ecoregion 72c",* the Southern Wabash Lowlands.

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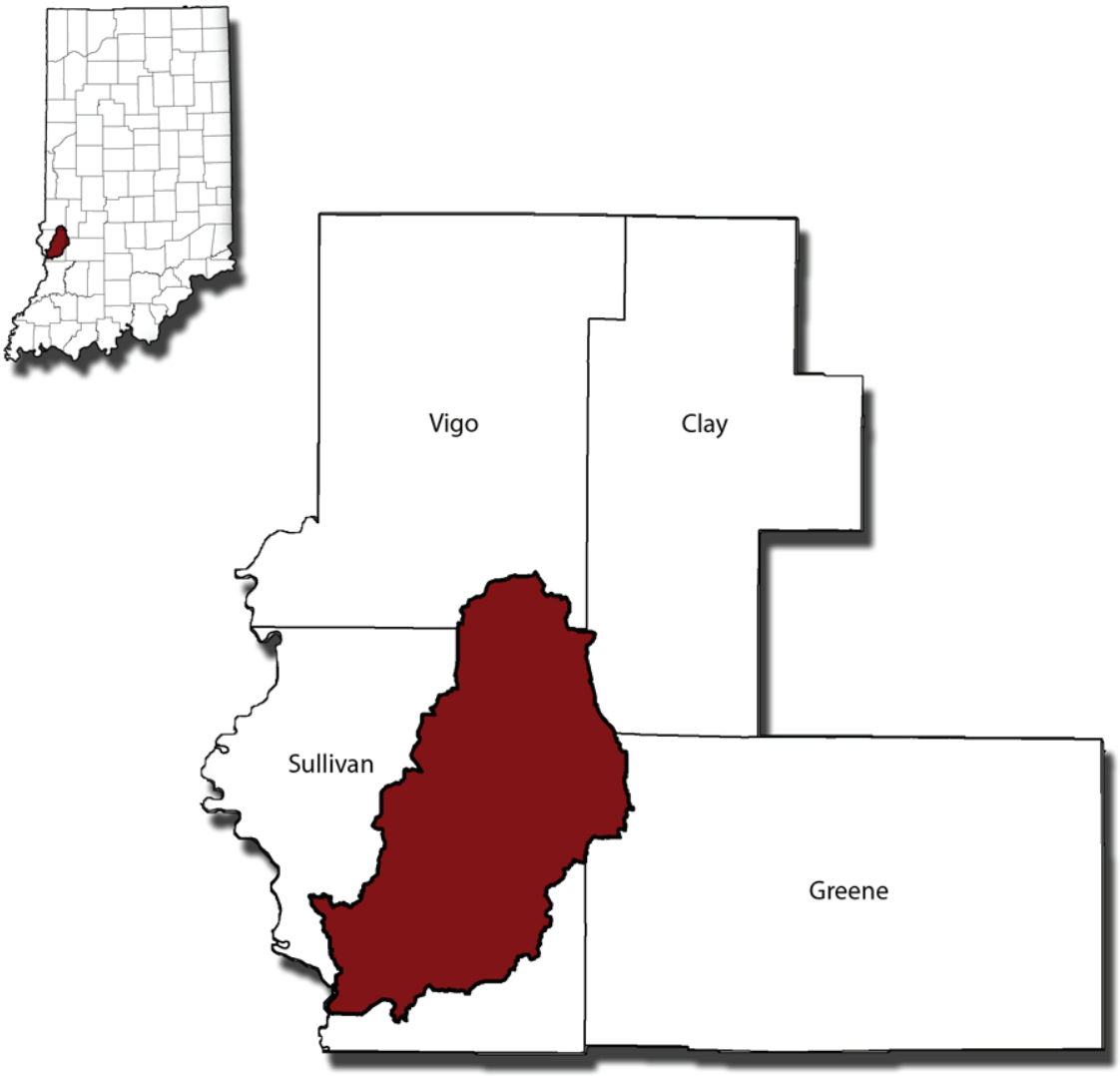


Figure III-1 – BCW Location

Table III-1 – County Acres

Clay	-	5,266 Ac
Greene	-	11,729 Ac
Sullivan	-	136,262 Ac
Vigo	-	10,064 Ac
Total	**-**	**163,321 Acres**

(b) Subwatersheds

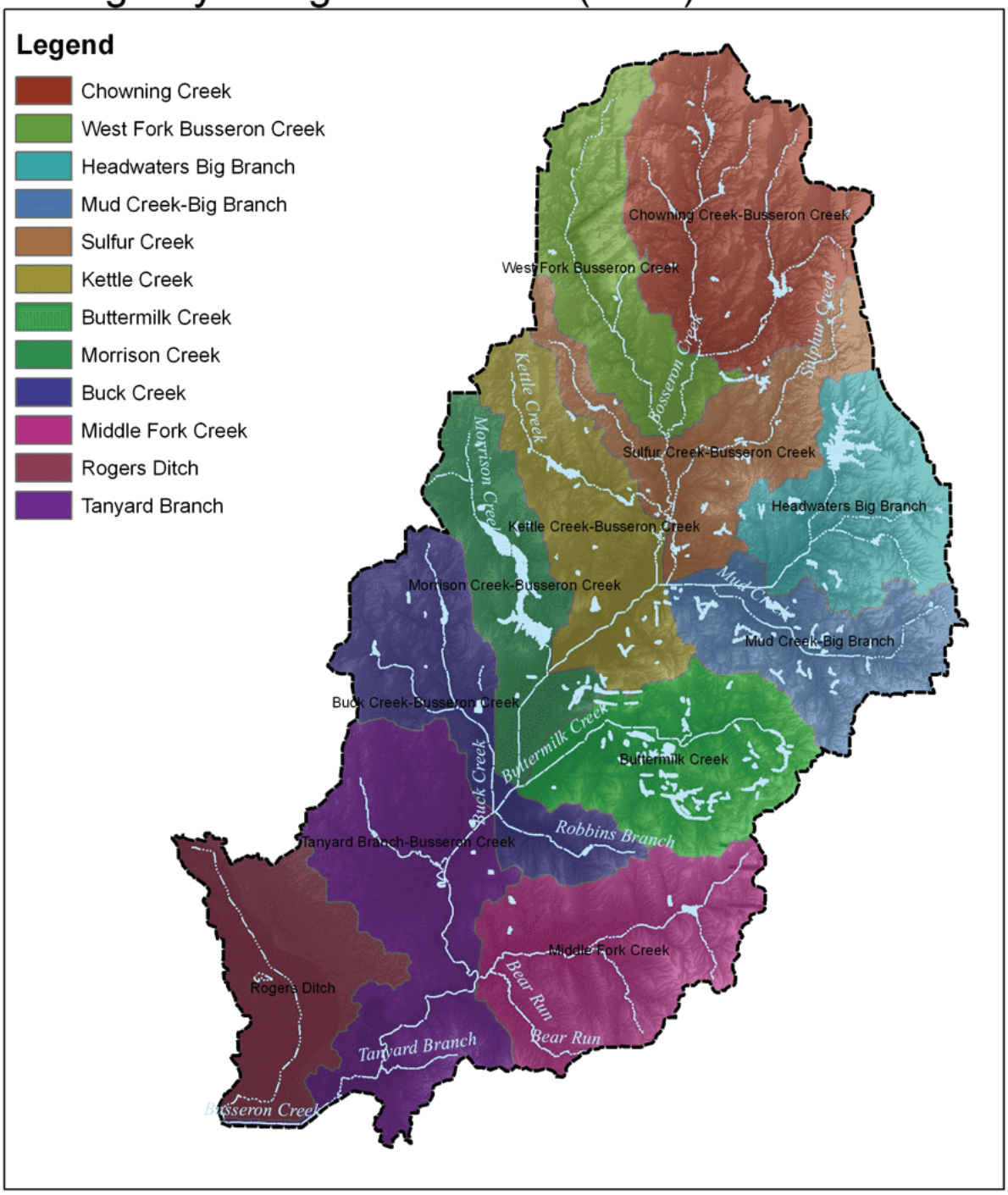
Watersheds in the United States and the Caribbean were delineated by the U.S. Geological Survey using a national standard hierarchical system based on surface hydrologic features. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the level of classification, with 2-digit HUCs being the largest (area) unit of classification and 12-digit HUCs being the smallest.

The Busseron Creek Watershed, which is approximately 255 square miles, is a 10-digit watershed (0512011115). It consists of twelve separate 12-digit sub-watersheds that range in size from just over 10,800 acres to just under 19,900 acres. *(See Table III-2 below for subwatershed sizes, and Figure III-2 - Subwatersheds).*

Table III-2 – 12-Digit Subwatersheds

NAME	HUC Code	Area (Acres)	Area (Sq Mi)	Stream Length (Mi)	Lake Area (Ac)	County
Chowning Creek - Busseron Creek	051201111501	19,312.94	30.18	23.68	155.52	C,S, V
West Fork Busseron Creek	051201111502	11,696.63	18.28	16.91	25.00	S, V
Headwaters Big Branch	051201111503	11,601.54	18.13	27.50	441.21	C, S, G
Mud Creek - Big Branch	51201111504	10,844.20	16.94	31.57	257.51	G, S
Sulfur Creek - Busseron Creek	51201111505	12,338.98	19.28	29.29	138.51	C, S
Kettle Creek - Busseron Creek	51201111506	12,852.43	20.08	27.21	219.17	S
Buttermilk Creek	51201111507	13,354.45	20.87	27.21	520.80	S
Morrison Creek - Busseron Creek	51201111508	10,687.48	16.70	32.56	641.65	S
Buck Creek - Busseron Creek	51201111509	12,959.86	20.25	19.56	89.36	S
Middle Fork Creek	51201111510	15,808.91	24.70	2.74	56.52	S
Rogers Ditch**	51201111511	11,979.95	18.72	9.01	26.77	S
Tanyard Branch - Busseron Creek	51201111512	19,884.06	31.07	26.21	27.30	S
		163,321.4	**255.19**	**273.46**	**2599.32**	

12 Digit Hydrologic Unit Code (HUC) Subwatersheds



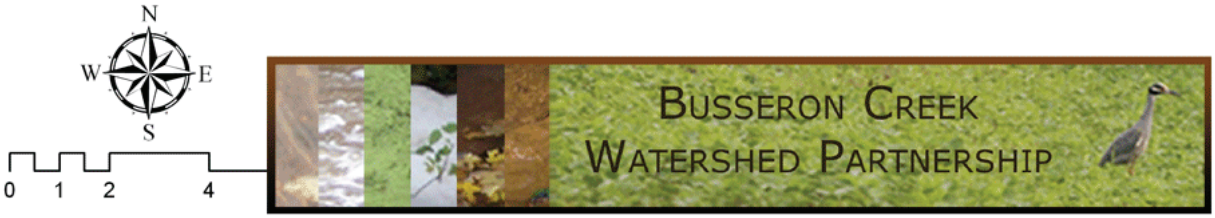


Figure III-2 - Subwatersheds

(c) Elevation

Characterized by a broad lowland tract, the elevation of the BCW ranges from 677 to 415 feet *(Figure III-3 - Elevation)* with an average fall of 5.4 foot per mile. For perspective, a typical sidewalk has a cross-slope of ¼" per foot – or ***twenty times*** the Busseron's average fall.

Because of this low-slope, much of the watershed's creeks are slow-moving with few ripples – a condition associated with naturally occurring low dissolved oxygen levels.

There is little backpressure from Wabash River flooding events. Affected areas are generally restricted to western floodplains of the Rogers Ditch and Tanyard Branch Subwatersheds.

Elevations

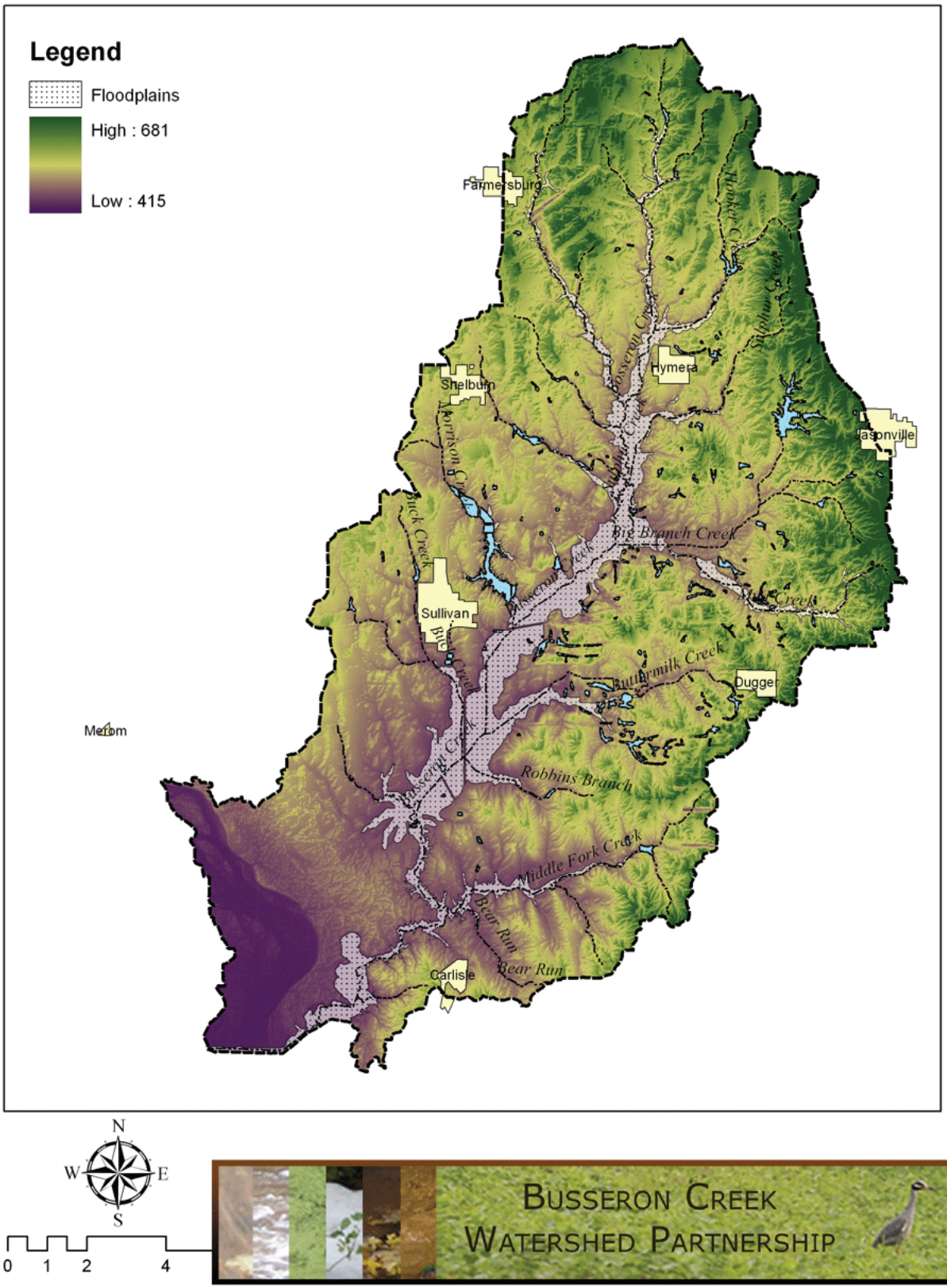


Figure III-3 - Elevation

(d) Soil Characteristics

(i) General Soil Characteristics

As defined by the NRCS Soil Survey Handbook, soil associations are groups of two or more similar soils or miscellaneous areas included with named components. The soil associations found within the Busseron Creek Watershed are described below. Soil Association acreage may be found in *Table III-3 – Soil Association Acres*. Revised soil surveys may replace the currently noted soil associations with the Fairpoint - Bethesda association in areas affected by recent surface mining. *Figure III-4 – Soil Associations with Surface Mine Overlay* illustrates the listed soil associations with areas of anticipated change (surface mine overlay).

Cincinatti - Ava (s2355)
Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately-well to well drained. Water movement in the most restrictive layer is moderately to very low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 30-39 inches during January, February, March, April, December. Organic matter content in the surface horizon is about 1-2 percent. This soil does not meet hydric criteria.

Stoy – Hosmer – Hickory (s2268)
Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. Available water to a depth of 60 inches is high. Shrink-swell potential is low to moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

Wilbur – Wakeland - Haymond (s2356)
Bottomland soils. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately drained to well drained with pockets of somewhat poorly drained areas. Soils are seasonally flooded with ponding in low-lying areas. A seasonal zone of water saturation is generally greater than 60 inches with low-lying Wakeland areas at 12-24 inches. Shrink-swell potential is low to moderate. Pockets of this soil may meet hydric criteria.

Princeton-Bloomfield-Ayrshire-Alvin (s2361)
Slopes are 2 to 6 percent. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 2e. This soil does not meet hydric criteria.

Rensselaer – Patton – Lyles – Henshaw (s2365)
Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low to moderate. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 0 inches during March, April, May, June. Organic matter content in the surface horizon is about 2-5 percent. This soil meets hydric criteria.

Hickory - Cincinnati (s2377)
Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This soil does not meet hydric criteria.

Fairpoint - Bethesda (s2370)
Nearly level to moderately sloping, well drained upland soils formed in mine spoil that was shaped and smoothed after surface mining operations. (Pre- and early- SMCRA regulated mining operations.) Mine spoil consists mainly of masses of soft shale fragments, moderately fine and medium textured soil, glacial till, and sandstone fragments. The spoil is mostly neutral, but some spots are extremely acid and some areas are mildly alkaline. Most sandstone fragments larger than 4 to 6 inches across have been buried during shaping and smoothing operations. Areas typically range from 60 to 250 acres in size.

In a typical profile, the surface layer is brown shaly silt loam about 1 inch thick. The substratum, to a depth of 60 inches, is yellowish brown, shaly silt loam, shaly silty clay loam, and very shaly silty clay loam that is 30 to 40 percent gray shale fragments and 5 to 15 percent sandstone fragments. In some areas the substratum below a depth of 30 inches is mostly sandstone and shale fragments.

Included in mapping are some areas where a minimum of land shaping was done after mining: only the peaks were smoothed, leaving elongated pits that mostly contain water. The sides of many of these pits are very steep, and large sandstone fragments are exposed at the surface. Also included are abandoned mine haul roads that mostly consist of extremely acid carbonaceous shale and other coal mining refuse. These inclusions make up 10 to 15 percent of the unit.

Warsaw-Shipshe-Elston (s2323)
Slopes are 0 to 2 percent. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 2s. This soil does not meet hydric criteria.

Vigo – Shakamak – Cincinnati – Ava (s2373)
Slopes are 1 to 3 percent. This component is on till plains. The parent material consists of Loess and the underlyimg paleosol in till. A restrictive root layer, frangipan, *may* be found at 30 to 40 inches. At slopes greater than 1%, the natural drainage class is moderately well to well drained. Water movement in the most restrictive layer is moderately low to low and available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 - 39inches during January, February, March. Organic matter content in the surface horizon is about 1-2 percent. This soil does not meet hydric criteria.

