Stormwater Master Plan

prepared for the

DEPARTMENT OF STORMWATER MANAGEMENT
GREENWOOD, INDIANA

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Wessler Project No. 220119-01-001

TABLE OF CONTENTS

List Of Appendices

List Of Acronyms

BMP – Best Management Practice

CFR – Code of Federal Regulations

CWA – Clean Water Act

ECOS – Environmental Conservation Online System

EPA – Environmental Protection Agency

ERU – Equivalent Residential Unit

GIS – Global Information System

HSG – Hydrologic Soil Group

HUC – Hydrologic Unit Code

IAC – Indiana Administrative Code

IC – Indiana Code

IDEM – Indiana Department of Environmental Management

IDNR – Indiana Department of Natural Resources

LID- Low Impact Development

MCM – Minimum Control Measure

MS4 – Municipal Separate Storm Sewer System

NOI – Notice of Intent

NPDES – National Pollutant Discharge Elimination System

NRCS – Natural Resources Conservation Service

NWI – National Wetlands Inventory

OHWM – Ordinary High Water Mark

PEM – Palustrine Emergent Wetland

PFO – Palustrine Forested Wetland

PUB – Palustrine Unconsolidated Bottom Wetland

PUBGx – Palustrine Unconsolidated Bottom Intermittently Exposed Excavated Wetland

SWCD – Soil and Water Conservation District

SWMP – Stormwater Master Plan

SWPPP – Stormwater Pollution Prevention Plan

SWQMP – Stormwater Quality Management Plan

TMDL – Total Maximum Daily Load

US – United States

USACE – United States Army Corps of Engineers

USGS – United States Geological Survey

1.0 PURPOSE

The City of Greenwood Stormwater Master Plan is a planning document divided into two parts:

1) Stormwater Management Plan (Sections 2 through 6)
2) Stormwater Capital Plan (Section 7)

The Stormwater Management Plan is a living document that outlines the City's approach to watershed-based stormwater management. The Plan includes an inventory of existing assets and resources, and a watershed-based approach to stormwater management.

The Stormwater Capital Plan is a detailed 5-year plan for capital expenditures. It is based on the City's needs and will be used as part of the 2020 Stormwater User Fee Rate Study. It includes system maintenance, operational expenses, drainage improvements, water quality initiatives and Public/Private Partnerships.

2.0 PLANNING AREA

The planning area is the City of Greenwood corporate limits. The City is located in Pleasant and White River Townships of Johnson County. The closest metropolitan area is Indianapolis, which is approximately 10 miles to the north.

2.1 Land Use

Currently the City of Greenwood has identified seventeen (17) zoning districts within their City's zoning map that is available to the public. In general, the zoning districts are broken up into 5 main zones of agriculture, commercial, industrial, residential, and recreational. These zones help to organize and classify the areas within the City to allow for the public to visually see the City's layout, enable the City to control the physical development of land, and to help the City plan for the future of its development. Please see **Figure 2.1** as well as **Figures 2.1.1 through 2.1.22** for the current land use of the City of Greenwood.

Agricultural: The agricultural zones are areas purposely designated for agricultural use whether that be for the purpose of raising livestock or crops. These zones help to protect farmlands from becoming residential, commercial, or industrially developed. Many of the agricultural zones lie on the southern end of the city corporate limits

Business-Professional and Office: This zone is meant to help the city maintain and grow in its small businesses and services provided to the communities. Examples of these businesses and offices include small businesses like a crafts shop, coffee shop, or a dentist's office. The majority of these zones can be found throughout the center of the city's corporate limits.

Commercial-Neighborhood: This zone is meant for commercial businesses that are either located within or nearby neighborhoods and work to provide services to those neighborhoods. Examples of these types of businesses would be gas stations, small general stores like Dollar General, or fast food chains. These zones are scattered throughout Greenwood, but are more heavily concentrated in the center of Greenwood.

Commercial-Tourist: The commercial-tourist zones are areas purposely meant for businesses that help to bring tourists to Greenwood and appeal to their needs. These zones can be found around historical sites, attractions, or near major traveled highways and interstates. Examples of these business can include hotels, water parks, or museums.

Commercial-General: this zone covers any businesses that do not fall within the first two commercial zones. This zone is found mainly in the center and northeast corner of Greenwood.

Industrial-Light: This zone is designated for smaller manufactures and storage facilities. This zone is found heavily on the northeast side of Greenwood.

Industrial-Heavy: This zone is designated for large manufactures and storage facilities where building heights, noise, and other elements are of no issue to the residents of Greenwood. These areas are developed to bring higher quantities of jobs to the City of Greenwood which in return helps to bring more permanent residents or nearby locals to the city. The heavy industrial zone is mainly located in the center of Greenwood on the southern end of the city.

Planned Unit Development: This zoned area is mostly for a community of homes owned by a homeowner's association or collectively by all invested parties. Most commonly these homes are known as condos and can be used as both residential and commercial units.

Residential-Single Family, Residential-Two and Multi-Family, and Residential-Multiple Family: These zones are areas mostly for residential homes broken out by the number of families living in the homes or buildings. These zones contain all the permanent residents of the city. For the three zones, single family means that only one family lives within a building, two and multi-family means that two or more families live within a building, and multiple family usually relates to an apartment complex with multiple families living within the building. These zones are located all throughout the city.

Mobile Home Park: This zone is a designated area for residents who chose to live in mobile homes.

Recreational Open Space: These zones are open to the public to be for recreational activities. Examples of these areas can be open grass fields, parks, dog parks, and hiking or biking trails. The purpose of these zones is to enable residents of the city to get outside and be healthy and active.

Suburban Fringe: This zone can be classified as the area between the city and county, the outskirts. These zones are areas that are being developed or have the potential for future development that will help the city grow and expand. These zones are located heavily on the southeastern side of Greenwood.

2.2 Environmental Resources Present

Introduction

The City of Greenwood complies with federal, state, and local regulations with regards to development and in the design, implementation, and management of stormwater within its corporate limits. Impacts to wetlands and waterways are regulated by United States Army Corps of Engineers (USACE) and Indiana Department of Environmental Management (IDEM) and include conditions for the protection of threatened and endangered species. The Flood Control Act (IC 14-28-1) regulates development activities within floodways by requiring Indiana Department of Natural Resources (IDNR) approval prior to the beginning of the project. The City of Greenwood is a Municipal Separate Storm Sewer System (MS4) regulated by the general permit rule 327 IAC 15-13 (Rule 13). As required by Rule 13, Greenwood maintains and implements its Stormwater Quality Management Plan and

submits annual reports on its Stormwater Quality Management Plan (SWQMP) to IDEM. Other environmental concerns, such as pollutant concerns and soil infiltration rates, are also taken into consideration for stormwater management and development projects.

Waterways

The City of Greenwood contains many water resources vital to the health and wellbeing of the community and for the detention and conveyance of stormwater. The United State Geological Survey (USGS) Topographic Map (**Figure 2.2.1**) identifies the following major waterways within the City of Greenwood: Pleasant Creek, Pleasant Run Creek, and East Grassy Creek. Within the corporate limits there are also many smaller waterways and tributaries, including Auburn Branch, Fair Brook, Fairview Creek, Fountain Creek, Grassy Creek, Grubbs Ditch, Honey Creek, Hurricane Creek, Jolly Brook, Short Run, Tracy Ditch, Turkey Pen Creek; as well as lakes and ponds (**Figure 2.2.2**). The USACE regulates the discharge of dredged or fill material into waters of the US. Section 401 of the Clean Water Act (CWA) (33 U.S.C. §1251 et seq.) gives the State of Indiana the authority to regulate proposed USACE Section 404 permitted activities that may result in a discharge to water bodies through the state water quality certification program. Waters of the US are defined by the Navigable Waters Protection Rule (33 CFR Part 328). Their identification is based upon the presence of an ordinary high water mark (OHWM), observable bed and bank, and the presence of documented surface water connections to navigable waters of the US. Permits from IDEM and USACE may therefore be required for work within waterways for the purposes of stormwater management.