Table III-3 – Soil Association Acres

Soil Association	Acres
Cincinnati-Ava	86,248
Stoy-Hossmer-Hickory	32,941
Wilbur-Wakeland-Haymond	16,556
Princeton-Bloomfield-Ayrshire-Alvin	9,126
Rensselaer-Patton-Lyles-Henshaw	7,464
Hickory-Cincinnati	4,996
Fairpoint-Bethesda	2,724
Warsaw-Shipshe-Elston	2,197
Vigo-Shakamak-Cincinnati-Ava	1,069
	163,321

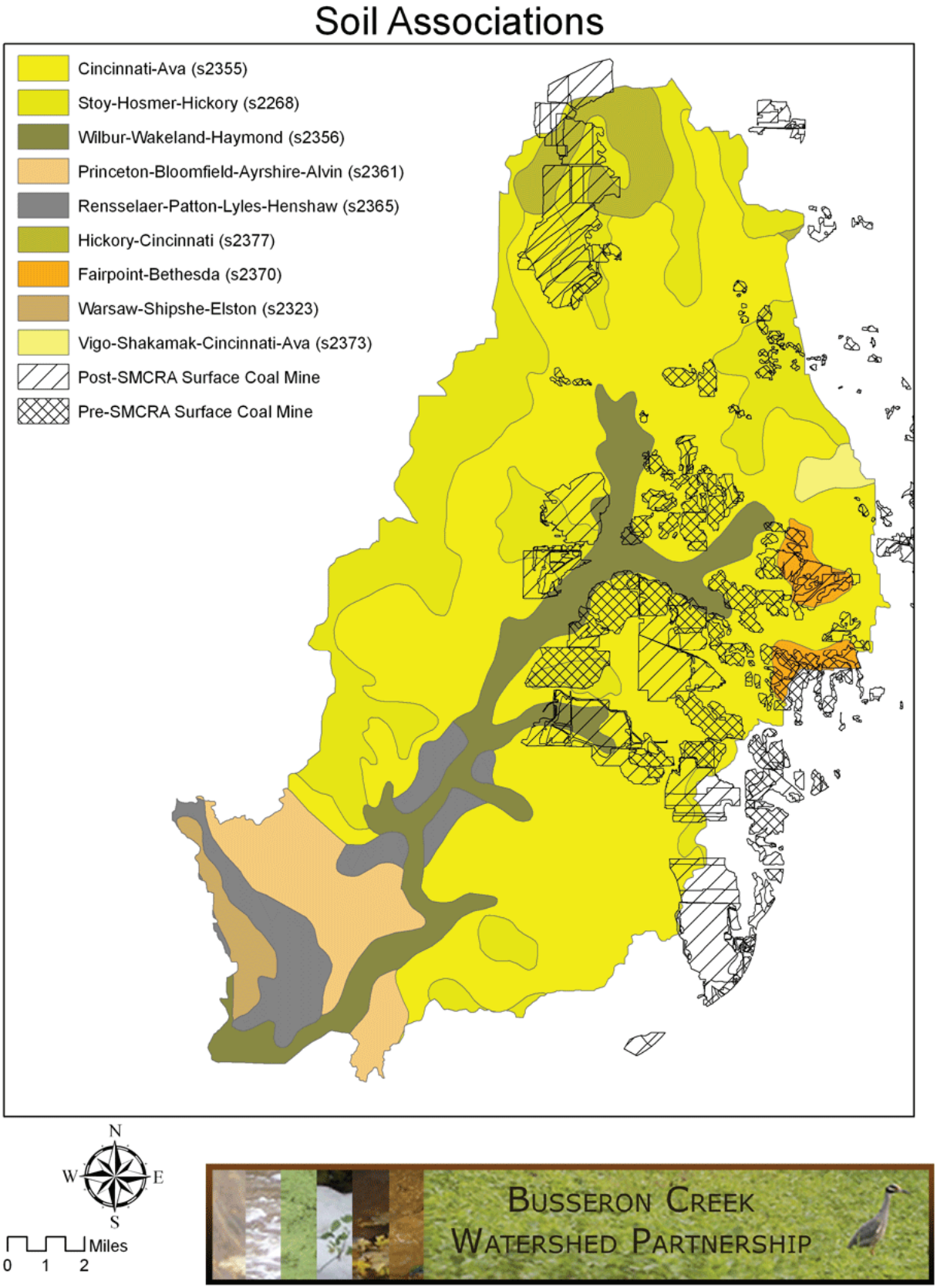


Figure III-4 – Soil Associations with Surface Mine Overlay

(ii) Drainage

Of the nine soil associations, only one, the Rensselaer –Patton-Lyles-Henshaw group, can be considered truly hydric in nature. In addition to that hydric classification, soils located along the floodplains of the main Busseron Channel may have been formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in their upper parts. *Figure III-5 – Hydric Soils* illustrates the location of hydric soils within the watershed.

Figure III-6 – Soil Drainage Classes illustrates drainage classes of the Busseron Creek Watershed. Most of the agricultural lands currently under cultivation are either a type B or type C drainage class and much of the reclaimed coal acreage is a type B drainage class.

A drainage class is a hydrologic grouping of soils having the same runoff potential under similar storm and cover conditions. Hydrologic groups are used in equations that estimate runoff from rainfall. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. The soils of the U.S. are placed into four groups A, B, C, D. Definitions of the classes are as follows:

- **A:** Soils with low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well drained to excessively well-drained sands or gravels.

- **B:** Soils having moderate infiltration rates even when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderatelycoarse textures.

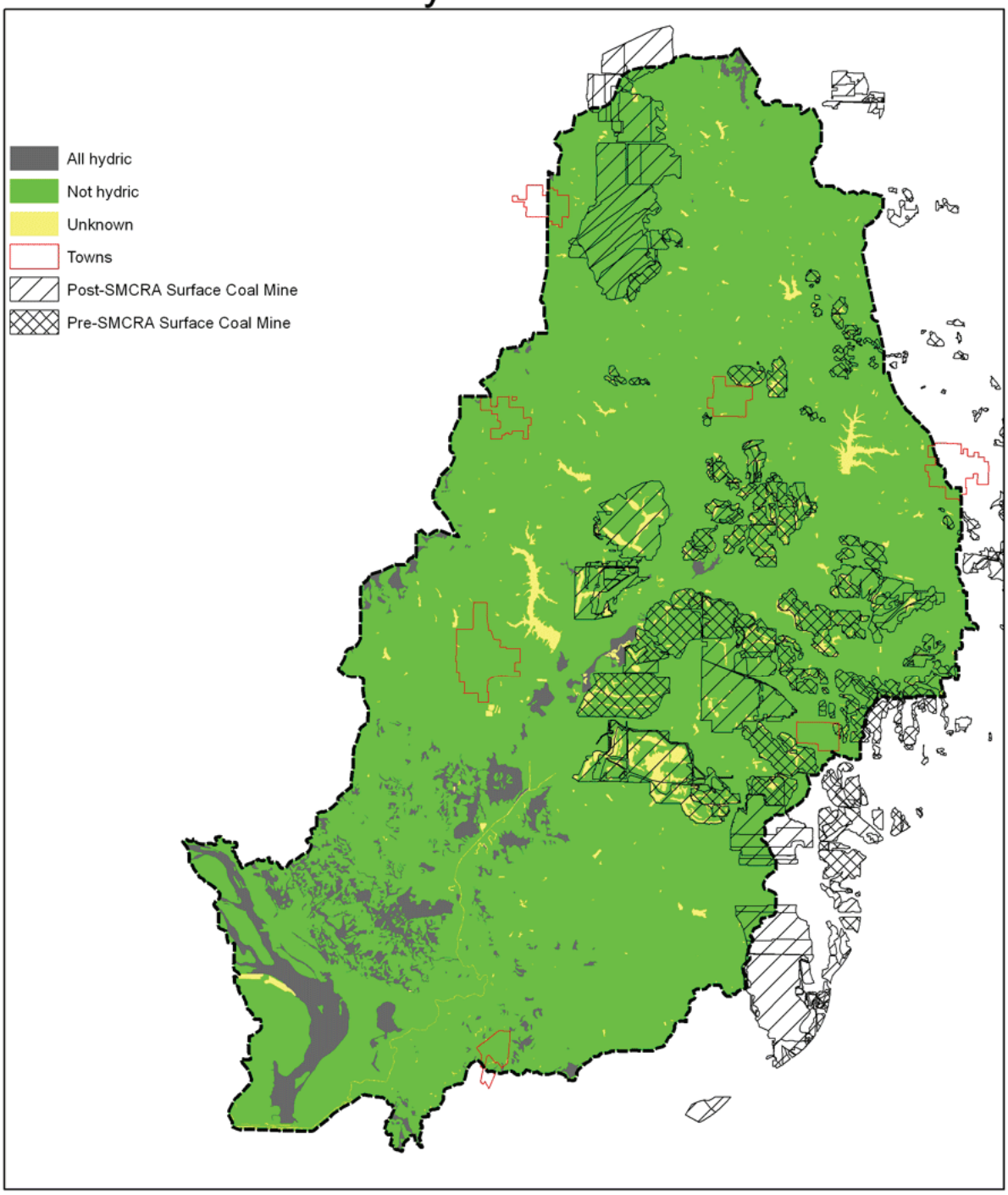
- **C:** Soils having slow infiltration rates even when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.

- **D:** Soils with high runoff potential. Soils having very slow infiltration rates even when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.

(iii) Highly Erodible Lands (HEL)

Approximately 1/3 of the Cincinnati-Ava soils association *may* be classified as highly erodible. In otherwords, just under 1 out of every 5 acres in the watershed may be classified as HEL. Actual classifications may be viewed on Farm Service Agency (FSA) farm tract maps.

Hydric Soils



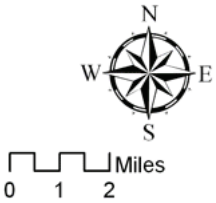


Figure III-5 – Hydric Soils

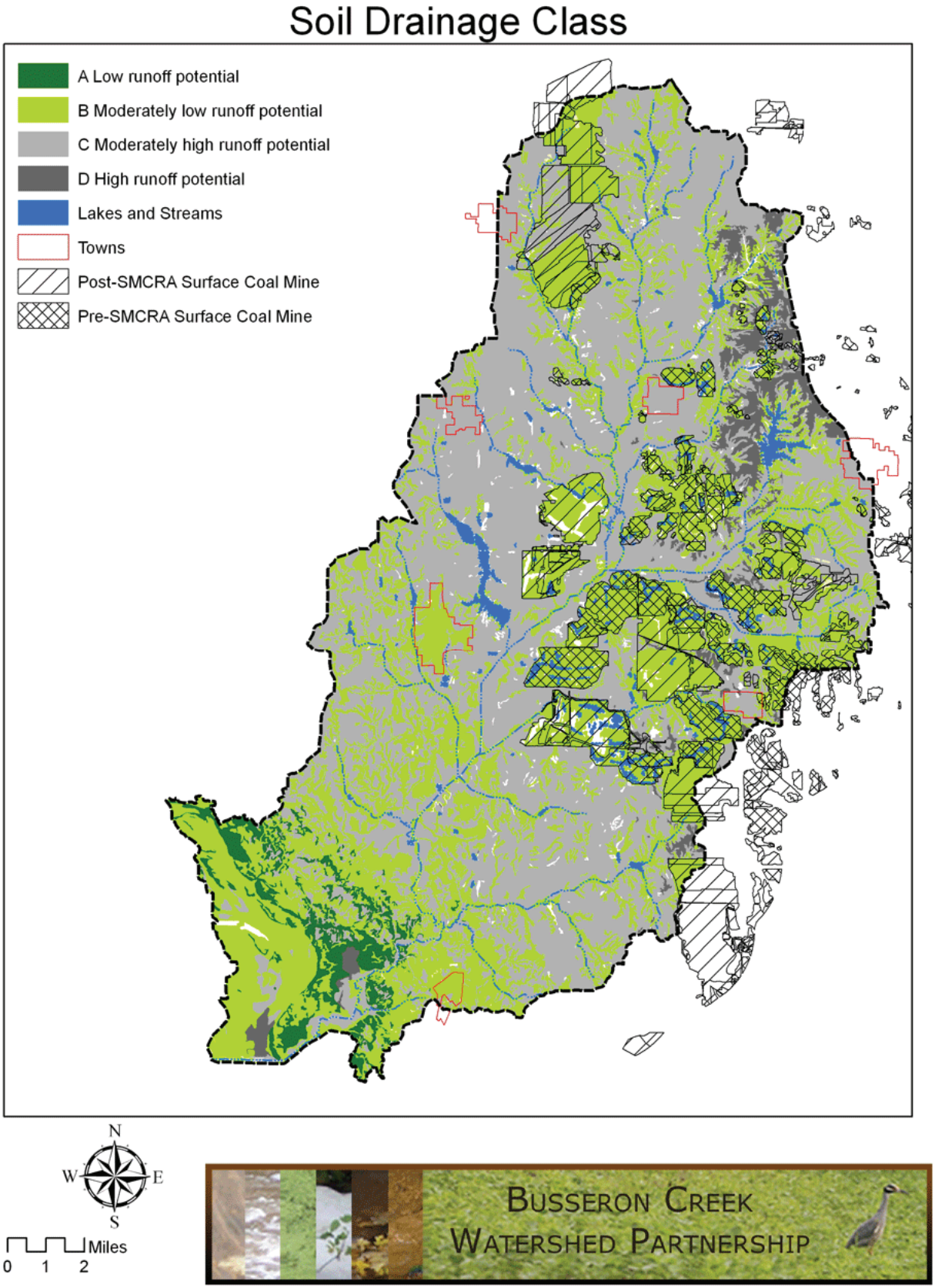


Figure III-6 – Soil Drainage Classes

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(e) Land Use / Land Cover

The majority of the BCW consists of cultivated croplands, followed by forested areas. Identified by types of landcover (i.e. cultivated fields, forested areas, wetlands, etc), the acreage of each type of land use is illustrated in *Figure III-7 – Landcover* and has been tabulated below.

Table III-4 – Landcover Acres

Landcover Class	Acres		Percent
Cultivated Crops		85,175	52.15%
Wooded		49,918	30.56%
Deciduous Forest	*47,170*		
Evergreen Forest	*2,739*		
Mixed Forest	*10*		
Hay/Pasture		10,295	6.30%
Developed		11,465	7.02%
LD - Residential	*9,356*		
HD - Residential	*1,573*		
Commercial	*426*		
Industrial	*111*		
Open Water		3,934	2.41%
Herbaceous / Scrub		1,339	0.82%
Wetlands		1,094	0.67%
Barren Land		102	0.06%
TOTALS		**163,321**	**100.00%**

It should also be noted that 9,113 acres of those listed above lie within the permitted area of active surface mining operations and 2,602 acres lie within permitted surface mining areas that have temporarily ceased operations.

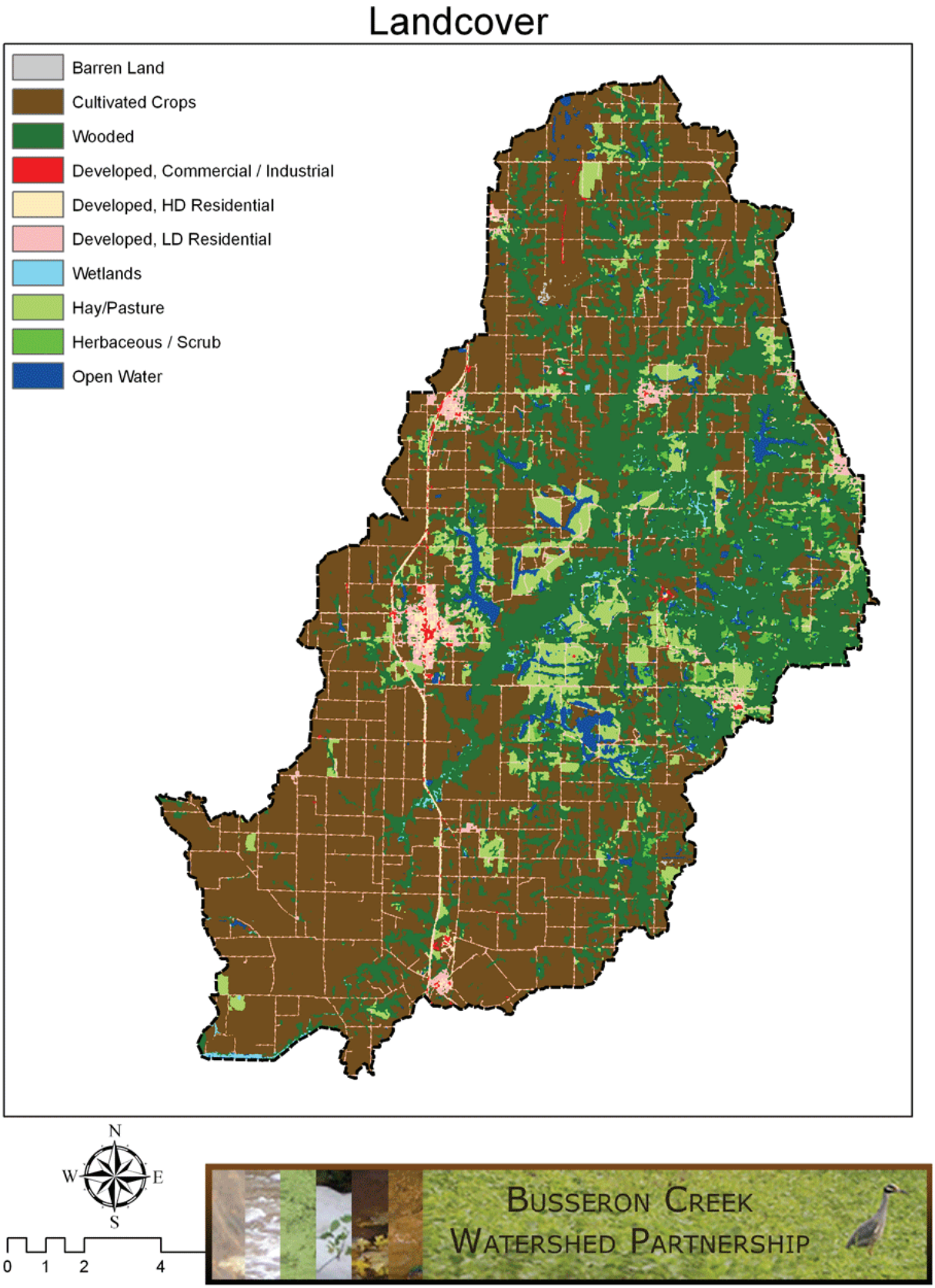

Figure III-7 – Landcover

(f) Agriculture

Fifty-two percent of the BCW is cultivated. Farming within the watershed consists primarily of small grains along with some pasture and haylands. As with most agriculture production in the Midwest, the diversity of crops grown have shrunk dramatically. Some melon crops are produced in the southeastern area of the watershed. Other cultivated areas are typically kept in a corn-soybean rotation. A minor percentage of that area is kept in a corn-wheat-soybean rotation. *Table III-5 – Tillage Practices*, below, identifies current tillage practices within the watershed. Adoption of conservation tillage practices within the watershed fall well below the Indiana median of 27% no-till corn and 67% no-till soybeans in 2007.

Table III-5 – Tillage Practices

Tillage Practices				
	Corn	**Soybeans**	**Total**	
Conventional	46%	15%	39,605	46%
Reduced Tillage	23%	18%	19,571	23%
Mulch Tillage	11%	20%	9,645	11%
No-Till	18%	47%	15,633	18%
TOTALS			**85,175**	**99%**

Tilled areas are often small bottomland areas or highly erodible hilltops and slopes. Past practices have resulted in erosion of top soils and loss of fertility – extensive use of fertilizers are required to raise acceptable crops. In addition, crop production on highly erodible slopes without benefit of conservation tillage, cover crops and nutrient and pest management plans has accelerated movement of soil, nutrients, and other pollutants into streams. Wetlands in low-lying areas next to streams have been replaced with actively cultivated acreage – again, allowing soil, fertilizers, and pesticides to runoff into waterways.

The NRCS National Soil Survey Handbook farmland classification system identifies the location and extent of the most suitable land for producing food, feed, fiber, forage, and oilseed crops. Prime farmland is land that has the best combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time and it either does not flood frequently during the growing season or is protected from flooding. Acreage of farmland classes is listed in *Table III-6 – Prime Farmland Classification.* Locations of farmland classes are illustrated in *Figure III-8 – Farmland Classification*.

Very little of the watershed would be considered to be prime farmland unless some type of drainage or protection operations were undertaken. Those areas under heavy cultivation (over 75% of total acreage under cultivation, as illustrated in *Figure III-8 – Farmland Classification)* reflect the soil types considered to be prime farmland or prime farmland if drained. Of these heavily cultivated areas, 14% is considered to be prime farmland (with no alterations or protection) and 57% is considered to be prime farmland after tiling or other drainage operations.

Of the slightly less intensively cultivated areas (51% to 75% under cultivation) a significant proportion (43%) is *not* considered to be prime farmland. This may be attributed to poor soil drainage in these areas. Over half (53%) of these less intensively cultivated areas are type C soils.

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Table III-6 – Prime Farmland Classification

Prime Farmland	Acres	Percent
Farmland of State importance.	55	0.03%
All areas are prime farmland.	24,307	14.9%
Prime farmland if drained.	56,162	34.4%
Prime farmland if protected from flooding or not frequently flooded during the growing season.	6,558	4.0%
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.	12,201	7.5%
Not prime farmland.	64,038	39.2%
TOTALS	**163,321**	**100%**

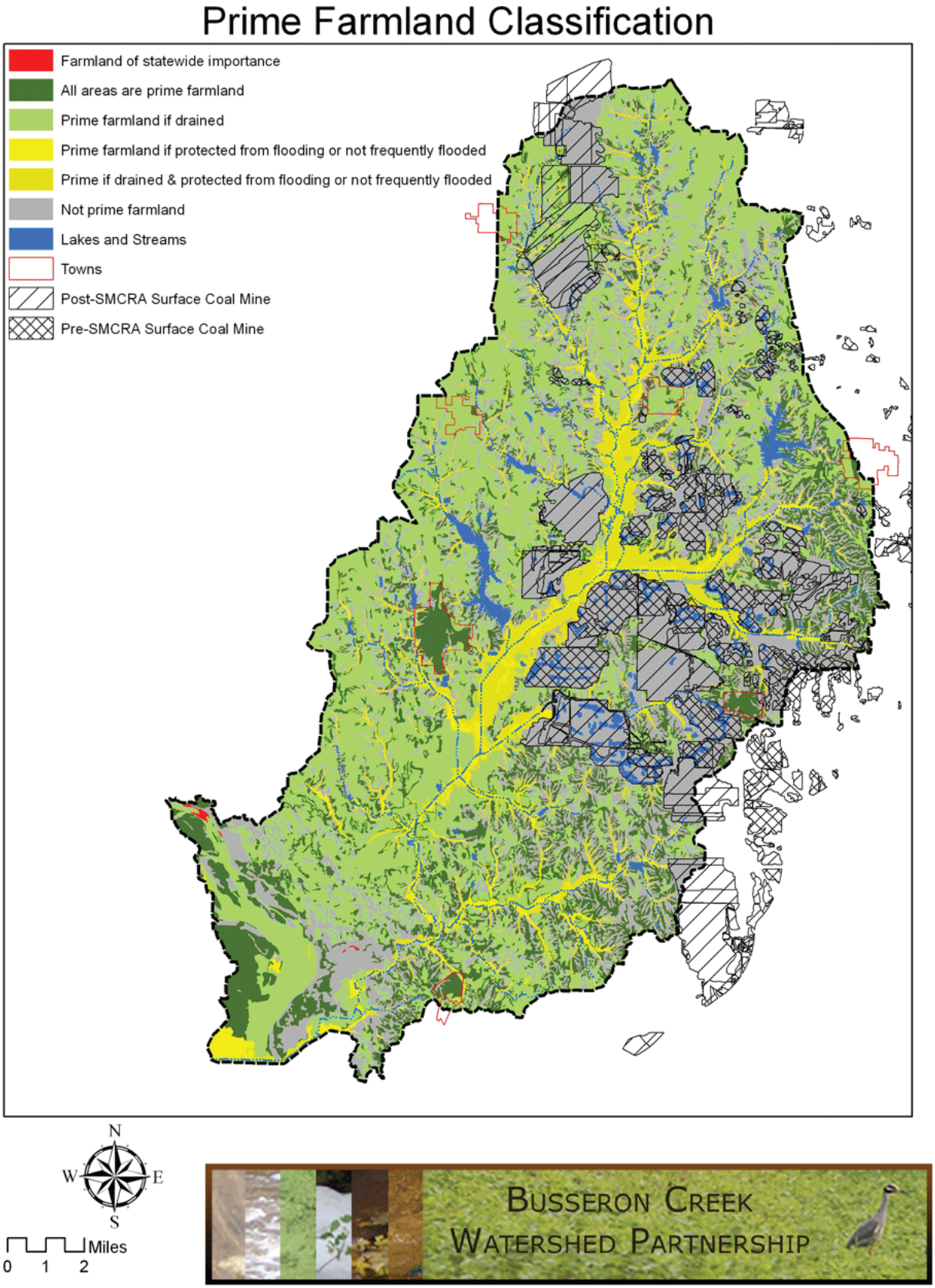

Figure III-8 – Farmland Classification

Agriculture, continued

Agricultural Density is defined as a percentage of total acreage under cultivation. (i.e. 75 acres of a 100 acre tract under cultivation = 75% agricultural density) The acres of varying degrees of agricultural density are shown in *Table III-7 – Agricultural Density*, below. Agricultural density is illustrated in *Figure III-9 – Cultivated Areas*. The densest concentrations of acreage under cultivation are located within the more productive Stoy – Hosmer – Hickory soil associations, followed by un-mined Cincinnati – Ava assocations.

Table III-7 – Agricultural Density

Agricultural Density	Acres	Percent
> 75% Cultivated	44,182	27.1%
51% - 75% Cultivated	28,304	17.3%
15% - 50% Cultivated	64,617	39.6%
< 15% Cultivated	21,473	13,1%
Agri-Urban (< 100 homes / Sq Mi)	2,477	1.5%
Commercial (> 100 homes / Sq Mi)	122	0.1%
Non-Agricultural**	1,741	1.1%
Water**	405	0.2%
TOTALS	**163,321**	**100%**

**Based on 2004 USDA Cultivated Areas geo-spatial data set. Shakamak State part was the only area classified as “non-agricultural” and only Sullivan Lake was classified as “water”.

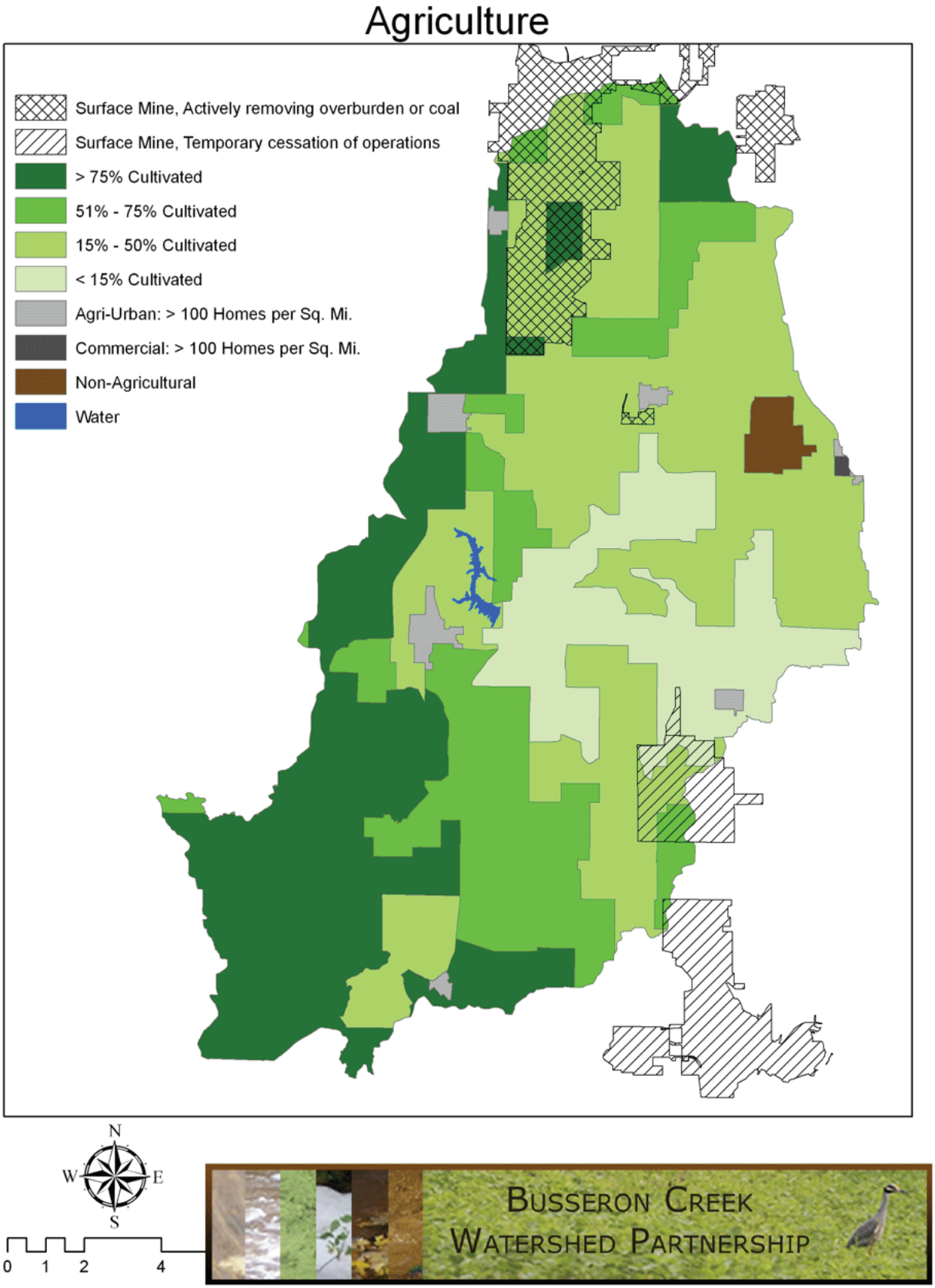

Figure III-9 – Cultivated Areas

Agriculture, continued

Based on geo-referenced data sets from the United States Department of Agriculture, National Agricultural Statistics Service (*Figure III-10 – 2006 Crops* and *Figure III-11 – 2003 Crops*), one-fifth to one-quarter of the cultivated acreage is planted to corn or wheat – both of which are crops which required relatively high amounts of nitrogen fertilizer. The areas in which these crops are grown have been extensively tiled for drainage purposes. These crops are typically rotated with soybean or double-crop wheat/soybean crops. Acreage and percentage of crop types are listed in *Table III-8 – Crop Types,* below.

The sandier soils of the Wabash River bottoms are extensively irrigated. Geo-referenced statistics were unavailable at the time of writing. However, of the 9,657 acres reported to be under irrigation in Sullivan County (2007), the overwhelming majority are located in the Rogers Ditch and Turtle Creek (N of Rogers Ditch) watersheds.

An increasing percentage of the irrigated acres are producing specialty crops such as watermelon, cantaloupe, pumpkin, tomatoes, and green beans. Irrigated acreage is also used for the production of seed corn and wheat. Currently, both specialty and seed crops are grown with the use of extensive cultivation practices. NASS reports appear to under-estimate the acreage of specialty crops. Those statistics also group seed corn and wheat crops with commodity production.

The central areas of the watershed are predominantly wooded, pastured, or managed as upland wildlife habitat. A majority of these areas were mined before 1977 and in the early years of the Surface Mining Control and Reclamation Act (SMCRA) regulations.

Table III-8 – Crop Types

Crop Types 2006	Acres	Percent
Corn	29,782	18.24%
Soybeans	25,530	15.63%
Other Small Grains & Hay	6,408	3.92%
Wheat / Double Crop Wheat-Soybeans	3,616	2.21%
Other Crops	311	0.19%
Fallow / Idle Cropland	1,289	0.79%
Pasture / Range / CRP / Non Ag	52,077	31.89%
Woods, Woodland Pasture	33,413	20.46%
Urban	5,635	3.45%
Water / Wetlands	5,261	3.22%
	163,321	**100.00%**
Crop Types (2003)	**Acres**	**Percent**
Corn	39,278	24.05%
Soybeans	27,864	17.06%
Other Small Grains & Hay	1,109	0.68%
Wheat / Double Crop Wheat-Soybeans	1,329	0.81%
Sorghum	143	0.09%
Other Crops	547	0.33%
Fallow / Idle Cropland	6,107	3.74%
Pasture / Range / CRP / Non Ag	39,997	24.49%
Woods, Woodland Pasture	36,352	22.26%
Urban	4,492	2.75%
Water / Wetlands	6,105	3.74%
	163,321	**100.00%**

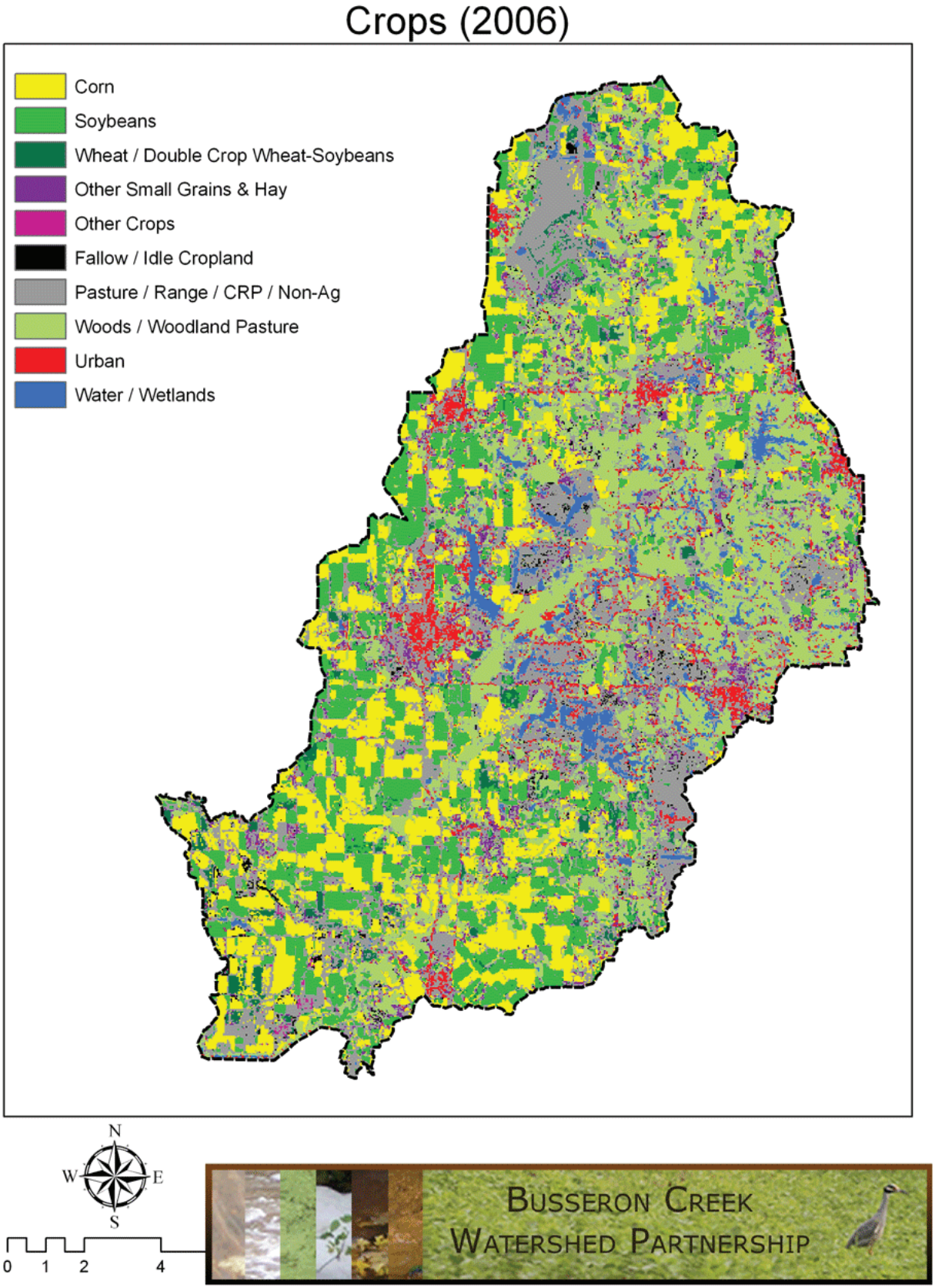

Figure III-10 – 2006 Crops

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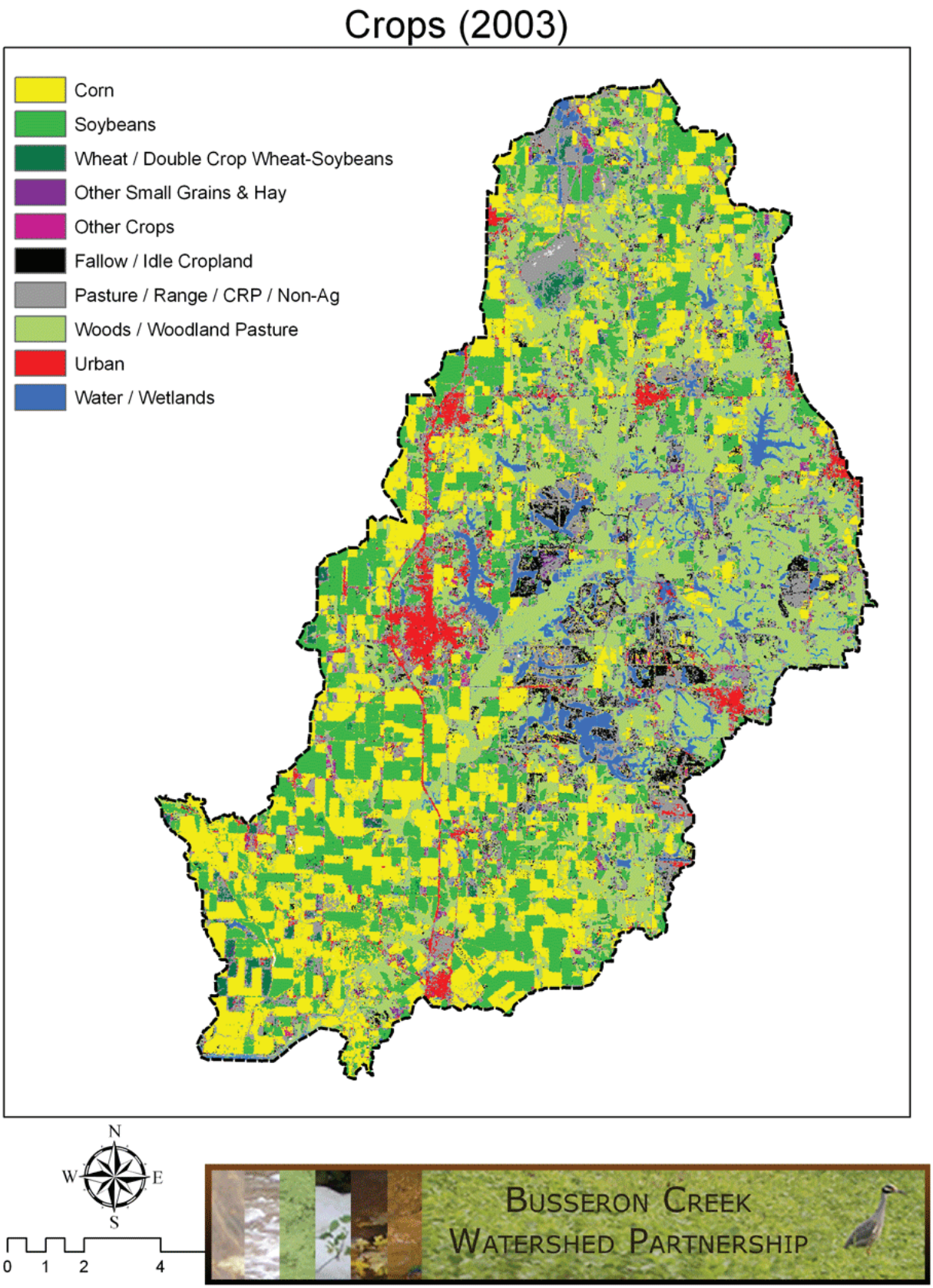