Alterations to County legal drains within Greenwood are subject to Johnson County Drainage Board review. These legal drains include the following open drains: East Grassy Creek, Julia Johnson Ditch, L W Jones Ditch, L W Jones Ditch, Lee Park Ditch, P R Griffith Ditch, Polk Ditch, R A Alexander Ditch, Rob Crawford Arm, Sam Gregg Ditch, Scott Highbridge Ditch, Tracy Ditch, and Villa Heights Ditch; as well as additional underground tile drains.

Floodplains

Mapped floodplains are shown on **Figure 2.2.3** along waterways including: Pleasant Run Creek, Fountain Creek, Pleasant Creek, Hurricane Creek, Grassy Creek, East Grassy Creek, Tracy Ditch, Short Run, and Honey Creek. Regulations and protections for floodplains are important for the protection of life and property from floodwaters. In addition, limiting development in floodplains allows them to perform important water quality functions, preserves habitat for wildlife resources, and preserves greenspace for recreational use. IDNR approval is required for construction in mapped floodways as well as impacts to waterways with a greater than one square mile drainage area. This includes activities such as building, grading, excavating, and filling which may be necessary for development and associated

stormwater management projects. Where conditions are met, exemptions are provided for logjam or debris removal, utility lines, wetlands, and outfalls.

Prior to the commencement of any development activities in areas of special flood hazard, the City of Greenwood requires a Floodplain Development Permit through its Improvement Location Permit process in conformance with Ordinance No. 6.36.06. This permitting process serves to guide development away from areas prone to flooding; protect public health, safety, and general welfare from the negative impacts of flooding; and reduce the negative impacts from increases in flood heights and velocities.

EPA 303(d) List

Two waterways within the corporate boundary of Greenwood are included on the most recently published Environmental Protection Agency (EPA) 303(d) List (USEPA 2018). In accordance with the CWA, the primary purpose of the 303(d) list is to identify where many of Indiana's water quality problems exist and the impairments for which a total maximum daily loads (TMDL) study is needed. There have not been established TMDLs for waterbodies within Greenwood yet. A TMDL identifies the maximum amount of pollutant that a waterbody can receive and still meet water quality standards and allocates pollutant loadings among point and non-point sources. Refer to **Table 2.2.1** for a summary of impaired waters and TMDLs within Greenwood.

Table 2.2.1: Impaired Waters and TMDLs

Waterbody	303(d) List	TMDL
Pleasant Creek	Biological Integrity E. coli	None
Pleasant Run Creek	Biological Integrity E. coli	None

Resources: 303(d) List of Impaired Waters Approved by USEPA 2018, IDEM Online e303(d) Tool 2020, and IDEM TMDL Reports 2020

Per 327 IAC 15-13-10, MS4s are currently required to incorporate requirements for control of stormwater discharges within their jurisdiction into their SWQMP for TMDLs. IDEM is developing a new general permit for MS4s and additional requirements are anticipated with regards to 303(d) listed waters and waters with approved TMDLs. MS4s with 303(d) listed impaired waters or TMDLs for receiving waters will be required to review and modify their SWQMP when a TMDL is approved. MS4s will be required to impose additional water

quality-based limitations on a site-specific basis or have stricter permit requirements based on TMDLs. This may include the requirement to install additional stormwater management measures to comply with a waste load allocation for the specified receiving water and retrofit MS4-owned and/or operated structural BMPs to reduce loadings of pollutants of concern.

As Greenwood looks to a watershed approach to stormwater quality management, the listing of Pleasant Creek and Pleasant Run Creek on the 303(d) list for biological integrity and E. coli will be taken into consideration. This may include additional practices to disconnect sources of E. coli from waterways and BMPs that provide additional treatment to stormwater. Several factors that impact biological integrity, such as stream bank erosion, channelization, lack of vegetated buffers, and thermal pollution may need to be addressed to reduce stressors on aquatic life and improve the biological integrity of the impaired waters.

Wetlands

Wetlands provide important ecological, stormwater quality, and flood management functions. Construction, development, and activities intending to impact a wetland area are regulated by USACE and IDEM as "waters of the United States (US)" under Sections 404 and 401 of the CWA, respectively, or as isolated wetlands by IDEM under Indiana's State Isolated Wetlands Law. For this reason, there are limitations on the use of regulated wetlands for stormwater management. The National Wetlands Inventory (NWI) mapping (**Figure 2.2.4**) shows wetlands along waterways and within other areas of Greenwood (USFWS 2020). The majority of these wetlands are shown as palustrine unconsolidated bottom intermittently exposed excavated (PUBGx) wetlands, some of which may represent retention ponds, detention ponds, and other manmade depressions. Facilities constructed for stormwater management and meeting the definition of a stormwater management facility under the Navigable Waters Protection Rule (33 CFR Part 328) may be exempt from wetland regulations. Available Global Information System (GIS) mapping for stormwater Best Management Practices (BMPs), which includes retention and detention ponds, is discussed in Section 5.3 below. There are also occurrences of additional unconsolidated bottom (PUB), emergent (PEM), forested (PFO) and other types of wetlands shown on **Figure 2.2.3**.

Threatened and Endangered Species

The Endangered Species Act of 1973 (16 U.S.C. Sections 1531-1544) was passed by the U.S. Congress to protect and conserve threatened and endangered plants, animals, and the ecosystems that support them. To protect threatened and endangered species and as a requirement for regulatory permitting, projects must be evaluated for potential impacts. Critical habitat, as defined and used in the Endangered Species Act, is a geographic area that contains features essential to the conservation of an endangered or threatened species and that may require special management and protection. Critical habitat may also include areas that are not currently occupied by the species but will be needed for its recovery. Greenwood

does not include any critical habitat (USFWS Environmental Conservation Online System 2020). Species currently listed by USFWS as endangered or threatened within Johnson County are included in **Table 2.2.2**. Projects may require additional coordination, management practices, such as limitations on tree removal for listed bat species and/or limitations on waterway impacts to Sugar Creek for mussel species.

Table 2.2.2: Johnson County Threatened and Endangered Species

Species	Status	Habitat
Indiana bat	Endangered	Hibernation occurs in caves and mines, with swarming in surrounding wooded areas. Summer roosting and foraging habitat occurs in wooded stream corridors and in bottomland and upland forests and woods.
Northern long-eared bat	Threatened	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.
Rayed bean mussel	Endangered	Sugar Creek
Snuff box mussel	Endangered	Sugar Creek

Resource: USFWS Midwest Region Endangered Species List 2020

Hydrologic Soil Groups

Determining an area's soil infiltration rate through available data and field testing can be an important step for stormwater management. Hydrologic soil groups (HSGs) are classified by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Group A and B soils have the highest infiltration rates and are best suited for infiltration practices. Group C and D have low infiltration rates and are usually more appropriate for detention basins. For duel groups (A/D, B/D, and C/D), the first letter refers to the drained condition and the second letter is the drained condition. An HSG map of Greenwood is provided as **Figure 2.2.5** (Indiana Geographic Information Council IndianaMap 2020). A large portion of Greenwood consists of C and C/D soils. There are also large areas of group B/D soils. Group B and A/D soils tend to be present near major waterways. HSG mapping information is not available for some areas within Greenwood's corporate limits.

Brownfields

There are five sites in Greenwood identified on IndianaMap (Indiana Geographic Information Council IndianaMap 2020) (refer to **Table 2.2.3** below and **Figure 2.2.6**) as part of the EPA Brownfields Program. Brownfield Sites are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Some stormwater management practices, especially

those that utilize infiltration, may not be appropriate on Brownfield Sites, therefore their locations are noted for project planning purposes.

Table 2.2.3: Brownfield Sites

Site Name and IDEM ID	Site Address
Commercial Strip Mall 4171203	172 Melody Lane
Grain Elevator 4010023	200 E. Main Street
Smittys Transmission 4010024	160 E. Main Street
Standard Oil Bulk Facility 4190704	173 Broadway Street
Blackthorne Property 4200101	E. Main Street and Dresdon Drive South

Resources: IndianaMap

2.3 Growth Areas and Population Trends

Greenwood is the most populous city or town in Johnson County with 37.6% of the county population. According to census data, Greenwood's population in 2019 was 59,458. The County population has increased 13.1% since 2010 and is projected to increase another 12.3% by 2030 (Indiana Business Research Center Stats America Data 2020). To accommodate this growth, Greenwood is expected to see continued development and redevelopment. According to Greenwood's 2007-2027 Comprehensive Plan, residential development has tended to be in the form of isolated developments that terminate in cul-de-sacs and conventional tract housing. As part of its Downtown Revitalization, Greenwood is adding nine miles of new or reconstructed streetscape, nine acres of new or upgraded open space, over 75,000 square feet of retail/office space, more than 450 apartments, and more than 130 townhomes in the downtown area. Greenwood has also seen development in formerly agricultural areas, additional annexation of portions of unincorporated Johnson County, and growth along the Interstate 65 corridor. Updates to design standards and stormwater quality

management plan requirements discussed in Section 4.1 below may continue to encourage mixed use developments, higher density residential developments, redevelopment projects, floodplain and waterway buffers, and space allocated for stormwater management and associated easements.

3.0 WATERSHED CLASSIFICATION

As a part of this study, three levels of watershed classifications were taken into consideration. The goal of these classifications is to organize the areas to better determine the percentage of impervious area and stormwater infrastructure in each area, and as a result, allocate the budget to each watershed proportionally. The three classifications from broadest to most refined are HUC 08, HUC 14, and Primary Watersheds.

3.1 HUC 08

The entire city of Greenwood is encompassed in two HUC 08 watersheds: 05120201 on the approximate Northwest half of town and 05120204 on the Southeast half. See **Figure 3.1 and Figures 3.1.1 through 3.1.22** for the locations and layouts of each delineated watershed. Figure 1 also contains HUC 08 and HUC 14. HUC 08 and HUC 14 do not take subsurface stormwater infrastructure into consideration. HUC 14 watersheds have not been edited by Wessler.

3.2 HUC 14

3.2.1 Grassy Creek-East Grassy Creek

The Grassy Creek-East Grassy Creek Huc 14 watershed is located in the south-central part of the City of Greenwood. This HUC 14 watershed consists of the following watersheds within the City Limits: East Grassy, New East Grassy-Floyd Sheek, Floyd Sheek, and Tracy Watersheds.

3.2.2 Honey Creek-Turkey Pen Creek

The Honey Creek-Turkey Pen Creek watershed is located on the westernmost side of the City of Greenwood. This HUC 14 watershed consists of parts of the following watersheds in the City Limits: parts of Fairview Creek, Pleasant Run Creek, Villa Heights, and Tracy. The majority of the Turkey Pen Creek, Upper Honey Creek, Auburn, Lower Honey Creek, and Scott Tile are within the Honey Creek-Tukey Pen Creek Watershed.

3.2.3 Hurricane Creek (Johnson)

The Hurricane Creek (Johnson) watershed is located on the easternmost side of the City of Greenwood. This HUC 14 watershed consists of the following watersheds in City Limits: Hurricane/Griffith, P R Griffith, and Grubbs.

3.2.4 Little Sugar Creek-Campbell Ditch

The Little Sugar Creek-Campbell Ditch watershed is located at the northeastern corner of the City of Greenwood. This HUC 14 includes the Shirley Tile within Greenwood City Limits

3.2.5 Pleasant Run Creek-Buffalo Creek

The Pleasant Run Creek-Buffalo Creek watershed is located on the north side of the City Limits. This watershed consists of the following smaller watersheds within the City: Fairview Creek, Villa Heights, Jennings, Pleasant Run Creek, Lee Park, and a portion of Shirley Tile.

3.2.6 Youngs Creek-Brewers/Canary Ditches

This watershed covers a small section of the southwest corner of the City of Greenwood. It is primarily farmland and mostly includes the Daniel Brewer watersheds described below.

3.2.7 Youngs Creek-Roberts Ditch

This watershed in the City of Greenwood consists of only a small section of the southeast corner of the corporate limits of the City. It is also primarily farmland and mostly includes the Robards/Pruner and R A Alexander watersheds described below.

3.3 Primary Watersheds

Each HUC 14 Watershed is comprised of multiple tributaries, including legal drains. The following are the Primary Watershed delineations for these tributaries.

3.3.1 Auburn

The Auburn watershed was delineated by Wessler to the Auburn Branch of Turkey Pen Creek. The watershed in the Greenwood Corporate encompasses approximately 704.8 acres of land. The watershed land use consists of Residential Area, Commercial Area, Tax Exempt Area, and some Agricultural Area.

3.3.2 Daniel Brewer

The Daniel Brewer watershed was derived from the shapefiles supplied by the City. The watershed in the Greenwood Corporate boundaries covers only approximately 49.7 acres of land. The watershed land use within the city limits consists of mainly farmland.

3.3.3 East Grassy

The East Grassy Watershed was edited by Wessler. Part of the previous East Grassy Watershed has been It drains to East Grassy Creek. This watershed in the city limits encompasses approximately 1,650.2 acres of land. The watershed land use consists of Residential Area, Commercial Area, Tax Exempt Area, and some Agricultural Area.

3.3.4 Fairview Creek

The Fairview Creek watershed was delineated by Wessler to Fairview Creek, this area excludes the existing Villa Heights and Jennings watersheds within the Fairview Creek watershed. This watershed in the Greenwood Corporate Boundaries encompasses approximately 649.4 acres of land. The watershed land use consists of Residential Area, Commercial Area, and some Agricultural Land.

3.3.5 Floyd Sheek

The Floyd Sheek watershed was revised by Wessler, and it drains to Tracy Ditch/Grassy Creek. Part of the Floyd Sheek watershed was reorganized to the New East Grassy-Floyd Sheek Watershed. The watershed within the Greenwood Corporate encompasses approximately 566.9 acres of land. The watershed land use consists of Residential Area, Commercial Area, and some Agricultural Area.

3.3.6 Grubbs

The Grubbs Watershed was delineated by Wessler to Grubbs Ditch. The watershed in the Greenwood Corporate Boundary is very small and encompasses only approximately 5.0 acres of agriculture land.

3.3.7 Hurricane/Griffith

The Hurrican/Griffith watershed was delineated to Hurricane Creek. The watershed in the Greenwood Limits encompasses approximately 95.9 acres of primarily agricultural land.

3.3.8 Jennings

The Jennings watershed was an existing watershed in the City of Greenwood. After further watershed delineation, it is located within the new Fairview Creek watershed delineated by Wessler. This watershed has an area of approximately 46.3 acres. The land use in this watershed consists of Residential Area and Commercial Area.

3.3.9 Lee Park

The Lee Park watershed is one of the larger watersheds in the City of Greenwood. It drains to Pleasant Creek. The watershed, within the Greenwood Corporate Boundaries, encompasses approximately 2,284.8 acres of land. The watershed land use consists of Residential Area, Commercial Area, and some Agricultural Area. The Greenwood Municipal Airport is located largely within this watershed as well.