Figure III-11 – 2003 Crops

Agriculture, continued

Most livestock operations are often small and unregulated animal feeding operations (AFO). There are two active confined feeding operations (CFO) located within the BCW (*Figure III-12 – Confined Feeding Operations and Pasture / Hayland*), however neither are large enough to be classified as a concentrated animal feeding operation (CAFO). As such, those operations are not subject to the more stringent regulations governing CAFOs. Disposal of manure and/or litter generated by CFOs may contribute to elevated E. coli and phosphorus levels in waterways.

In other areas, improperly managed grazing lands allow livestock uncontrolled access to streams and creeks. Although pastures may be relatively large and animal densities low, manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated runoff during a storm event.

Animal Operations

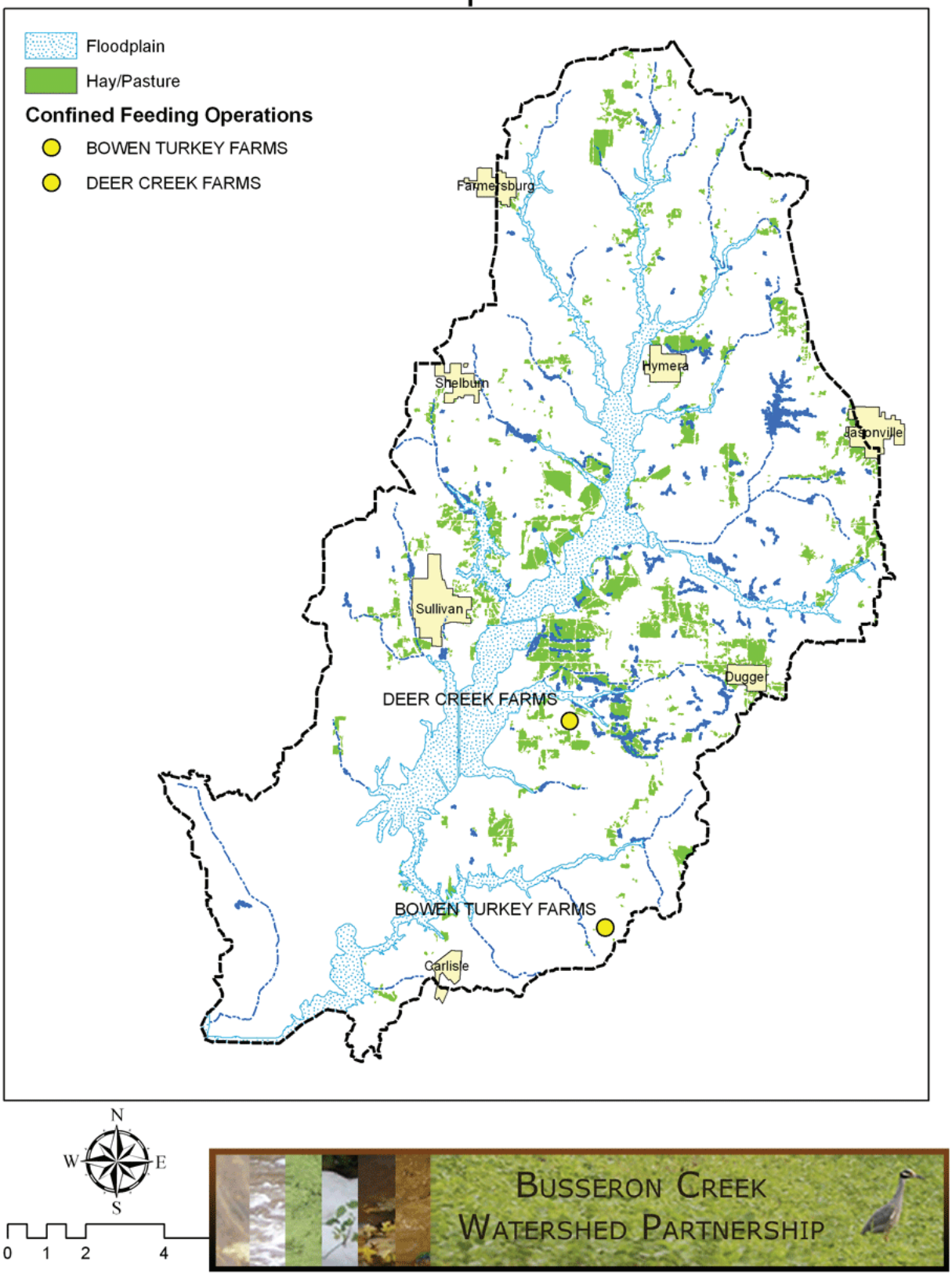

Figure III-12 – Confined Feeding Operations and Pasture / Hayland

(g) Pre-SMCRA and Abandoned Mine Lands

A majority of the BCW is covered by abandoned surface and underground mining sites. The Surface Mining Control and Reclamation Act (SMCRA) of 1977 addresses the water-quality problems associated with acid mine drainage and requires that extensive information about the probable hydrologic consequences of mining and reclamation be included in mining-permit application so that the regulatory authority can determine the probable cumulative impact of mining on the hydrology. The Indiana regulatory authority lies within the Department of Natural Resources – Division of Reclamation (DoR).

After the passage of SMCRA, taxes have been levied and collected against each ton of ore produced. These funds are used to reclaim abandoned mine lands. In addition, mining operations are required to bond their activities to insure reclamation is completed according to current standards. Should a coal company fail to reclaim a site, the bond is forfeited and used to restore the lands. Should the surety company file bankruptcy, the property is reclaimed using the AML funds generated through ore production taxes.

The BCW was extensively coal mined (surface and underground) from the late 1800's (*Figure III-13 – Lands Designated as Abandoned Mine Lands, Figure III-14 – Closed Surface Mine Areas, and Figure III-15 – Closed Underground Mines*). Historic, pre-law practices have had a significant influence on the streams and surrounding landscape of the watershed, including:

- Residual strip mine ponds and mine waste piles (gob piles)
- Surface hydrology alteration
- Complete elimination of some headwater streams
- Altered topography and vegetation
- Increased stream bank erosion and sedimentation
- Introduction of invasive species

Additional coal mining impacts can include mine collapses/blowouts, subsidences, and improper burial of gob. In some cases, abandoned underground mines may cave in (also known as subsidence) and "capture" a stream flowing over it. More likely, according to anecdotal evidence, areas of subsidence are utilized as a means of grey water and/or septic disbursal. Water flow may be routed underground into a series of old shafts and mining rooms. Pre-1977 surface mines may have placed pyrite-containing deposits at or above water tables, allowing ground water to infiltrate those layers.

As the water mixes with oxygen and comes into contact with pyrite in the residual coal seams, sulfuric acid is formed. The highly acidic water eventually percolates to the surface elsewhere in the watershed through rock fractures or man-made intrusions and has the ability to significantly influence water quality.

The residual effects of pre-law mining have scarred the terrestrial landscape of the watershed, and these impacts have had a significant influence on water quality as Acid Mine Discharge (AMD) from seeps, mine tailings/gob piles and exposed coal seams enter Busseron Creek and its tributaries. AMD generally displays elevated levels of one or more the following parameters:

- Acidity
- Metals
- Sulfates
- Suspended Solids

Post-SMCRA mining is regulated by the Indiana Department of Natural Resources, Division of Reclamation.