3.3.10 Lower Honey Creek

The Lower Honey Creek watershed was delineated by Wessler to Honey Creek. It is separated from the Upper Honey Creek by the Scott Tile watershed. The watershed in the Greenwood Corporate limits is approximately 1,080.9 acres of land. The watershed land use consists largely of Agricultural Area, with some Residential Area, Commercial Area, and Tax Exempt Area.

3.3.11 New East Grassy-Floyd Sheek

The New East Grassy Floyd Sheek watershed was delineated by Wessler to East Grassy Creek through the Floyd Sheek Watershed. This watershed was originally part of the East Grassy watershed, but through drainage infrastructure has been redirected through the Floyd Sheek watershed. The watershed encompasses approximately 542.5 acres of land and consists mainly of Residential Area.

3.3.12 P R Griffith

The P R Griffith watershed, on the east side, was delineated to Hurricane Creek. The watershed measures approximately 1,115.7 acres in area within the Greenwood Corporate Limits. The watershed land use consists of Residential and Agricultural Area.

3.3.13 Pleasant Run Creek

The Pleasant Run Creek watershed was delineated by Wessler to Pleasant Run Creek. This watershed in the City of Greenwood includes approximately 3,628.9 acres of land. This

watershed's land use consists of mainly of Residential Area and Commercial Area, with some Agricultural Area as well.

3.3.14 R A Alexander

The R A Alexander watershed was delineated to Alexander Ditch. A small portion of this watershed is withing the southern part of the City of Greenwood. The watershed within the Greenwood Corporate Boundaries encompasses approximately 200.7 acres of land. The watershed land use consists entirely of farmland.

3.3.15 Robards/Pruner

The Robards/Pruner watershed was delineated to Roberts Ditch. The watershed in the Greenwood Corporate Limits encompasses approximately 185.8 acres of land. The watershed land use is mainly agricultural.

3.3.16 Scott Tile

The Scott Tile watershed was altered by Wessler and drains to the drain tile with the same name. The tile has been largely vacated so the watershed size has decreased. The updated watershed within the Greenwood Corporate Limits encompasses approximately 251.0 acres of land. The watershed land use consists of Residential Area and Agricultural Area.

3.3.17 Shirley Tile

The Shirley Tile Watershed was delineated by Wessler to the Shirley Drain Tile. This watershed, within the Greenwood Corporate Boundary, takes up approximately 118.7 acres of land. The watershed land use consists of all Agricultural Area.

3.3.18 Tracy East

The Tracy East watershed drains to East Grassy Creek in the City, and eventually drains to Tracy Ditch south of the city limits. The east watershed within the Greenwood Corporate Limits encompasses approximately 1,541.6 acres of land. There are 2 sections of the Tracy Watershed, an east and west fork which join south of the City. The watershed's land use consists of Residential Area, Commercial Area, and Agricultural Area.

3.3.19 Tracy West

The Tracy West watershed was delineated to Tracy Ditch. The west watershed within the Greenwood Corporate Limits encompasses approximately 1,681.1 acres of land. This is the second of the two Tracy watersheds. This watershed's land use consists of Residential Area, Commercial Area, Tax Exempt Area, and some Agricultural Area.

3.3.20 Turkey Pen Creek

The Turkey Pen Creek watershed was delineated by Wessler to Turkey Pen Creek. The watershed in the Greenwood Limits includes approximately 636.8 acres of land. The watershed land use consists of Residential Area, Commercial Area, and some farmland.

3.3.21 Upper Honey Creek

The Upper Honey Creek watershed was delineated by Wessler to Honey Creek. It is separated from the Lower Honey Creek by the Scott Tile watershed. The watershed in the Greenwood Corporate Limits encompasses approximately 750.5 acres of land. The watershed land use consists of Residential Area, Commercial Area, and Agricultural Area.

3.3.22 Villa Heights

The Villa Heights watershed reviewed by Wessler, and it drains to Fairview Creek. The watershed in the Greenwood Corporate encompasses approximately 106.8 acres of land. The watershed land use consists of Residential Area, Commercial Area, and some Agricultural Area.

3.4 Subdivision and Neighborhood Delineations

The City of Greenwood has roughly 437 subdivisions. Each of these subdivisions contain both public and private assets that collect and guide stormwater through Greenwood's system and its watersheds. It is important to know and understand the delineation of these subdivisions to ensure that current assets function properly and that future assets are designed correctly to handle projected flows. It is also important to recognize that all surface waters ultimately drain to other bodies of water and affect other communities downstream. Having recognized this, delineation can help to determine and understand the downstream impacts which in return can help to develop best management practices upstream. Lastly, delineation of subdivisions will help in the total health and management of all the watersheds within and surrounding the City of Greenwood.

4.0 UTILITY OPERATIONS

The Department of Stormwater Management is a Stormwater Utility as defined by IC 8-1.5-5. The Utility collects and manages stormwater user fees, which are a dedicated source of funding to pay for stormwater management and stormwater infrastructure. The City of Greenwood is an MS4 and the Department of Stormwater Management, with cooperation from other City and County entities, is tasked with completing the requirements of Rule 13.

4.1 Regulatory Requirements

NPDES Requirements

The National Pollutant Discharge Elimination System (NPDES) permit program was created under the Clean Water Act (CWA) to regulate the discharge of pollutants into waters of the US. When stormwater is absorbed into the soil in undeveloped areas, it is filtered and ultimately replenishes groundwater or flows into waterways. In contrast, when stormwater is conveyed on impervious surfaces or areas saturated by water, it runs across the surface and into conveyances (waterways, ditches, storm sewers, etc.). Because of human activity, such as development, these conveyances have the potential to convey stormwater runoff that often carries debris, eroded soil, chemicals, bacteria, and other pollutants.

As an MS4, the City of Greenwood complies with Rule 13, including requirements to maintain and implement its SWQMP and submit annual reports to IDEM on this implementation. City-owned construction projects are also responsible for submitting Stormwater Pollution Prevention Plans (SWPPPs) to the Johnson County Soil and Water Conservation District (SWCD) and submitting Notices of Intent (NOIs) to IDEM under 327-IAC 15-5 (Rule 5). Private development projects submit SWPPPs to Greenwood for City review prior to submitting their NOIs to IDEM. SWPPPs must include measures that will be installed to control pollutants in stormwater discharges that will occur after construction activities have been completed, such as infiltration of runoff, flow reduction by use of open vegetated swales and natural depressions, buffer strip and riparian zone preservation, filter strip creation, minimization of land disturbance and surface imperviousness, maximization of open space, and stormwater retention and detention ponds.

Rule 13 requires implementation of six Minimum Control Measures (MCMs): (1) public education and outreach, (2) public participation and involvement, (3) illicit discharge detention and elimination, (4) construction site stormwater runoff control, (5) post construction stormwater runoff control, and (6) municipal operations pollution prevention and good housekeeping. Required annual reporting includes programmatic indicators for each MCM, information on stormwater BMPs installed or initiated, funding sources and expenditures, and the identification of stormwater quality improvement projects.

Rule 5 is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land-disturbing activities and applies to land-disturbing activities that results in the disturbance of one acre or more. If the land-disturbing activity results in the disturbance of less than one acre of total land area, but is part of a larger common plan of development or sale, the project is still subject to Rule 5.

Additional information regarding MCMs 4, 5, and 6 and their programmatic indicators as they relate to this Storm Water Master Plan are included under their headings below. IDEM is currently developing a new general permit for MS4s and changes to the requirements may occur and become more stringent. Based on Environmental Protection Agency (EPA) guidance, national regulatory trends, and draft language available from IDEM, there will be requirements for MS4s to update their ordinances and standards for new development and redevelopment to meet additional, specific requirements. This is discussed in the MCM 5 subsection below.

MCM 4: Construction Site Stormwater Runoff Control

The minimum tracking requirements below are specific to MCM 4, construction site stormwater runoff control. The City is required to track the following information and report it to IDEM.

1. Number of construction sites obtaining an MS4 entity-issued storm water runoff permit in the MS4 area.
2. Number of construction sites inspected.
3. Number and type of enforcement actions taken against construction site operators.
4. Number of, and associated construction site name and location for, public informational requests received.

Table 4.1.1 below provides the specific rule language from 327 IAC 15-13-15 related to MCM 4, and a summary of the program requirements.

Table 4.1.1: Rule 13 MCM 4 Construction Site Stormwater Runoff Control

Rule Reference	Rule Language	Summary of Requirement
327 IAC 15-13-15(a)	An MS4 operator shall develop a Stormwater Quality Management Plan (SWQMP) that includes a commitment to develop, implement, manage, and enforce an erosion and sediment control program for construction activities that disturb one (1) or more acres of land within the MS4 area.	Enforce an erosion and sediment control program for construction projects that disturb one or more acres of land.
327 IAC 15-13-15(b)	Through an ordinance or other regulatory mechanism, the MS4 operator shall establish a construction program that controls polluted run-off from construction activities with a land disturbance greater than or equal to one (1) acre, or disturbances	Develop an ordinance that contains, at a minimum, the requirements of 327 IAC 15-5 and that provides the necessary legal authorities to control,

	of less than one (1) acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one (1) or more acres of land. Except for state permitting process references and submittal deadlines of construction plans and permit applications in 327 IAC 15-5, this ordinance or other regulatory mechanism must contain, at a minimum, the requirements of 327 IAC 15-5. The MS4 operator may establish a permitting process and timetable for plan and application submittals that are different than that established under 327 IAC 15-5. The permitting process must include a requirement for the construction project site owner to submit a copy of the application directly to the department. A certification form shall be completed and submitted to the department once the ordinance or other regulatory mechanism is developed and a program has been implemented or three hundred sixty-five (365) days from the date the initial Notice of Intent (NOI) letter submittal was received by the department, whichever is earlier. In subsequent permit terms, the certification form does not need to be completed and submitted. At a minimum, every five (5) years the regulatory mechanism and program shall be reviewed for adequacy and accuracy and updated as necessary. Until the MS4 operator program is implemented, NOI letters and construction plans for construction activities within the MS4 area will be submitted in accordance with 327 IAC 15-5-5 and 327 IAC 15-5-6 to the department and the local Soil and Water Conservation District (SWCD).	and penalize the source of, polluted construction site run-off from regulated construction projects
327 IAC 15-13-15(c)	If the MS4 operator has not entered into a written agreement with the local SWCD to review and approve construction site plans or conduct construction site inspections, the MS4 operator shall provide an opportunity to the local SWCD to provide comments and recommendations to the MS4 operator on individual projects. This process may be accomplished by the MS4 operator establishing a local plan review and comment procedure, a project technical review committee, or other mechanism to solicit the input of the local SWCD.	MS4 operator shall provide an opportunity to the Johnson County SWCD to provide comments and recommendations to the MS4 operator on individual projects
327 IAC 15-13-15(f)	The MS4 operator, or a designated MS4 entity, shall meet the following: (1) Develop requirements for the implementation of appropriate BMPs on construction sites to control sediment, erosion, and other waste. (2) Review and approve the construction plans submitted by the construction site operator before construction activities commence. (3) Develop procedures for site inspection and enforcement to ensure that BMPs are properly installed. (4) Establish written procedures to identify priority sites for inspection and enforcement based on, at a minimum, the nature and extent of the construction activity, topography, and the characteristics of soils and receiving water quality. (5) Develop procedures for the receipt and consideration of public inquiries, concerns, and information submitted regarding local construction activities. (6) Implement, at a minimum, a tracking process in which submitted public information, both written and verbal, is documented and then given to appropriate staff for follow-up.	Develop requirements for and implement the following: • Appropriate erosion and sediment control BMPs on construction sites • Review and approval of submitted construction plans • Site inspection and enforcement • Written procedures to identify priority sites for inspection and enforcement based on, at a minimum, the nature and extent of the construction activity, topography, and the characteristics of soils and receiving water quality • Receipt and consideration of public inquiries, concerns

		and information submitted regarding local construction activities • Tracking process in which submitted public information is documented and given to appropriate staff for follow-up
327 IAC 15-13-15(g)	MS4 area personnel responsible for plan review, inspection, and enforcement of construction activities shall receive, at a minimum, annual training addressing such topics as appropriate control measures, inspection protocol, and enforcement procedures	Personnel responsible for plan review, inspection, and enforcement shall, at a minimum, receive annual training.
327 IAC 15-13-15(i)	For those construction activities operated by the MS4 operator or MS4 municipalities within the MS4 area, construction plans must be submitted to the local SWCD or other entity designated by the department for review and approval. If the MS4 operator does not receive either a notice of deficiency or an approval within thirty-five (35) days of the submittal, the plan will be considered adequate. After a one (1) year period of compliance, the MS4 operator or the designated MS4 entity need not submit the plans and may review MS4-operated project construction plans internally	Construction activities operated by the MS4 operator or MS4 municipalities within the MS4 area shall submit construction plans to the Johnson County SWCD for review and approval.

MCM 5: Post Construction Stormwater Runoff Control

MS4 communities are required per 327 IAC 15-13-8 to track and report the following programmatic indicators to IDEM. The minimum tracking requirements below are specific to MCM 5, Storm Water Quality Management for Post-Construction Stormwater Runoff. The City is required to track the following information and report it to IDEM.

1. Annual storm water quality training on relevant topics such as post-construction BMPs, maintenance and inspection protocols, and enforcement topics.
    a. Type of training presented, including the name of the training, and the training source.
    b. Names, titles and departments of each employee that attended training.
    c. Date(s) that training was presented/attended.
2. Updates to the post-construction ordinance and post-construction design standards (as applicable).
3. Inspections of structural BMPs completed once per permit term.
4. Type and location of structural BMPs installed.
5. Number and type of structural BMPs maintained or improved.
6. Type and location of nonstructural BMPs utilized.

Table 4.1.2 below provides the specific rule language from 327 IAC 15-13-16 related to MCM 5, and a summary of the program requirements. Each minimum requirement (third column in **Table 4.1.2**) should be incorporated into the City's permit program.

Table 4.1.2: Rule 13 MCM 4 Construction Site Stormwater Runoff Control

Rule Reference	Rule Language	Summary of Requirement
327 IAC 15-13-16(a)	An MS4 operator shall develop a SWQMP that includes a commitment to develop, implement, manage, and enforce a program to address discharges of post-construction storm water run-off from new development and redevelopment areas that disturb one (1) or more acres of land or disturbances of less than one (1) acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one (1) or more acres of land within the MS4 area.	Enforce a post-construction storm water quality program for construction projects that disturb one or more acres of land.
327 IAC 15-13-16(b)	Through the use of an ordinance or other regulatory means, an MS4 operator shall implement planning procedures to promote improved water quality. These planning procedures must include, at a minimum, the postconstruction requirements of 327 IAC 15-5-6.5(a)(8). Where appropriate, and to the extent of the MS4 operator's authority, the procedures may also include the following: (1) Buffer strip and riparian zone preservation. (2) Filter strip creation. (3) Minimization of land disturbance and surface imperviousness. (4) Minimization of directly connected impervious areas. (5) Maximization of open space. (6) Directing the community's physical growth away from sensitive areas and toward areas that can support it without compromising water quality.	Develop an ordinance that contains, at a minimum, the post-construction storm water run-off requirements of 327 IAC 15-5-6.5(a)(8) and that provides the necessary legal authorities to control, and penalize the source of noncompliance to the MS4 entity specifications created for post-construction runoff from regulated construction projects. A certification form for the post-construction run-off control minimum control measure program, available from IDEM, must be signed and submitted, at the latest, 730 days from the initial NOI letter submittal. This certification submittal is only necessary to establish the initial implementation of each control measure, and, therefore, only needs to be submitted during the first 5-year permit term.