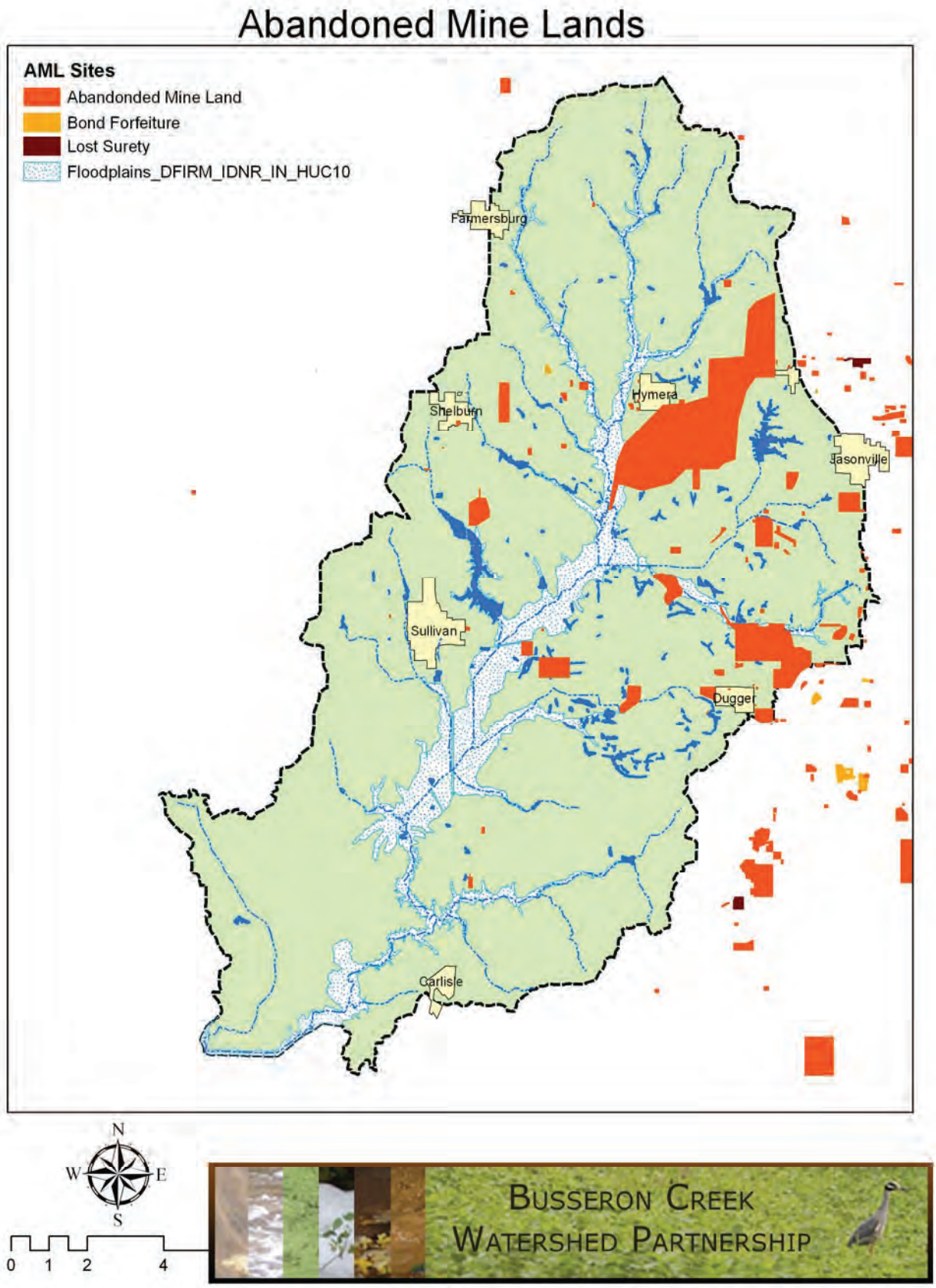

Figure III-13 – Lands Designated as Abandoned Mine Lands

Closed Surface Mines

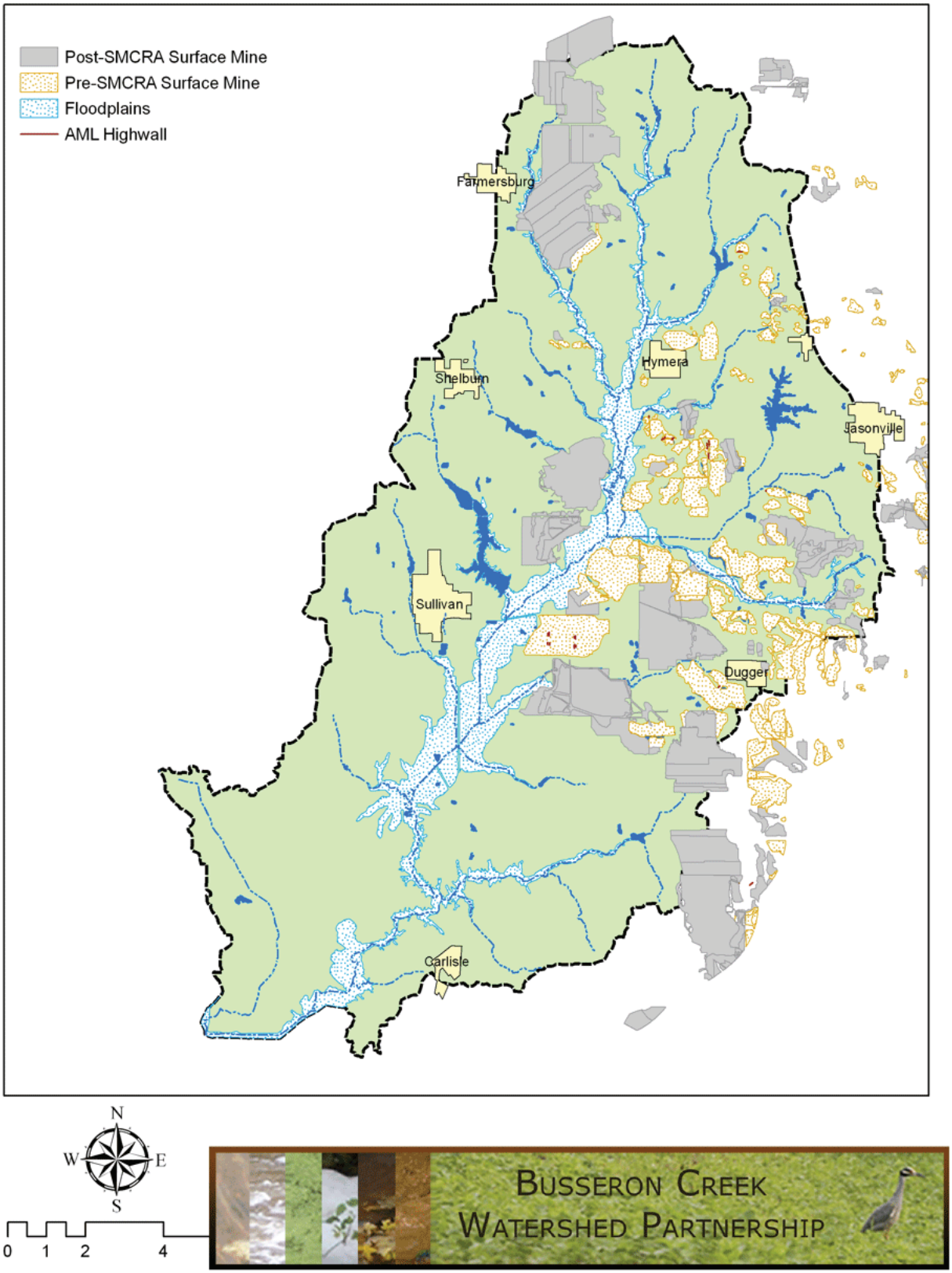

Figure III-14 – Closed Surface Mine Areas

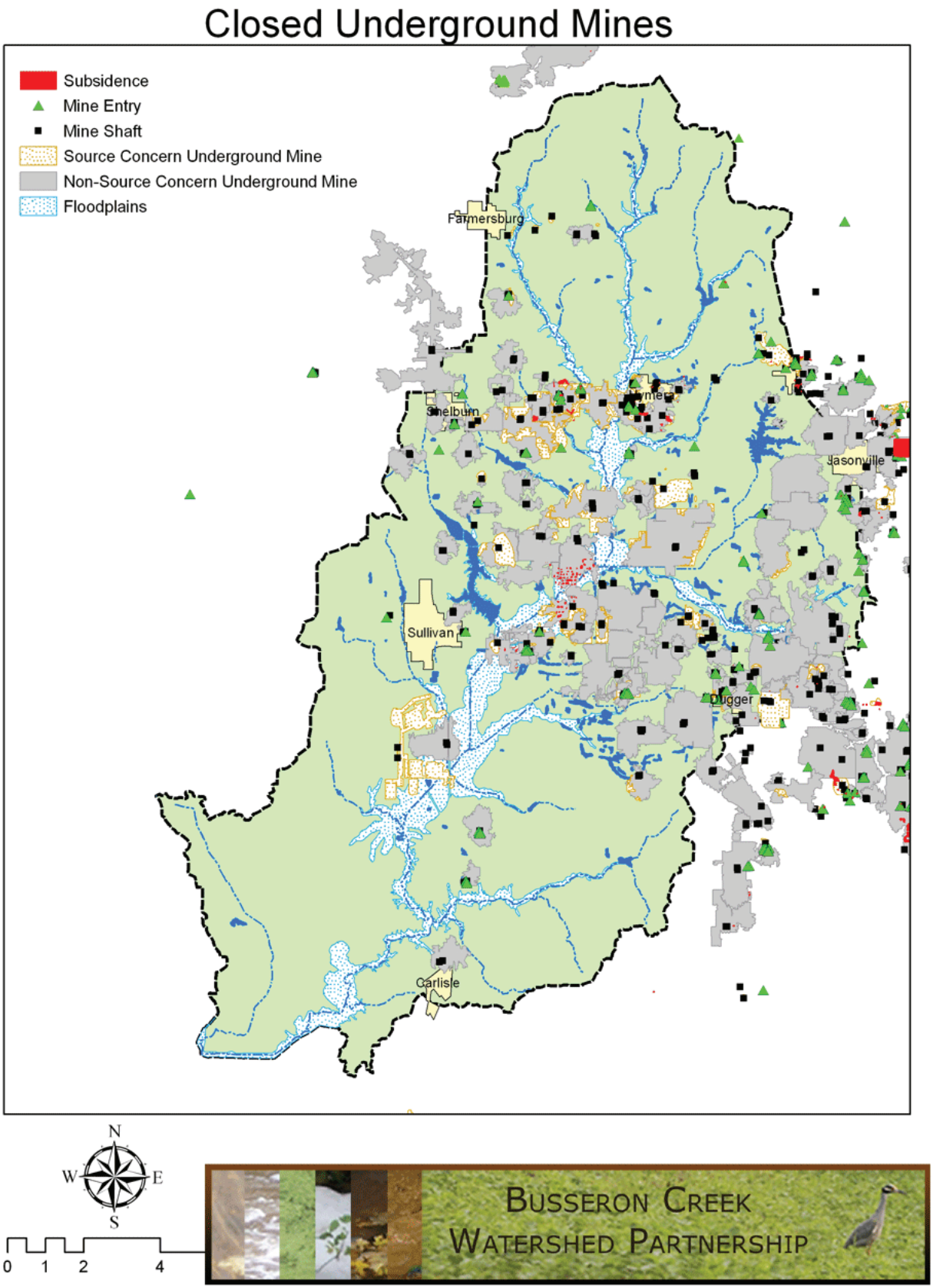

Figure III-15 – Closed Underground Mines

(h) Active Mines

There are currently two surface mining operations actively removing overburden and/or coal, one active underground mining facility, and one surface operation that is making preparations to resume operations (See *Figure III-16 – Active Coal Mines*). Section 404 of the Clean Water Act established a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the U.S. regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and *mining projects*. Section 404 requires a permit before dredged or fill material may be discharged into waters of the U.S. and is administered by the Army Corps of Engineers and the Environmental Protection Agency.

In addition, the Indiana Department of Natural Resources – Division of Reclamation (DOR) administers Indiana's Surface Coal Mine Reclamation Act following the grant of primacy to the state by the United States Department of Interior, Office of Surface Mining, in 1982.

The following is from the DOR website (http://www.in.gov/dnr/reclamation/8394.htm)

(i) Topsoil Removal and Storage

Before mining begins, mining companies must plan for the replacement of topsoil after the coal has been removed. Details involving the removal, storage, replacement, and protection of the topsoil from erosion are listed in the mine operation plan. Topsoil, which is removed in a separate layer from areas to be disturbed, is either immediately replaced, or stored on approved locations. Topsoil depth must be determined before mining to assure proper replacement for growing row crops and other vegetation. The replaced soil profile on areas designated as prime farmland must be at least 48 inches including topsoil and subsoil.

(ii) Overburden Removal and Placement

The coal operator places the blasted rocky material in the bottom of the pit once coal removal in the area is complete. Overburden can contain layers with pyrite, which when exposed to air and water, can produce acid. Mixing these layers and burying them with neutral materials in the pit, prevents acid production by blocking exposure to oxygen

To assure that a suitable rooting material is available for cropland capability, the subsoil layers are placed on top of the graded rocky overburden during reclamation. Any toxic overburden identified in the pre-mining inventory must be treated or covered with an adequate layer of nontoxic, noncombustible material.

To prevent water pollution, all water affected by the mining operation must pass through approved sediment control structures before leaving the mine site, and must be in compliance with all applicable State and federal water quality laws, including water discharge permits issued by the Indiana Department of Environmental Management.

Coal companies maintain siltation structures on the site until permanent vegetation has been established, and water quality coming into the pond meets water quality limitations. Ponds not approved for retention after mining must be removed and reclaimed.

It is the responsibility of mining operators to monitor groundwater levels and quality throughout the mining and reclamation process. The operator will furnish an alternative water supply, in conformance with Indiana water law, where an existing water supply from groundwater used as a drinking water source is affected by contamination, depletion, or interruption due to surface mining activities.

(iii) Coal Processing Waste Disposal

The operation plan must detail where coal will be stockpiled, as well as what type of cleaning and processing are to occur. The waste produced from the coal cleaning process can be potentially acid-forming and detrimental to plant life. The material must be adequately treated or covered with an adequate layer of nontoxic, noncombustible earthen material, to neutralize and prevent production of acid water. Toxic materials must be placed in areas of the mine where contact with surface and groundwater is minimized.

(iv) Mine Reclamation Planning

Throughout the reclamation process, coal operators must meet detailed requirements. A mine reclamation plan will show how overburden will be graded, subsoil and topsoil replaced and re vegetated, post mining land uses established, and pre-existing streams restored. Coal operators give a timetable for the completion of each step in the reclamation process. They must also give an estimated cost of reclamation, including a statement as to how the operator plans to comply with the law.

Mining companies must plan to provide rough grading of mined overburden within 180 days of coal removal and have no more than four un graded spoil ridges behind the active pit, unless additional time is granted for a good reason such as adverse weather conditions. The replaced overburden must be shaped to the approximate original contour of the land so that it drains properly and pre-mining drainage patterns are re-established.

Materials from the initial pit or box cut must be graded to blend with un mined land. Final grading must be completed in a timely manner; usually in time for the next growing season. This includes any subsoil or topsoil replacement and installation of erosion control measures such as terraces, diversions, grass waterways, and drains. An attempt must be made to grade replaced soil in a manner which limits compaction. Most plans specify a crop of wheat or oats followed by a grass-legume mix for several years on reclaimed land to prevent soil erosion and to restore soil structure.

After this period, and before the company's reclamation responsibility ends, vegetation must be established which is consistent with the post-mining land use plan. Additionally, operators must establish row crop production on prime farmland areas. Field test plots are the most common method used to verify vegetative growth. A count of vegetation covering the ground is used on land uses other than row cropland. A five to ten-year vegetation liability period begins when all grading is completed and the land is planted to a crop capable of supporting the post-mining land use.

For prime farmland, full restoration of 100% of the original un mined land productivity is required. This may be accomplished using typical crops (eg. corn, soybeans, wheat) for three crop years before final release of reclamation responsibility.

Forest land use must show growth of 450 trees per acre for a three-year period. Permanent water impoundments may be constructed from the final pit of the mined area, or from a sediment pond, if the alternative land use proposal has been approved, or if water was present on the area prior to mining.

(v) Underground Mining

Today underground mining accounts for a relatively minor portion of Indiana production, with annual output of only about 5% of the total coal mined in the State. At this time the prevalent underground mining technique employed in Indiana is the room and pillar mining method. The tunnels where the coal is removed are called "rooms". The coal blocks which are left behind to support the roof and the surface are called "pillars". A machine called a continuous mining machine rips the coal from the seam with a rotating head. Blasting is seldom used in underground extraction

of coal in Indiana except for shaft development. Conveyors transport coal from the working face to the shaft or slope tunnel which transports coal to the surface for processing and shipping.

Other methods of extraction exist which allow subsidence to occur in a controlled and predictable fashion. The most common planned subsidence mining technique used in the United States today is called long wall mining. Secondary mining for partial pillar recovery is sometimes used for higher extraction. The Division of Reclamation regulates the environmental affects of underground mining. Other state and federal agencies, such as the Indiana Bureau of Mines and U.S. Mine Safety and Health Administration are responsible for safety of mine workers.

(vi) Underground Mine Permit Application Process and Requirements

Procedures for public notice, public participation and application review for underground permit applications are identical to those for surface mining applications. Environmental protection and reclamation requirements are also virtually identical, except that underground mining applications must also contain a subsidence control plan and special provisions for prior notice to surface owners, who will be affected by coal extraction.

(vii) Underground Mining: Subsidence Control Plan

Underground applicants must devise a detailed subsidence prevention or control plan based on detailed local geological analysis, engineered safety factor calculations and the sensitivity of surface features to be protected, such as buildings, impoundments, roads and utility transmission lines. Underground miners must provide information on the coal removal technique, percentage of coal extraction, pillar and room dimensions, geologic layers above and below the coal, mapping of proposed mined areas, groundwater systems as well as an extensive inventory of land features and structures located above the coal to be mined, such as homes, outbuildings, roads, churches, public buildings, impoundments, utility transmission lines and any other structures.

The DOR's subsidence specialist evaluates supplied information to obtain a determination that sufficient mine stability is designed for room and pillar mines; or, that planned subsidence mining, such as long wall mining or pillar removal mining, is designed to occur in a planned and predictable fashion which will be conducive to restoration of the land surface. In addition to plans to prevent or control subsidence, underground miners must provide back up plans for restoration of the surface land and features in the event that a subsidence results in damage in spite of extensive prevention provisions. The mitigation plan must demonstrate that the operator will restore the land and structures to a condition which will support the same uses which existed prior to subsidence. As an additional protection measure, the operators are required to carry a non-cancelable liability insurance policy which covers subsidence damages, should they occur.

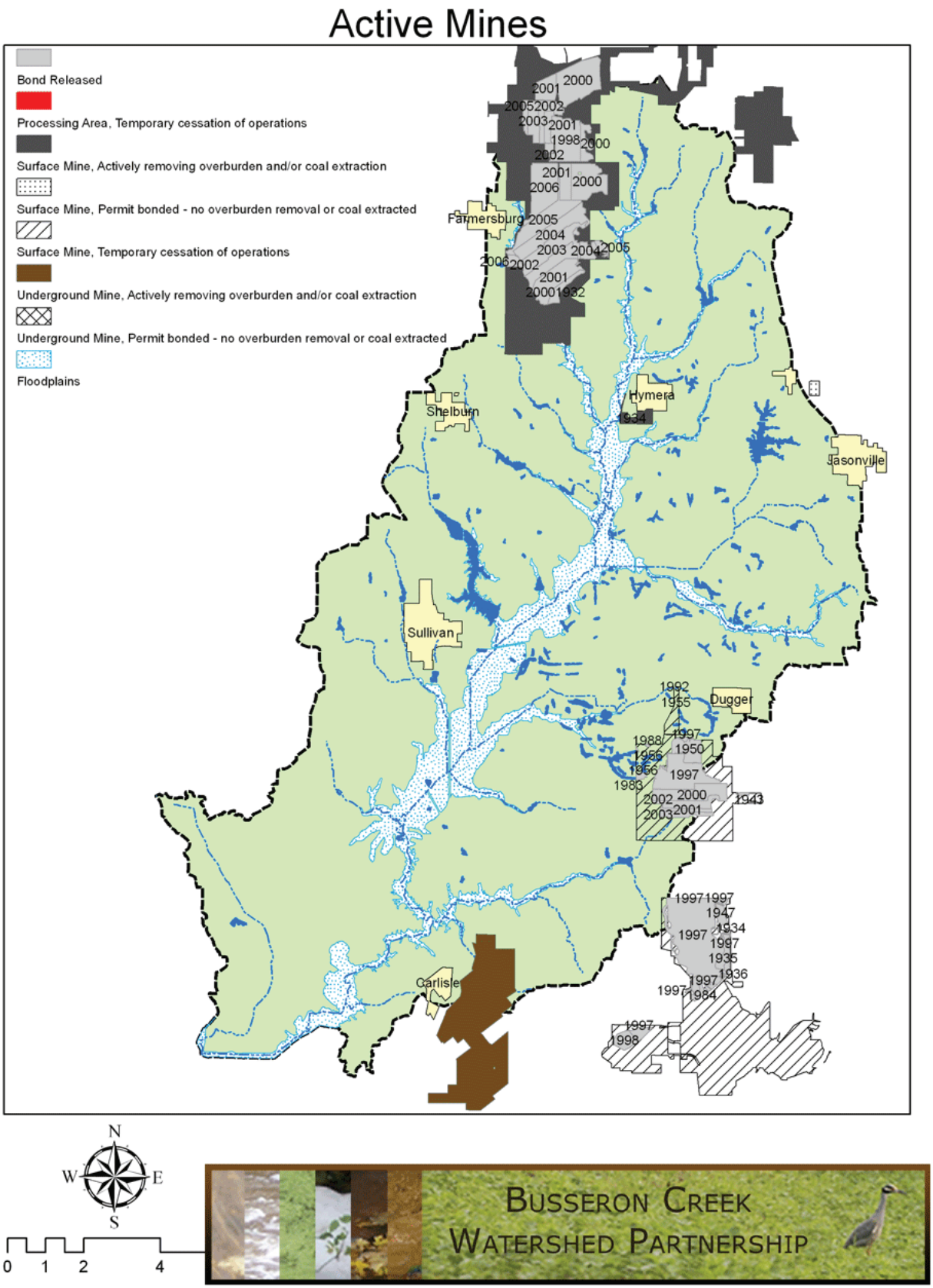

Figure III-16 – Active Coal Mines

(h) Oil & Gas Wells

As with coal, extraction of oil and gas has been an important source of economic development for the watershed. There is anecdotal evidence of orphaned wells in the region, but exact number, location, and severity is unknown at the time of publishing.

Current drilling activities appear to be concentrated in extraction of coal bed methane. Large gas pipeline installations are also currently underway in the watershed.

There are at least 1200 oil and gas wells in all of Sullivan County. The number of wells in the watershed is unknown, but *Figure III-17 – Oil and Gas Wells (IGS)* may be used to identify concentrations of wells and associated petroleum fields in the region.

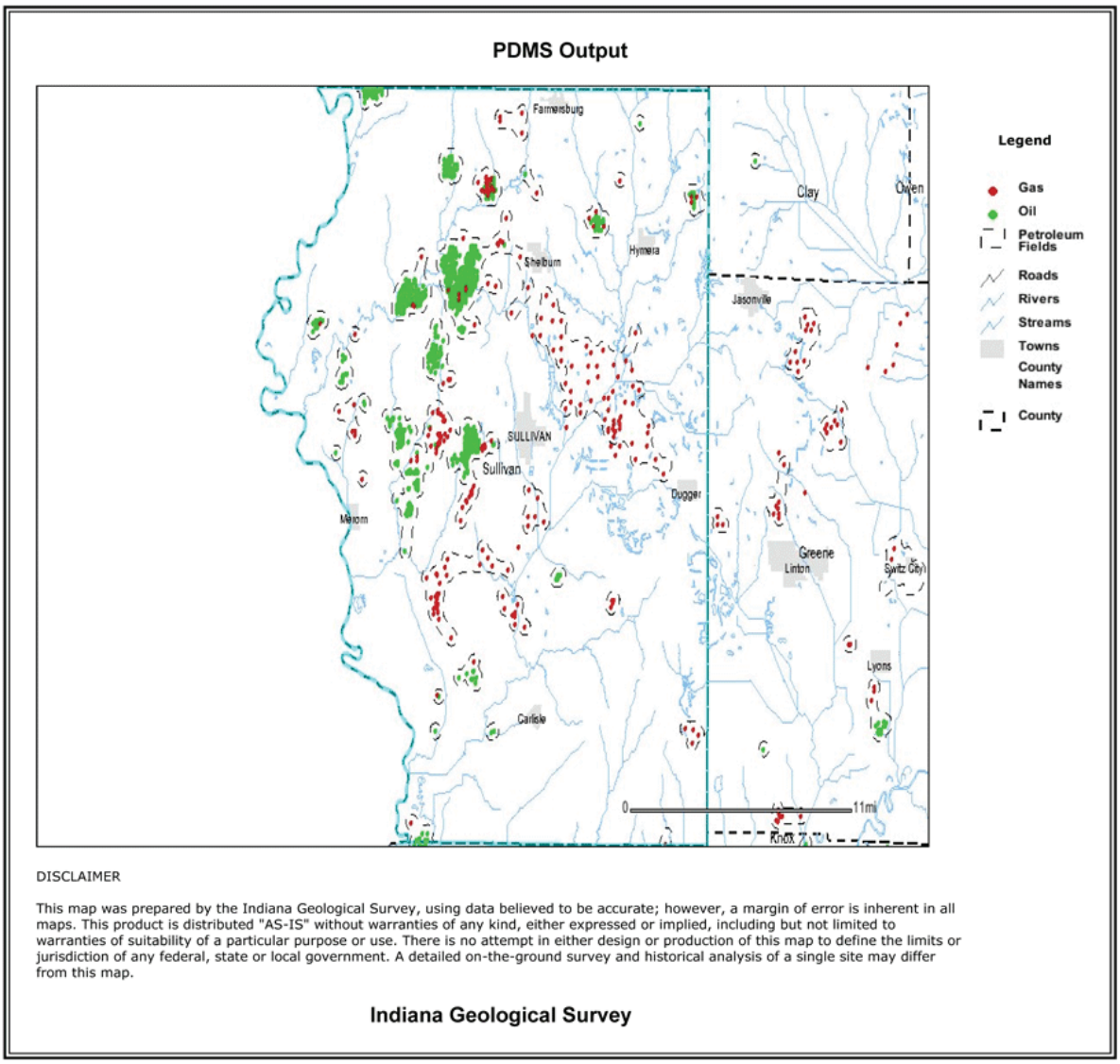

Figure III-17 – Oil and Gas Wells (IGS)

(i) Timber Management

Land use has been altered by removing high quality hardwood trees and replacing them with poorly grown, low quality pioneer species. Riparian areas have been damaged or destroyed and landowners have quickly converted to crop or pastureland, leading to uncontrolled soil erosion, lack of filtering capacity for farm chemicals and a decrease in wildlife based on loss of habitat.

The area contains approximately 7,500 forested acres. (See *Figure III-18 – Tree Cover* for locations of dense forest canopies.) The trees harvested from these areas supply local saw mills and a paper mill. It should be noted that the majority of current timbering activities are executed in such as way as to maintain future harvest quality.

Although executed in relatively small increments, *land clearing* activities – permanent removal of timber stands, fencerows, and riparian buffers – have significantly altered the landscape of the watershed.