	A certification form that combines the completed requirements of this subsection and subsection (e) shall be completed and submitted to the department once the ordinance or other regulatory means has been developed and a program has been implemented or seven hundred thirty (730) days from the date the initial NOI letter submittal was received by the department, whichever is earlier. In subsequent permit terms, the certification form does not need to be completed and submitted. At a minimum, every five (5) years the program shall be reviewed for adequacy and accuracy and updated as necessary.	
327 IAC 15-13-16(c)	Where appropriate, an MS4 operator shall use any combination of storage, infiltration, filtering, or vegetative practices to reduce the impact of pollutants in storm water run-off on receiving waters. In addition to the combination of practices, the following requirements shall be utilized: (1) Infiltration practices will not be allowed in wellhead protection areas. (2) Discharges from an MS4 area will not be allowed directly into sinkholes or fractured bedrock without treatment that results in the discharge meeting Indiana ground water quality standards as referenced in 327 IAC 2-11. (3) Any storm water practice that is a Class V injection well must ensure that the discharge from such practices meets Indiana ground water quality standards as referenced in 327 IAC 2-11. (4) As site conditions allow, the rate at which water flows through the MS4 conveyances shall be regulated to reduce outfall scouring and stream bank erosion. (5) As site conditions allow, a vegetated filter strip of appropriate width shall be maintained along unvegetated swales and ditches. (6) New retail gasoline outlets, new municipal, state, federal, or institutional refueling areas, or outlets and refueling areas that replace their existing tank systems shall be required	The developed ordinance or other regulatory document controlling post-construction stormwater runoff shall include practices (or BMPs) that reduce the impact/volume of pollutants in storm water run-off in addition to the 6 listed requirements that shall be enforced in the design of, and implemented on, the construction site.

	by MS4 ordinance or other regulatory means to design and install appropriate practices to reduce lead, copper, zinc, and polyaromatic hydrocarbons in storm water run-off.	
327 IAC 15-13-16(d)	MS4 area personnel responsible for plan review, inspection, and enforcement of post-construction BMPs shall receive, at a minimum, annual training addressing such topics as appropriate control measures, inspection protocol, and enforcement procedures.	Ensure all staff involved in implementing post-construction run-off control receive relevant annual training. This can be conducted "in-house" by MS4 entity staff or some other trainer. During an inspection of the MS4 area program, training documentation will be reviewed to verify that it is relevant and reaching all appropriate MS4 area personnel.
327 IAC 15-13-16(e)	An MS4 operator shall develop and implement a written operational and maintenance plan for all storm water structural BMPs. A certification form that combines the completed requirements of this subsection and subsection (b) shall be completed and submitted to the department once the plan has been developed and implemented or seven hundred thirty (730) days from the date the initial NOI letter submittal was received by the department, whichever is earlier. In subsequent permit terms, the certification form does not need to be completed and submitted. At a minimum, every five (5) years the program shall be reviewed for adequacy and accuracy and updated as necessary	A written operational and maintenance plan must be developed and implemented by an MS4 entity for all structural BMPs. The plan should address inspection, frequency, maintenance procedures, operational testing or observations to ensure proper function, preventative maintenance, and recordkeeping. A certification form shall be submitted to IDEM, at the latest, seven-hundred thirty (730) days from the initial NOI letter submittal and the O&M plan must be reviewed every 5 years. In situations where structural BMPs are privately owned, the maintenance of the BMP is the responsibility of the BMP private owner. However, the regulated MS4 entity that has responsibility for the storm water quality within the private owner's geographical area should try to encourage the BMP owner to properly operate and maintain the BMP
327 IAC 15-13-16(f)	An MS4 operator shall develop measurable goals for this measure. To comply with this measure, specific reduction percentages and timetables must be identified. At a minimum, goals must address relevant regulatory mechanism implementation, planning and structural BMP strategies, new impervious surface reduction, and discharge quality improvement.	Identify specific problem areas within the MS4 jurisdictions and initiate innovative solutions and designs to focus attention on those areas through local planning. Develop, implement and enforce a program that includes a plan to address storm water run-off from new development and redevelopment projects to MS4 conveyances using site-appropriate and cost-effective structural and non-structural BMPs, as appropriate

Future Indiana general permit requirements are anticipated to require MS4s to implement additional post-construction measures for both public and private projects. These are expected to include more stringent requirements for pollution prevention post-construction, Low Impact Development (LID) requirements, and requirements for infiltration measures.

MCM 6: Municipal Operations Pollution Prevention and Good Housekeeping

The City is required to implement a program to prevent or reduce pollutant runoff from municipal operations within the MS4 area. As it relates to this SWMP, this requires the City to complete and report on the following activities:

1. Periodic BMP structure cleaning.
2. Controls for reducing or eliminating the discharge of pollutants from operational areas, including roads, parking lots, maintenance and storage yards, and waste transfer stations.
3. Written documentation that new flood management projects are assessed for their impacts on water quality and existing flood management projects are examined for incorporation of additional water quality protection devices or practices.
4. Reporting of stormwater BMPs installed or initiated.
5. Reporting of funding sources and expenditures.
6. Identification of stormwater quality improvement projects.

Table 4.1.3 below provides the specific rule language from 327 IAC 15-13-15 related to MCM 6 and this SWMP, and a summary of the program requirements. The City must ensure each minimum requirement (third column in **Table 4.1.3**) has been incorporated into the City's SWQMP.

Table 4.1.3: Rule 13 MCM 6 Construction Site Stormwater Runoff Control

Rule Reference	Rule Language	Summary of Requirement
327 IAC 15-13-17(b)	Written documentation of maintenance activities, maintenance schedules, and long term inspection procedures for BMPs to reduce floatables and other pollutants discharged from the separate storm sewers. Maintenance activities shall include, as appropriate, the following: . . (B) Periodic BMP structure cleaning as defined in the MS4 area SWQMP.	Implement and track a structural BMP cleaning program. This may include cleaning and record-keeping for MS4 BMPs as well as programs that require the cleaning of privately-owned BMPs.
327 IAC 15-13-17(b)	Controls for reducing or eliminating the discharge of pollutants from operational areas, including roads, parking lots, maintenance and storage yards, and waste transfer stations. Appropriate controls shall include the following: (A) Covering or otherwise reducing the potential for polluted storm water run-off from deicing salt or sand storage piles.	Implement and track stormwater pollution prevention procedures for all municipal operations facilities, including salt storage, sand storage, snow disposal, spill containment, SOPs for spill prevention and clean-up, BMPs for vehicle maintenance, BMPs for wash water, BMPs for hydro demolition, minimization of fertilizers

	(B) Establishing designated snow disposal areas that have minimal potential for pollutant run-off impact on MS4 area receiving waters. (C) Providing facilities for containment of any accidental losses of concentrated solutions, acids, alkalies, salts, oils, or other polluting materials. (D) Standard operating procedures for spill prevention and clean-up during fueling operations. (E) BMPs for vehicular maintenance areas. (F) Prohibition of equipment or vehicle wash waters and concrete or asphalt hydrodemolition waste waters into stormwater run-off except under the allowance of an appropriate NPDES wastewater permit. (G) Minimization of pesticide and fertilizer use. Pesticides shall be used, applied, handled, stored, mixed, loaded, transported, and disposed of via office of the Indiana state chemist's guidance requirements. (H) Proper disposal of animal waste. If applicable, it is recommended that canine parks be sited at least one hundred fifty (150) feet away from a surface waterbody.	and pesticides, and proper disposal of animal waste.
327 IAC 15-13-17(b)	To the extent of their authority, an MS4 operator shall develop and implement a program to ensure that existing municipal, state, or federal operations are performed in ways that will reduce contamination of storm water discharges. . . This program must include the following: . . flood management projects are examined for incorporation of additional water quality protection devices or practices.	Flood management project shall be examined so that, in adding to addressing flooding, additional structural or non-structural BMPs are incorporated to address water quality.
327 IAC 15-13-18	An MS4 operator regulated under this rule shall submit an annual report to the department with the following information: . . . Storm water BMPs installed or initiated.	New stormwater BMPs shall be reported in annual reports to IDEM.
327 IAC 15-13-18	An MS4 operator regulated under this rule shall submit an annual report to the department with the following information: . . . Funding sources and expenditures.	Funding information, including how much money is collected and allocated for the MS4 program and how much is spent shall be reported in annual reports to IDEM.
327 IAC 15-13-18	An MS4 operator regulated under this rule shall submit an annual report to the department with the following information: . . . Identified stormwater quality improvement projects.	As stormwater quality improvement projects are identified, they shall be reported to IDEM in annual reports.

4.2 Current Ordinances and User Fee Credit Structure

Greenwood has a stormwater utility under Indiana Code 8-1.5-5 and Ordinance No. 12-11. The utility is operated by the Department of Stormwater Management. The Department of

Stormwater Management collects user fees, manages the MS4 program per Rule 13, and issues stormwater credits.

Stormwater Utility

Greenwood established a Stormwater Utility in 2012. This process involved the adoption of Indiana Code 8-1.5-5 by ordinance, which enabled the City to establish a Department of Stormwater Management. The Indiana Code allows for a Board to be appointed by the community's legislative body and is to consist of three directors, one of which is of a different political party than the other two. The Board of Directors controls the department, which is responsible for the management of the community's stormwater system and may fund stormwater management activities by charging user fees (after a rate ordinance is approved by the legislative body of the municipality). The members of a Board of Public Works or Sewer Utility Board could also serve as the Board of Directors for the Department of Stormwater Management.

There are two common scenarios in Indiana for setting up a stormwater utility established by Indiana Code: (1) setting up a separate Department of Storm Water Management (IC 8-1.5-5), as Greenwood has done, and (2) using the existing Municipal Sewage Works (IC 36-9-23). There are a variety of reasons why municipalities choose to use one Indiana Code or the other and review of options by an attorney is generally recommended.

Scenario 2, which Greenwood has not utilized, involves charging user fees for stormwater management activities under the existing Municipal Sewage Works operating under Indiana Code 36-9-23. The existing Board of Public Works or a Sewer Utility Board would control both the sanitary and stormwater operations. A separate stormwater rate and account would be maintained to fund stormwater management activities. Billing and collection procedures of the sanitary sewer utility would apply to the stormwater utility.

Stormwater Ordinance

Ordinance No. 12-11 establishes Greenwood's Department of Stormwater Management for the purposes of managing stormwater, collecting stormwater user fees and managing the MS4 program under Rule 13. The Department is responsible for and has the legal authority to conduct inspection, monitoring, maintenance, and enforcement procedures necessary for stormwater management. The Department uses its legal authority to regulate the contribution of pollutants to the stormwater drainage system from construction site stormwater runoff, post-construction stormwater runoff from new development and redevelopment, and illicit discharges and other inflow or infiltration into the stormwater drainage system. The Department regulates the development, implementation, and enforcement of the City's Stormwater Technical Standards Manual and implementation and reporting required by Rule 13.

Stormwater User Fees

Greenwood's stormwater user fees fund the cost of operations, maintenance, capital projects and planning for future expansion. All rates and fees collected for stormwater service are deposited into the City's Stormwater Management Account. Disbursements from this account are authorized by the Board and the Common Council. Disbursements are used for the operation, maintenance, and improvement of the stormwater management system and for reimbursement to the City for past and future stormwater maintenance and administration.

Because impervious surface results in runoff and increased water into the stormwater system, Greenwood's stormwater rates are based on the amount of impervious surface area on each parcel. The Equivalent Residential Unit (ERU) is defined as the approximate average impervious surface area on a residential property. The area of impervious surface on randomly selected residential properties was measured and it was determined that the ERU in Greenwood was 2,800 square feet. The ERU is considered the base billing unit and is used in the billing calculation for properties. The billing rate is currently $5.00 per ERU per month.

The Stormwater Utility's 2020 Annual budget is approximately $4,600,000 and includes expenditures for stormwater infrastructure extensions and replacements, stormwater capital improvements, legal drain reconstruction, repairs and maintenance of the stormwater system, and public private partnership program contributions. The Department of Stormwater Management maintains membership in the Johnson County Partnership for Water Quality which allows Greenwood to participate in stormwater activities with other MS4s in the county.

Stormwater User Fee Credits

Non-residential parcels can receive credits of up to 40% of their stormwater user fees for having stormwater control facilities in place to manage and reduce the impact on the drainage system. Greenwood maintains a Stormwater Credit Manual detailing the policies and procedures applicable to the stormwater service charge credit program. The following four types of credits are available:

> **Stormwater Quality Credits** – Credits are offered to properties that reduce pollutants in stormwater runoff through the use of BMPs. Credits are only granted to those exceeding removal rates (i.e. exceeding the standard) as provided in the most recent version of the Stormwater Technical Manual. These credits are also required to pass annual inspections, as set forth in Chapter 9 of the Municipal Code.
>
> **Stormwater Quantity Credits** – Credits are offered to properties that reduce the rate and/or the volume of stormwater runoff from the property. Credits are only granted

to those reducing flow rates (i.e. exceeding the standard) as provided in the most recent version of Stormwater Technical Manual. These credits are also required to pass annual inspections, as set forth in Chapter 9 of the Municipal Code.

Retrofit Credits – Credits are offered to previously developed properties should a property owner decide to upgrade or add facilities to meet or exceed the requirements provided in the most recent version of the Stormwater Technical Manual. These credits are also required to pass annual inspections, as set forth in Chapter 9 of the Municipal Code.

Education Credits – Credits are offered to educational institutions who educate students and staff about water quality, and the stewardship of natural resources, using state licensed instructors. These credits require annual reporting, which are outlined in the Education Credit section of the Credit Manual.

4.3 Construction Standards

Stormwater details are maintained by the City of Greenwood Engineering Division. The 2013 details were reviewed and updated as part of this Master Plan. They include curb and gutter, pipe bedding, pipe end sections, typical pond and swale sections, inlets and manhole details. Revisions to the current details are included in Appendix C, as well as suggestions for additional details.

4.4 Service Requests and Work Order

The City of Greenwood uses Cityworks software solutions to manage service requests, work orders, permits, inspections, and more across City departments. Greenwood primarily utilizes two Cityworks product lines: AMS (asset management system) and PLL (permits, licenses and land). Service Requests and Work Orders live inside AMS. Permits and fees are tracked with PLL. The two systems work together. For instance, a workflow within PLL may trigger a service request to perform an inspection. However, the tracking and reporting of expenses and revenues has not been optimized.