Wildlife habitat and water quality have been reduced by removing buffers from creeks, field edges and by improperly planned and executed timber harvests. Biotic communities have become impaired by increased soil erosion from timber harvests.

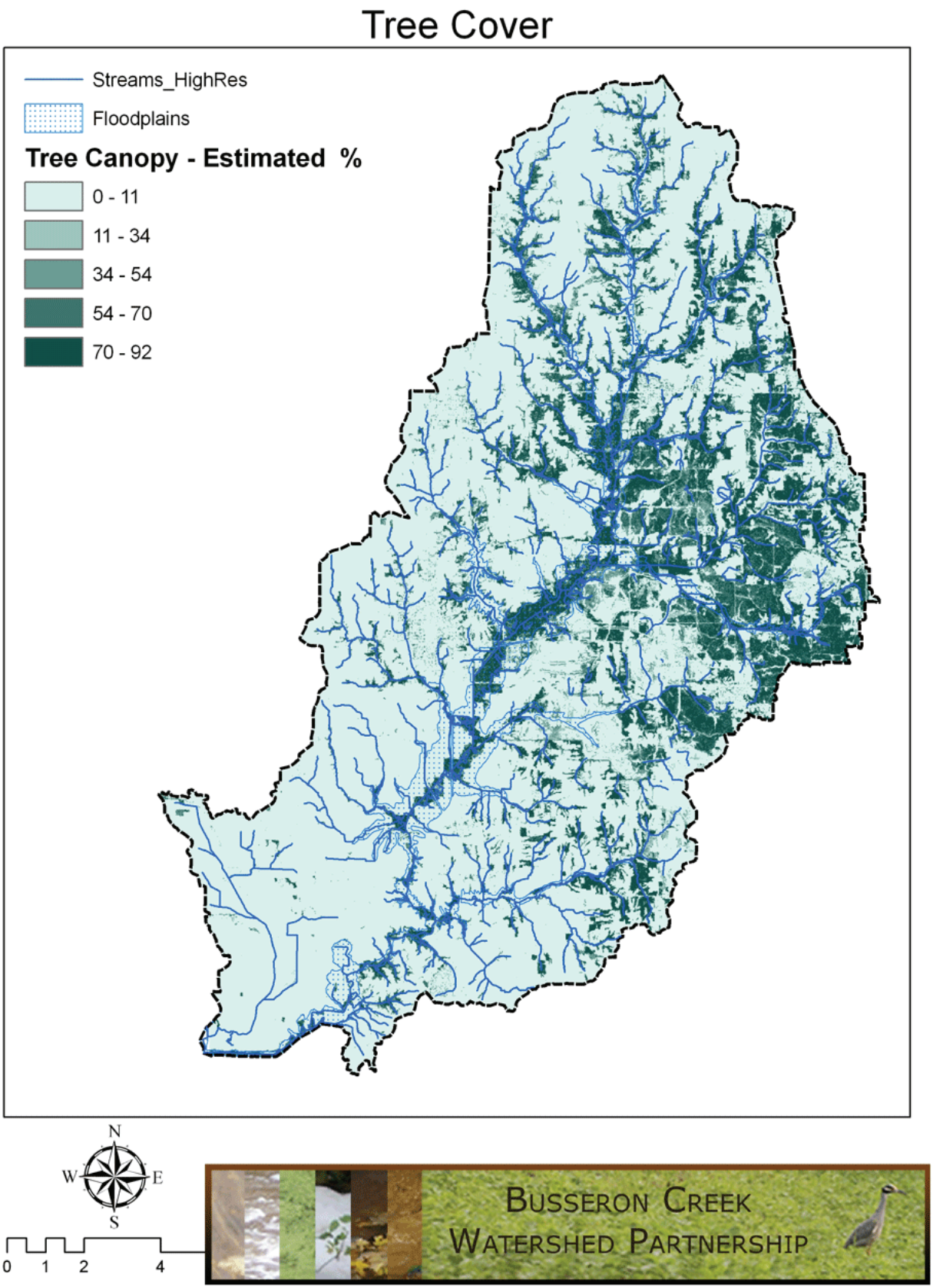

Figure III-18 – Tree Cover

(j) Impervious Surfaces

Impervious surfaces are hard surfaces such as asphalt, concrete, rooftops, and highly compacted soils. *Figure III-19 - Impervious Cover* illustrates areas of imperviousness – generally roads and towns. This impervious cover prevents rain water from entering into the soil and forces it to run off the land until reaching a place where it can enter the soil or is incorporated into a man-made drainage system that carries it directly to a stream or lake. In developed areas, land that once absorbed rainfall is now covered with buildings and pavement, thus more rainfall is entering drainage systems and surface waters.

Particularly in incorporated towns, high volumes of surface runoff overload storm sewer systems, resulting in combined sewer overflows in and downstream from the town of Sullivan and localized flooding in Sullivan and elsewhere. In addition, water velocities associated with these rain events further channelize streams and degrade stream banks.

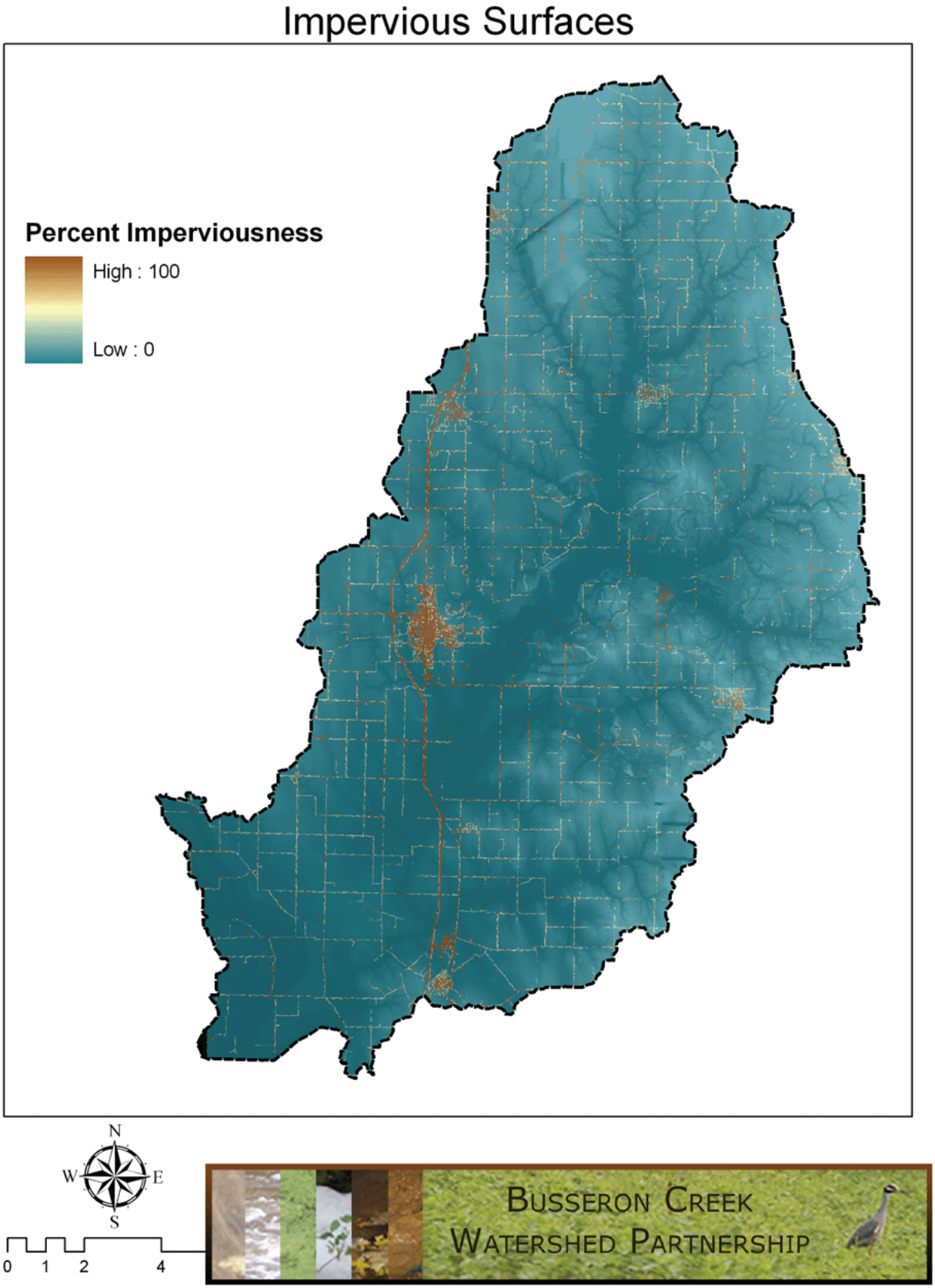

Figure III-19 - Impervious Cover

(k) Wastewater Systems

Facilities with National Pollutant Discharge Elimination System (NPDES) permits to discharge wastewater within the BCW include small to large publicly owned wastewater treatment facilities as well as industrial dischargers. There are 18 NPDES facilities within the watershed. Those which are neither related to mineral extraction nor national security are illustrated in *Figure III-20 – NPDES Permit Locations.* Names of permit holders and activity descriptions are noted in *Table III-9 – NPDES Facilities*, below. The seven Wastewater Treatment Plants (WWTP) in the watershed are potential sources of nutrients and the various industrial dischargers associated with mining activities area potential sources of Total Suspended Solids (TSS) and metals. *Table IV-1 NPDES Permit Violations*, *page 87*, summarizes facility violations that occurred over a 4-year period ending in December 2007. (See Appendix D-b, for violation specifics)

Water quality problems associated with waste water treatment and septic systems are found everywhere in the watershed. The area is populated with people that have inherited their properties. Improperly designed, installed, and maintained septic systems are allowing untreated or improperly treated effluent to reach streams. This has resulted in unacceptable levels of E. coli, breeding grounds for West Nile Virus bearing mosquitoes and other health related issues. The general population has a lack of understanding about the need to maintain these systems. Old wells have not been properly closed and are often used for waste disposal. All urban areas within the watershed have or are experiencing sewage disposal problems ranging from incomplete treatment to unplanned overflow during storms.

There are no Municipal Separate Storm Sewer System (MS4) entities permitted under 327 IAC 15-13 (Rule 13) located within the watershed.

Table III-9 – NPDES Facilities

NPDES ID	Facility Name	Activity
INP000149	ALLOMATIC PRODUCTS CO	MOTOR VEHICLE PARTS AND ACCESSORIES
ING040195	ATKINSON EXCAVATING CALDONIA PIT	BITUMINOUS COAL AND LIGNITE SURFACE MINING
IN0039837	CARLISLE MUNICIPAL STP	SEWERAGE SYSTEMS
IN0046809	CARLISLE PUBLIC WATER SUPPLY	WATER SUPPLY
IN0039322	DUGGER MUNICIPAL STP	SEWERAGE SYSTEMS
IN0021148	FARMERSBURG MUNICIPAL WWTP	SEWERAGE SYSTEMS
IN0059633	GLENDORA TEST FACILITY	NATIONAL SECURITY
ING040198	HYMERA MINE	BITUMINOUS COAL AND LIGNITE SURFACE MINING
IN0040134	HYMERA MUNICIPAL STP	SEWERAGE SYSTEMS
ING040127	KINDILL MINING MINE 3	BITUMINOUS COAL AND LIGNITE SURFACE MINING
INP000161	NORTH AMERICAN LATEX CORP.	FABRICATED RUBBER PRODUCTS, NOT ELSEWHERE CLASSIFIED
ING040010	PEABODY COAL COMPANY	BITUMINOUS COAL AND LIGNITE SURFACE MINING
IN0060364	PULSE ENERGY SYSTEMS LLC	NATURAL GAS TRANSMISSION
IN0020389	SHELBURN MUNICIPAL WASTE WATER TREATMENT PLANT	SEWERAGE SYSTEMS
IN0024554	SULLIVAN MUNICIPAL WWTP	SEWERAGE SYSTEMS
ING040199	SUNRISE COAL CARLISLE MINE	BITUMINOUS COAL UNDERGROUND MINING
ING040062	BLACK BEAUTY CO FARMERSBURG MINE	BITUMINOUS COAL AND LIGNITE SURFACE MINING
IN0002119	LATTA INDIANA DIESEL HOUSE	RAILROADS, LINE-HAUL OPERATING
IN0030228	SHAKAMAK STATE PARK	LAND, MINERAL, WILDLIFE, AND FOREST CONSERVATION

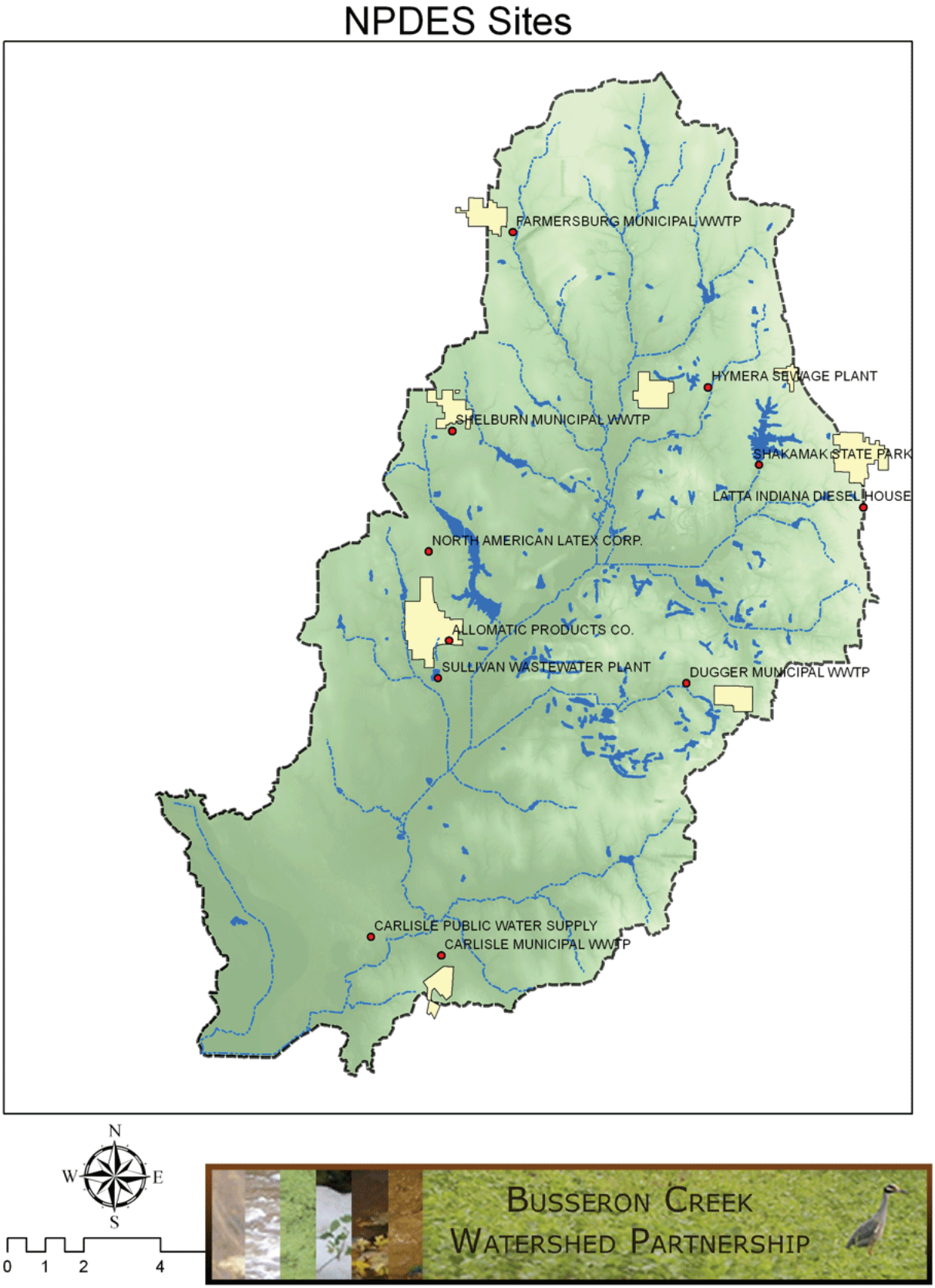

Figure III-20 – NPDES Permit Locations

(I) Solid Waste Management

In most instances solid waste disposal is done on a fee basis. Illegal dumping in streams is rampant and burning of household trash is common. Construction and shop debris is often buried causing decay and leaching of heavy metals through the soil. These practices are common throughout the watershed.

The public has the misconception that mineland is wasteland and does not hesitate to add to the problem by dumping household and hazardous waste on the surface of these lands, in used mine shafts, and in openings created by subsidence.

Of the two permitted solid waste facilities shown in *Figure III-21 – Permitted Solid Waste Sites*, only the Sullivan County Landfill is open to the general public.

Solid Waste

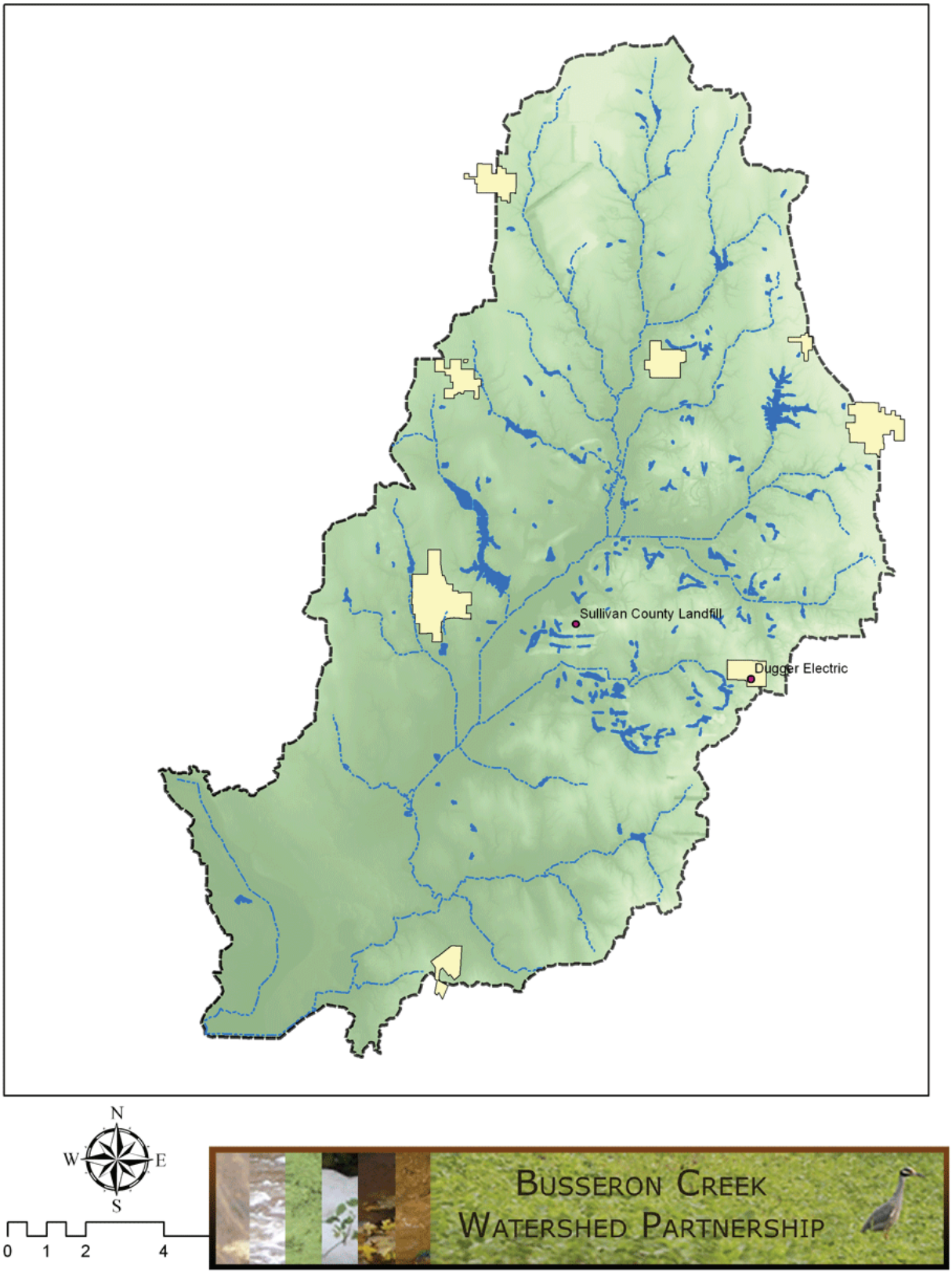

Figure III-21 – Permitted Solid Waste Sites

(m) Brownfields

Generally, a brownfield is a property where redevelopment is complicated due to actual or potential environmental contamination.

Indiana defines a brownfield as:

- a parcel of real estate that is abandoned or inactive; or may not be operated at its appropriate use;
- and on which expansion, redevelopment, or reuse is complicated;
- because of the presence or potential presence of a hazardous substance, a contaminant, petroleum, or a petroleum product that poses a risk to human health and the environment.

As shown in *Figure III-22 - Brownfields*, four sites are located within the watershed:

(i) Stringer Welding and Machine Company

8196 Station Street, Dugger

"Comfort Letter" prepared and issued by IDEM. A Comfort Letter is issued to a party that qualifies for an applicable exemption to liability found in Indiana law or IDEM policy, but is not a legal release from liability. The Comfort Letter explains the applicable liability exemption or IDEM's exercise of enforcement discretion under an applicable IDEM policy.

Arsenic levels above the 2001 Risk Integrated System of Closure Residential Default Closure Level of 3.9 ppm, but below the Industrial Default Closure Level of 19.55 ppm. The following restrictions have been placed on the property:

The Owner shall:

A) Not use the property for agricultural purposes
B) Neither engage in nor allow the installation or use of potable water wells on the Real Estate. There shall be no use of groundwater underlying the Real Estate that could cause exposure of humans or animals to the groundwater underlying the Real Estate, other than for site investigation or remediation purposes, without department (IDEM) *approval.*
C) Not use the Real Estate for residential purposes including, but not limited to daily care facilities (e.g. daycare center).

(ii) Former Hopewell Gas Station

307 Hopewell, Farmersburg (Current Farmersburg Town Hall)

"No Further Action" letter prepared and issued by IDEM regarding investigations and removal of underground storage tanks. A no further action letter is similar to a comfort letter (see i. Stringer Welding) but it is issued specifically for abandoned gas station properties.

Levels of contaminants remain above Residential Closure Levels. The following restrictions have be placed on the property:

The Owner shall:

A) Not use the Real Estate for residential purposes including, but not limited to daily care facilities (e.g. daycare center).
B) Not use the property for agricultural purposes
C) Neither engage in nor allow the installation or use of potable water wells on the Real Estate. There shall be no use of groundwater underlying the Real Estate that could cause exposure of humans or animals to the groundwater underlying the Real Estate, other than for site investigation or remediation purposes, without department (IDEM) *approval.*

(iii) General Motors Auto Dealer and Gas Station

102 S Alexander, Carlisle

"No Further Action" letter prepared and issued by IDEM July 2006. (See ii Hopewell Gas Station) Site is "Ready for Redevelopment"

(iv) Former Swan Service and Tire

Dugger

"Site Status" letter prepared and issued by IDEM January 2007. Site is "Ready for Redevelopment"

A Site Status Letter is issued to a party that did not cause or contribute to or knowingly exacerbate the contamination and can demonstrate that current levels of contaminants of concern at the brownfield substantially meet current cleanup criteria as established by IDEM under the Risk Integrated System of Closure. The potential liability of the party requesting the letter is not addressed. The Site Status Letter states that based on a technical analysis of information submitted to IDEM pertaining to site conditions, IDEM concludes that current site conditions do not present a threat to human health or the environment and that IDEM does not plan to take or require a response action at the brownfield site.

(v) Castle Scrap Processing

Jasonville

Complaint issued August 2005.

Petroleum Remediation Grant awarded June 2007.

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Brownfields

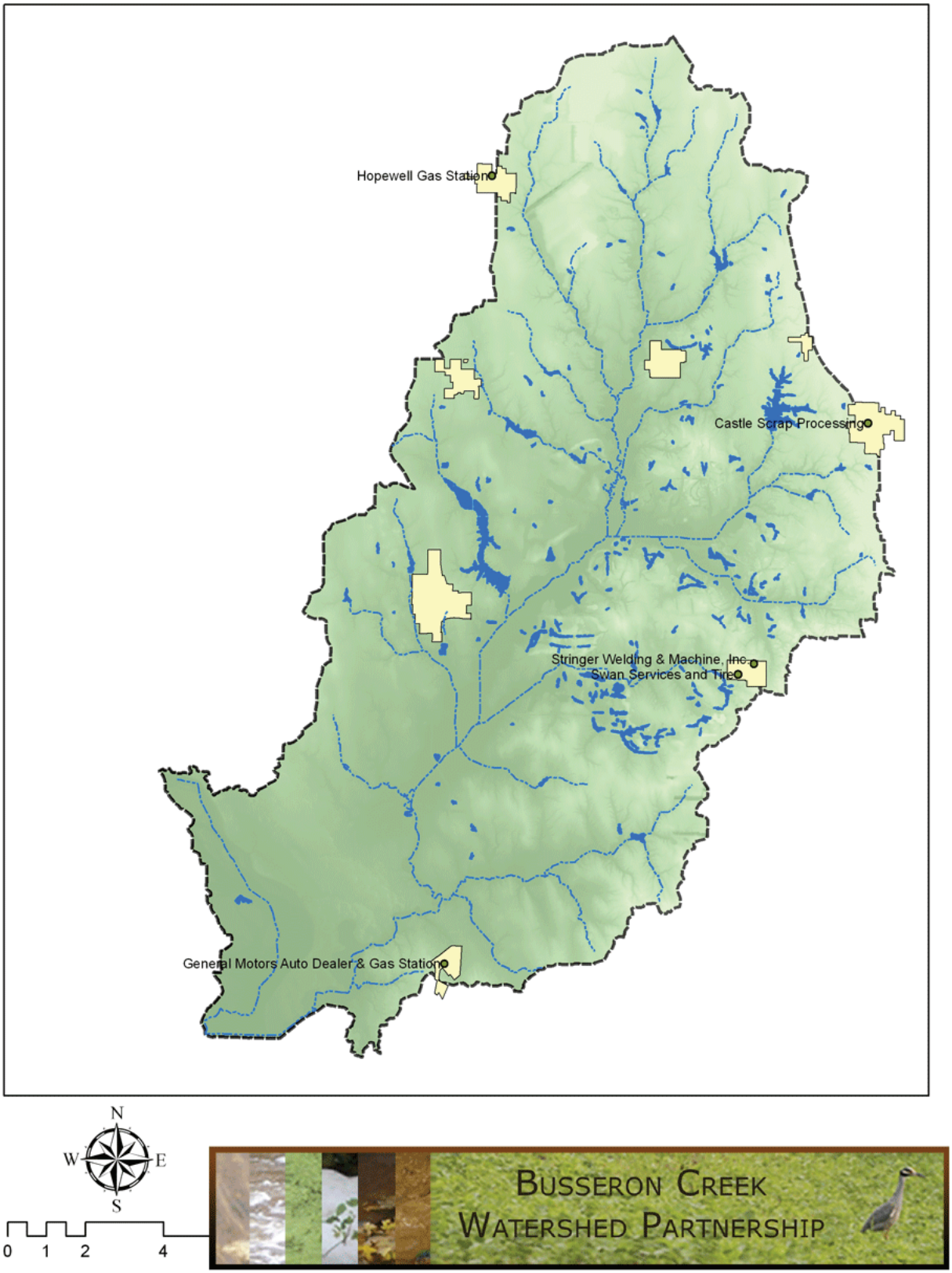


Figure III-22 - Brownfields

(n) Wildlife and Recreation Areas

The Busseron Watershed is a Mecca for outdoor and natural resource management. The watershed contains two highly developed recreation parks that have included swimming: Shakamak State Park, a State-managed property and Sullivan Park and Lake, a County-managed property.

The 1700 acre Shakamak Park is the site of three man-made lakes covering approximately 400 acres. The lakes of Shakamak park are the receiving bodies of water for approximately 1/3 of the Chowning Creek – Busseron Creek subwatershed (HUC 12). The lakes were once a Mecca for recreational activity as enthusiasts trekked to the park for the opportunity to camp, fish, and swim. During summer months cars often waited over an hour to enter the park and swimmers crowded its beaches. Years of degradation, particularly upstream from the lakes, had its devastating effect. Sedimentation filled the fingers of the three lakes. Documentation dating back to 1963 indicates that park staff was no longer able to control vegetation in the lake shallows due to sedimentation and the nutrient-rich run-off entering the waters. Thirty years later, in 1994, the lakes that were once the site of national AAU swim meets were permanently closed to swimming activities due to ongoing health concerns – a negative impact to the community, both environmentally and economically.

Sullivan County Park and Lake (SCPL) is still open to swimming as well as boating, fishing, and camping. In 2008, the SCPL was awarded a Lake and River Enhancement (LARE) grant through the Indiana Department of Natural Resources to develop a Sediment Removal Plan as well as a Nutrient and Sediment Load Reduction Plan. Documentation from this as well as prior studies indicate high levels of sedimentation from upstream sources as well as bank erosion. Initial calculations show over 480,000 cubic yards of sediment deposited in 85 acres of the North and Central regions of the 468 acre lake.

Sullivan Lake was constructed in 1968 by the Busseron Conservancy District (BCD) as part of Indiana Watershed Protection and Flood Prevention Act (PL-566). The BCD was formed in 1958 for the purpose of sediment and flood control. Of 26 proposed reservoirs, 19 were actually constructed, including Sullivan Lake. The lakes of the Conservancy District were designed with a twenty-five year lifespan. Some 40 years later, most of these reservoirs have filled with sediment.

In addition to SCPL, local governments manage several other small sites, including reclaimed mineland lakes and 85 cemeteries. (*Figure III-23 – City & County Managed Lands*)

There are two golf courses in the watershed, both located in the town of Sullivan: the SCPL course and the Elks.

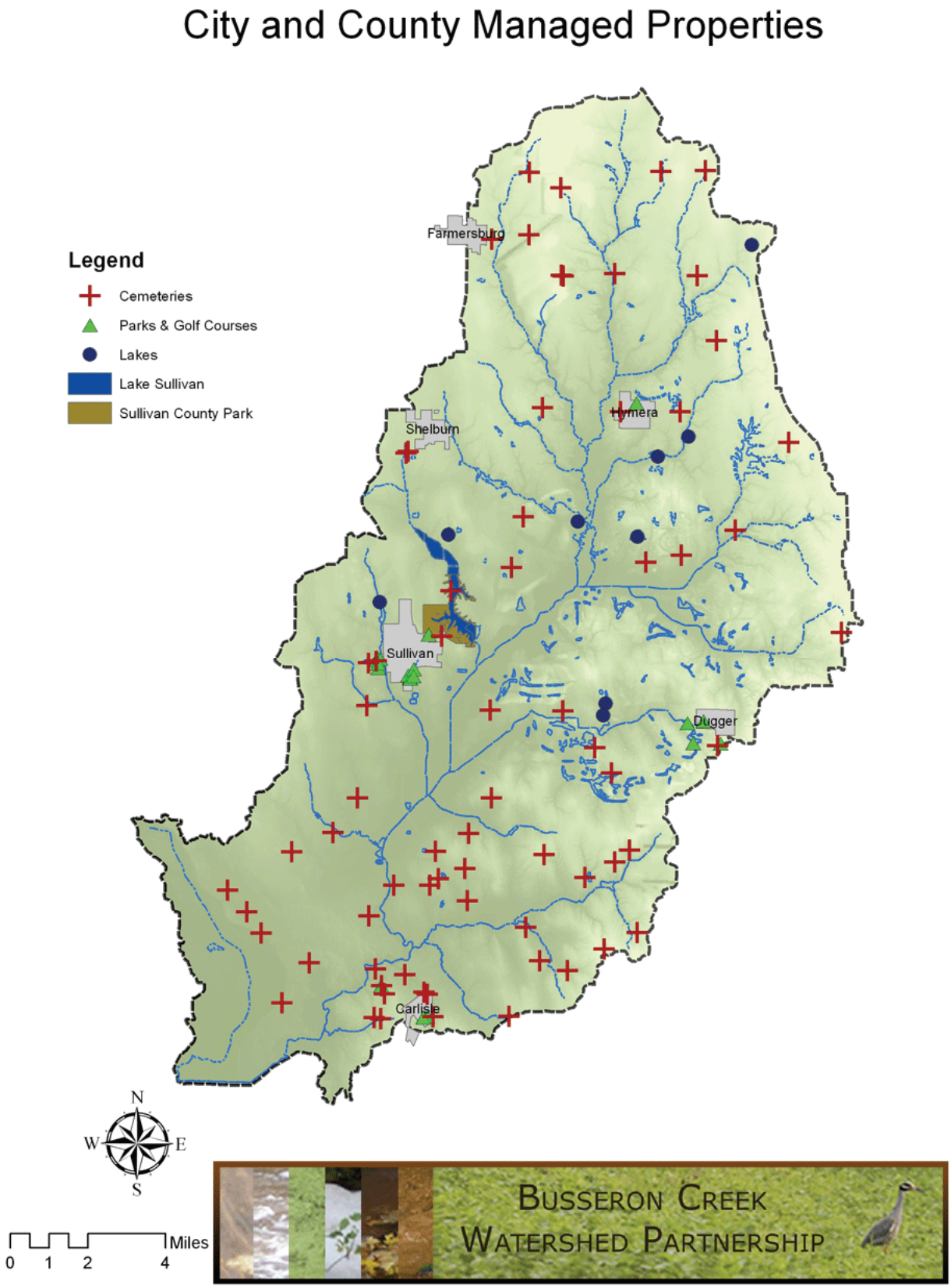


Figure III-23 – City & County Managed Lands

Wildlife and Recreation Areas, cont.

There are over 16,000 acres of public access wilderness lands in the Minnehaha Fish and Wildlife Area, Green Sullivan State Forest, and Redbird State Recreation Area. (*Figure III-24 – State Managed Lands*) Each of these attracts outdoor recreation enthusiasts that hunt, fish, and ride off road vehicles. The restoration of Goose Pond FWA in Greene County has increased the number of enthusiasts as well as the number and diversity of migratory bird species.

The relatively vast tracts of wilderness lands provide habitat for a number of endangered and marginal species including:

- Bald Eagle
- Yellow-Crowned Night Heron
- Prairie Falcon
- Henslow's Sparrow
- Short-Eared Owl
- Northern Harrier
- Least Bittern
- Cattle Egret
- Sandhill Crane
- Blandings Turtle
- Indiana Bat
- North American Cougar
- Bobcat

These areas also provide some of the larger tracts of wet-mesic forested floodplains, a high quality natural community considered to be rare or uncommon on both global and state scales.

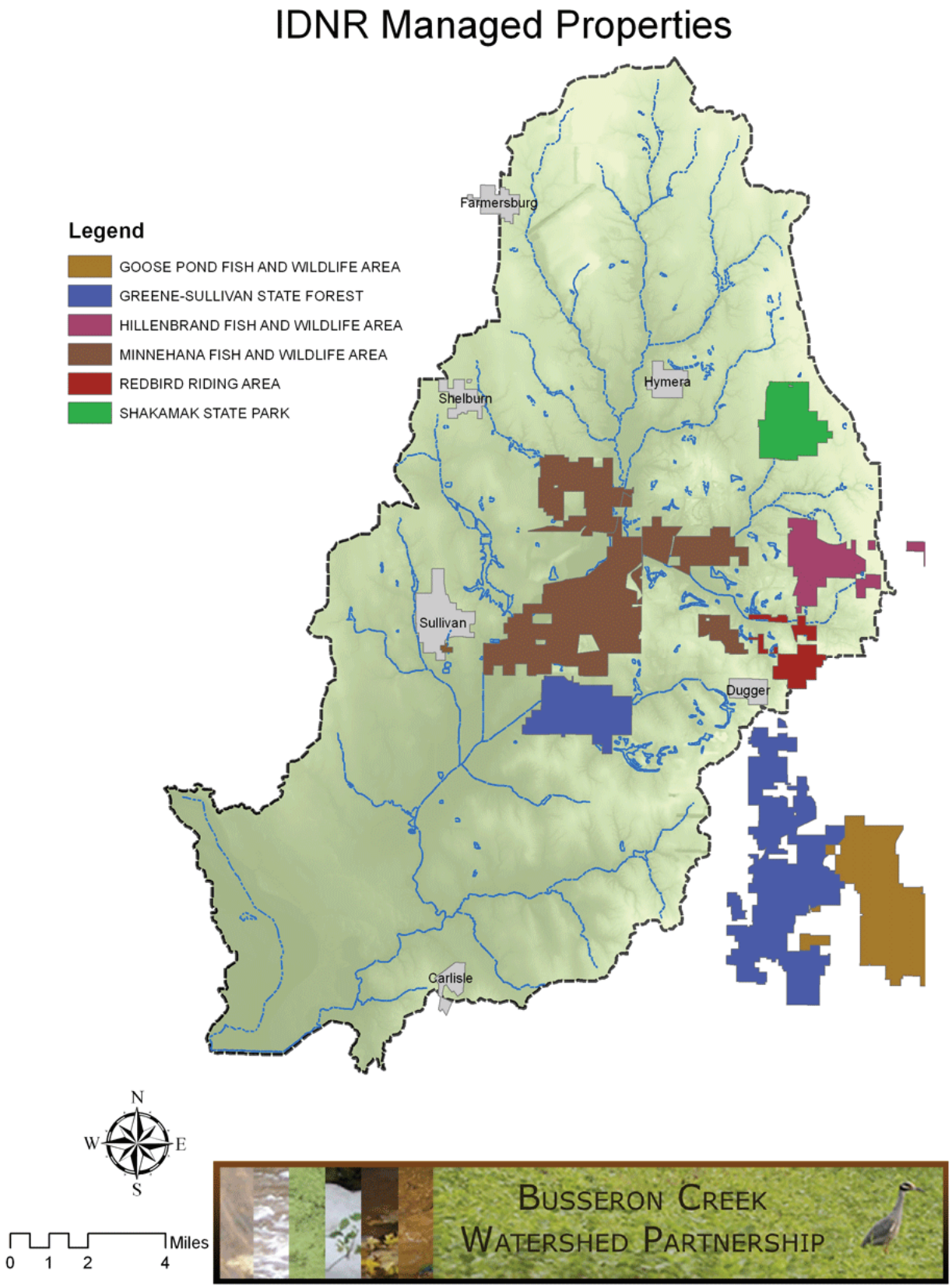
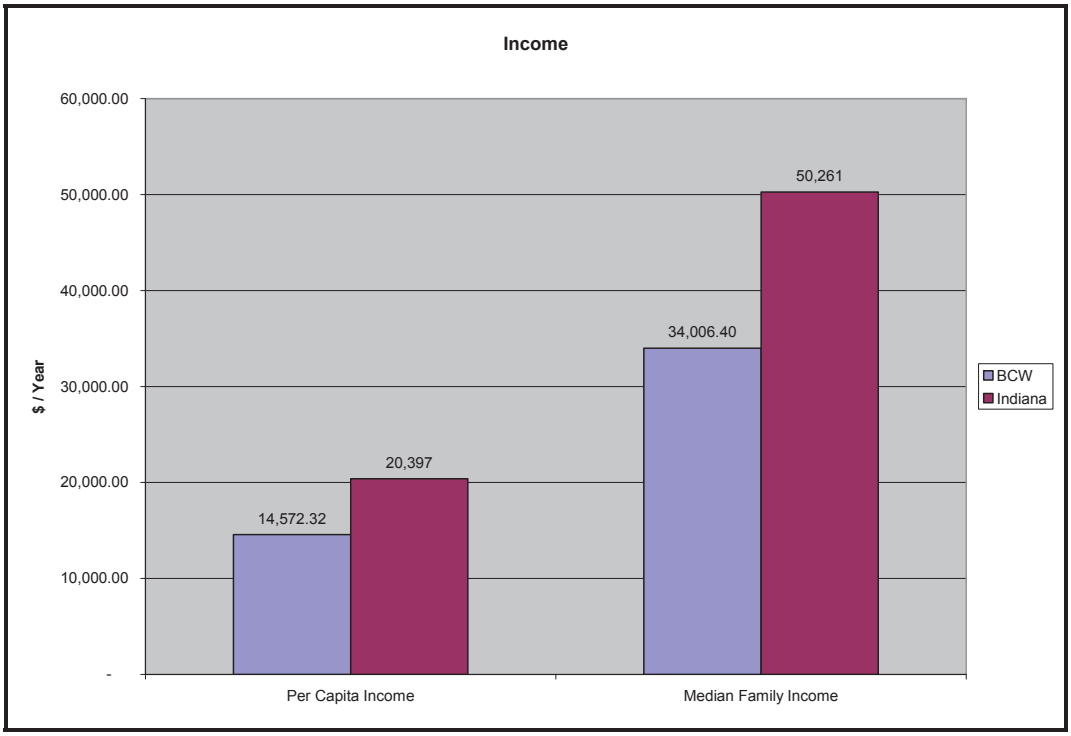


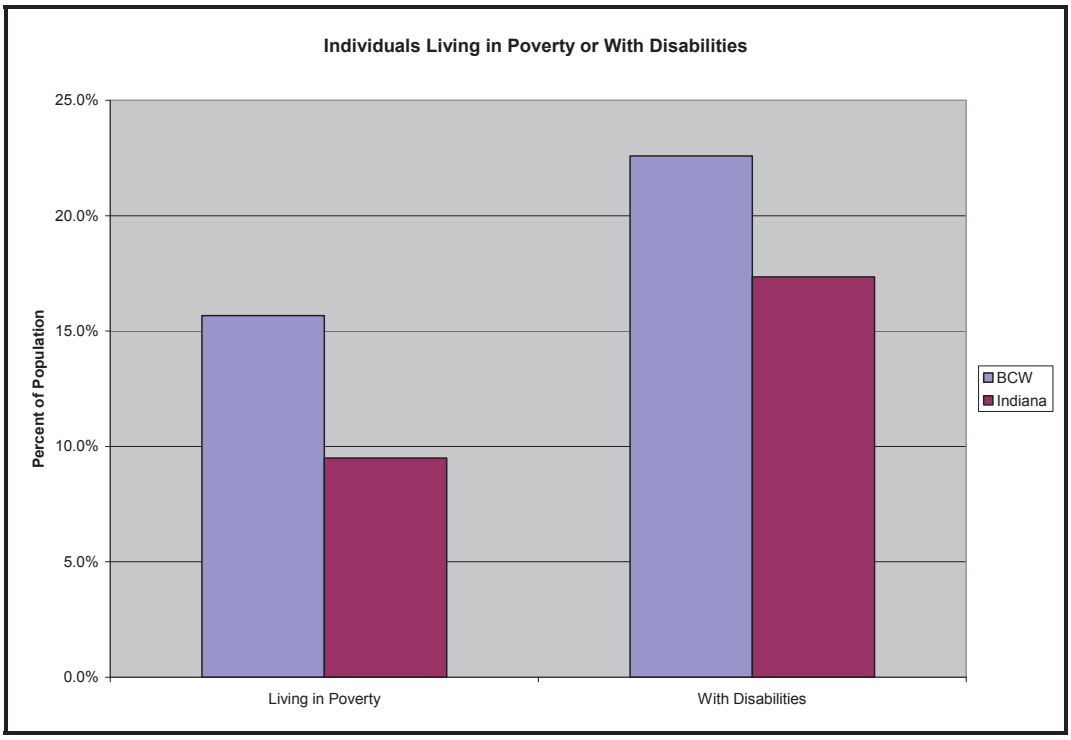
Figure III-24 – State Managed Lands

3.02 Demographics

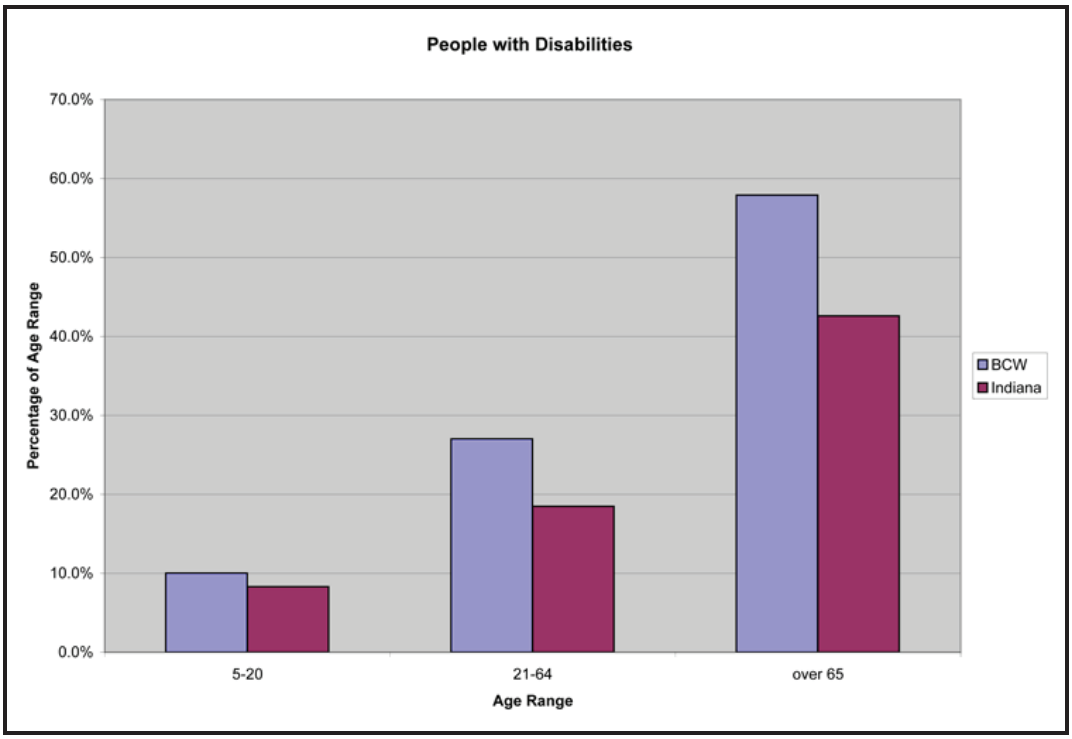
As evidenced in the Graphs III-1 – III-3, residents of the area tend to be poorer, falling substantially behind Indiana statistics for poverty and income. Residents of the area also have a substantially higher disability rate.



Graph III-1 – Per Capita and Median Family Income

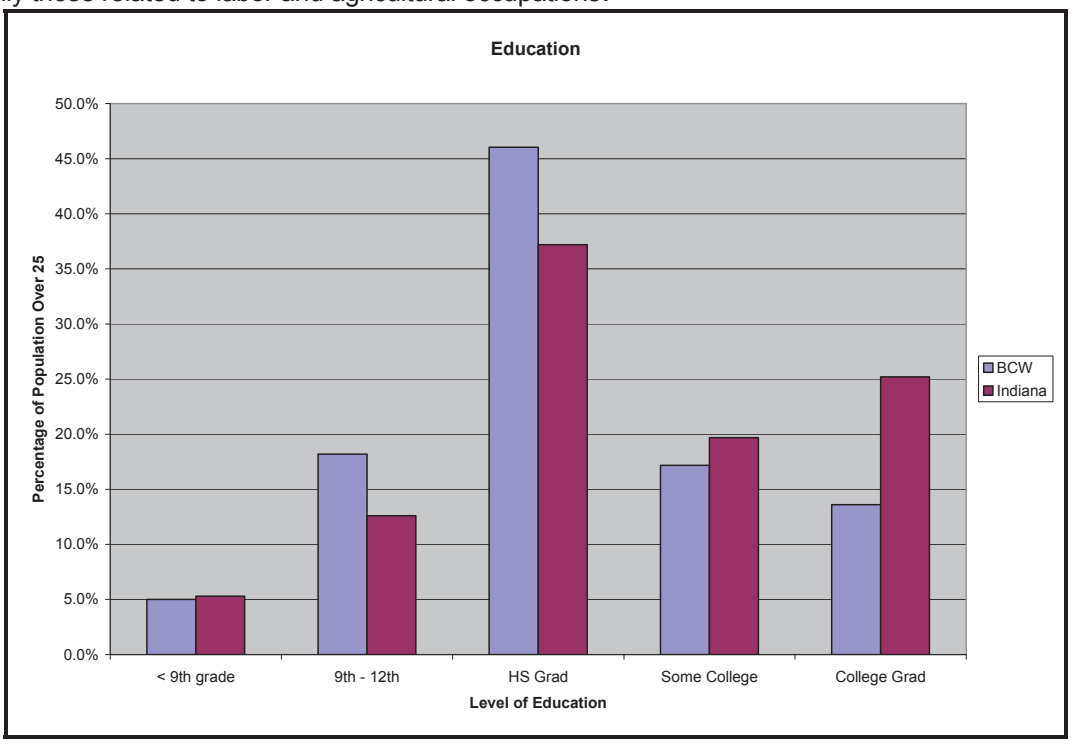


Graph III-2 – Individuals Living in Poverty or With Disabilities



Graph III-3 – Individuals Living with Disabilities by Age Range

As shown in Graph III-4, secondary education of the area population appears to exceed Indiana averages, but lags in attainment of post-secondary degrees. Unaccounted is the skill-sets developed over time, especially those related to labor and agricultural occupations.



Graph III-4 – Secondary and Post Secondary Education

3.03 General Condition of the Watershed

Over 66 miles of streams within the watershed have been classified as impaired. (*Figure III-25 – 303(d) Impaired Streams*)

The eastern regions of the study site are characterized by abandoned mine lands. TMDL sampling in that region indicate a high level of dissolved minerals – often associated with AMD.

Shakamak State Park and the town of Jasonville are located in the Northeast area of the watershed. Both of these locations have been found in regular and recent violations of NPDES standards. Both for TSS. Jasonville for recoverable iron. Shakamak for E. coli, nitrogen (ammonia), and dissolved oxygen.

The near eastern regions are also the site of three active mining operations, all of which have occasionally been found in violation of Environmental Protection Agency (EPA) NPDES standards.

The central and western regions of the study area are associated with agricultural production of corn, wheat and soybeans; reclaimed mine ground converted to wildlife or grazing areas; small towns with municipal WWTPs (Sullivan, Carlisle, Shelburn, Farmersburg, and Dugger); single-family plots and small communities on private septic systems. TMDL sampling points in these regions typically indicate higher turbidity and chlorophyl levels – often associated with agricultural fertilizer run-off and sewage discharge. BCWP sampling points frequently exceeded Indiana standards for E. coli (recreation), including samples taken during late fall and winter months. Higher phosphorus levels associated with these sampling events further indicate presence of human or animal waste. It should also be noted that all WWTPs except Carlisle have been found in violation of NPDES standards for biochemical oxygen demand, E. coli, and total suspended solids; all but Carlisle and Dugger for pH; and all but Carlisle and Sullivan for dissolved oxygen and nitrogen.

Lands associated with agricultural practices have been heavily altered from their native states. As with most Midwest farming regions, much of the area has been tiled for drainage purposes. Forested riparian areas associated with smaller order and ephemeral streams have been mostly removed. In areas where agricultural buffers have been installed, vegetation typically consists of cool season grasses. Seasonal turbidity, high water temperatures, and streambank erosion corroborate a degraded surface water quality and environment in these areas.

In areas of high agricultural activity, high levels of nitrogen are anticipated during the spring farming season. In the 2009 planting season (and benchmark water quality sampling events), farming activities fell far below normal. Late May corn planting was estimated to be below 25% complete and sampled nitrogen levels were also below those typically associated with spring seasons in agricultural lands. Based upon prior studies of nutrient loading from similar agricultural lands, it is believed that the central and western agricultural regions are a primary contributor of nitrogen and, to some extent, phosphorus.

The watershed in general exhibited low base flows during the summer and fall months, with some streams becoming disconnected pools. During these periods of low flow, visual evidence of heavy sedimentation and embeddedness was present. Outside of rain events, the relatively slow moving surface waters appear to readily drop sediment out of suspension. The low average stream slope, speed, and volume may contribute to low dissolved oxygen levels.

Lakes in the area, including the lakes of Shakamak Park and Sullivan Lake have documented substantial sedimentation over their lifespan. It can be assumed that primary delivery is through inflowing creeks and streams. Their reduced capacity can be classified as a symptom of overall surface water sedimentation issues.

Also contributing to the sedimentation and other pollutant loads are increasing flashiness of surface water volume and velocity following rain events. The area was heavily affected by flooding in June 2008, resulting in gully erosions of farm fields, severe bank erosion and damage to personal properties and infrastructure. In addition, E. coli sampling south of Sullivan clearly shows combined sewer overflow events during periods of moderate and heavy rains.

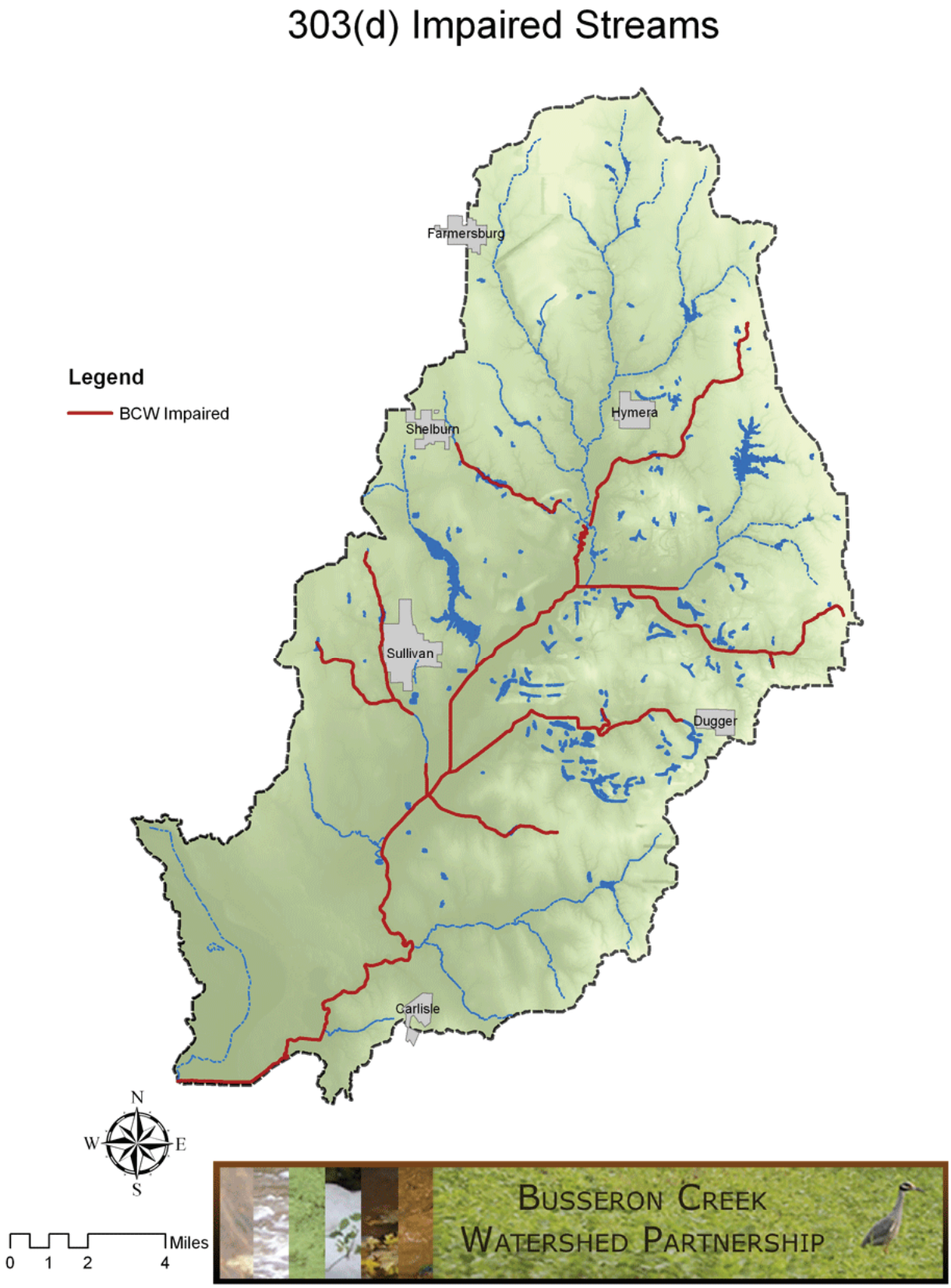


Figure III-25 – 303(d) Impaired Streams

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