Drainage complaints or other calls to action are logged in the system as a Service Request. The request is reviewed, and if warranted, a Work Order is issued directing staff to inspect and/or perform maintenance. City employees use mobile devices to log the work performed in the field, including the time spent performing the inspection and/or maintenance and the material and equipment used. This allows cost data to be stored in each Work Order.

New developments are entered into the system through PLL as part of the building permit process. Permit fees are tracked, and work orders are issued for the creation of ERUs, but the revenue for each parcel is not stored within Cityworks.

As of August 2020, Cityworks is preparing recommendations for operational efficiencies and improvements to Greenwood's Cityworks application. It is anticipated that the City will

contract with Cityworks to implement at least some of the recommendations. It is recommended that the following improvements to the Cityworks system be employed:

1. **Revenue Tracking** – ERUs and revenue can be entered in PLL and assigned to parcels. Once this information is stored within Cityworks it can be queried along with other GIS fields, such as watershed, to assist in asset management and decision making.
2. **ArcGIS Insights** – Cityworks is an ESRI partner. ESRI being the software provider of the City's Geographic Information System (GIS). ArcGIS Insights will allow the City to create infographics of revenues, expenses, or any other piece of data saved within Cityworks or the City GIS. For instance, a "heat map" of service requests can be created showing where in the City the majority of stormwater issues take place, how much money is spent on the corresponding work orders.
3. **User-Definable Expense Reports** – Using Crystal Reports and/or ArcGIS Insights, setup a dashboard for the Stormwater Director to be able to see the sum total of expenses over a selected time frame for a single parcel, subdivision or watershed.

4.5 Public Private Partnership Program

A portion of the annual stormwater capital project budget is allocated for Public Private Partnership (P3) projects. These projects, authorized by Resolution 15-04 of the Greenwood Board of Directors of the Department of Stormwater Management (The Board), improve privately-owned stormwater infrastructure such as detention basins and stormwater quality BMPs where there is a benefit to the larger community. For instance, a new control structure for a detention pond may protect adjacent city streets and control downstream flooding. P3 can also be used to encourage construction of innovative green infrastructure.

Property owners must apply for the program and The Board authorize and approve projects for the program with the input of the Department Director. The evaluation criteria defined in the resolution is subjective. As the program becomes more popular, eligibility and selection will need to be less subjective. With expenses tracked at watershed and subdivison level, the Utility can calculate return on Investment (ROI) for each project. The total City participation should not result in a payback period (i.e. time it takes subdivision user fees to pay for project) greater than 15 years.

For example, a Homeowner's Association (HOA) applies for a 50% cost share on a $300,000 detention pond rehabilitation project. The HOA generates $7,500 per year in user fee revenues. That means the ROI would be 20 years – 50% x $300,000 = $150,000 / $7,500 = 20. Instead, the Board could approve a 25% cost share of $112,500 ($300,000 / 15).

The Board can consider downstream impacts in their ROI calculation as well. For instance a commercial property owner that wants to install a BMP may benefit downstream properties. Revenue from the downstream properties can be included in the ROI calculation.

5.0 ASSET INVENTORY

The following section is a detailed asset inventory based off the available GIS data provided by the City of Greenwood. After reviewing the GIS data, Wessler has found there to be a good amount of documented inventory, however, many details related to each asset are missing. The tables and exhibits below will summarize some of the obtained GIS data and give an insight into each asset and what is known about those assets. In general, each layer was fairly consistent in the amount and type of recorded or missing data. A major concern is that the layers within the GIS map are lacking information and photos of the individual assets themselves. Most layers contain information related to ownership, management, and location and all assets do appear to have a general naming convention or identifying system. Outside of gathering and recording more information on each asset to better the GIS mapping and understanding of the current system, each layer could be better organized so that the fields it contains show data in an easy to read, consistent, and understandable table while removing repeated or similar fields.

5.1 Mapping and GIS Resources

The City of Greenwood has a total of 1,998 stormwater manholes recorded and shown within the GIS mapping. Within the 'swManhole' layer there are 41 different field columns. However, over half of the 41 columns are missing information. General details about the assets that are missing include: invert elevation, rim elevation, cover type, wall material, manhole type, manhole condition, and flow direction. Photos of each structure are also missing. These details are critical in predicting and understanding the condition of the City's stormwater system and in estimating maintenance and repair costs. A thorough manhole inspection project would help to complete much of the missing data. Field columns that seem to be partially or fully completed are: Owned By, Managed By, Subdivision, Township, Legal Drain, Creek, HUC 14, and HUC 08.

Table 5.1.1: Stormwater Manholes

GIS Layer	*Owned By*	*Managed By*	*Quantity*
swManhole	City of Greenwood	City of Greenwood	94
	INDOT	Private	15
	Private	Private	1,889

Within the 'swDischargePoint' layer, there are 3,410 assets. The assets are categorized as end sections, outfalls, pond outlets, or pond inlets. Again, many of the field columns pertaining to the assets' individual details are missing data and there are no photos. Location, discharge,

and watershed details appear to be partially or fully completed and can be found in the field columns of Subdivision, Township, Legal Drain, Creek, HUC 14, and HUC 08.

Table 5.1.2: Stormwater Discharge Points

GIS Layer	*Owned By*	*Managed By*	*Discharge Type*	*Quantity*
swDischargePoint	City of Greenwood	City of Greenwood	End Section	1,252
			Outfall (and Outfall2 = 11)	290 + 11
			Pond Inlet	551
			Pond Outlet	200
	INDOT	Private	End Section	69
			Outfall (and Outfall2 = 1)	9 + 1
			Pond Outlet	1
	Private	Private	End Section	471
			Outfall (and Outfall2 = 4)	84 + 4
			Pond Inlet	346
			Pond Outlet	121

Within the 'swInlet' layer there are 10,755 recorded assets. There are not any individual asset details outside of the inlet type and there are no asset photos. The last date recorded for assets that were vacuumed cleaned is September of 2014 for 56 inlets. Inlet Type, Owned By, Managed By, Legal Drain, Creek, HUC 14, and HUC 08 are the only field columns with partially or fully recorded data outside of asset names and the last known editor and date.

Table 5.1.3: Stormwater Inlets

GIS Layer	*Owned By*	*Managed By*	*Asset Type*	*Quantity (EA.)*
swInlet	City of Greenwood	City of Greenwood	Catch Basin	5
			Curb Inlet	4,460
			Grate Inlet	320
			Inlet	7
			Storm Inlet Structure – Special	5
			Yard Inlet Structure	2,223
	INDOT	Private	Curb Inlet	340
			Grate Inlet	5
			Yard Inlet	56
	Private	City of Greenwood	Curb Inlet	11
		Private	Curb Inlet	885
		City of Greenwood	Grate Inlet	37
		Private	Grate Inlet	1,652
			Inlet	20
			Storm Inlet Structure – Special	9
		City of Greenwood	Yard Inlet	67
		Private	Yard Inlet	653

The 'swOpenDrain' layer contains 745 recorded assets. Install date, Top Width, Bottom Width, Depth, Bed Material, Side Material, Left Slope, Right Slope, Up Top, and Down Top are all empty field columns. Owned By, Managed By, Drain Type, Subdivision Section, Creek, HUC 14, and HUC 08 are the field columns that appear to be completed. The rest of the field columns only contain a few recorded values. Photos are not available.

Table 5.1.4: Stormwater Open Drain

GIS Layer	*Owned By*	*Managed By*	*Discharge Type*	*Quantity (EA.)*
swOpenDrain	City of Greenwood	City of Greenwood	Concrete Swale	8
			Ditch	22
			Rip-Rap Stone	3
			Swale	4
	Private	Private	Bio Swale	1
			Concrete Swale	199
			Ditch	137
			Rip-Rap Stone	42
			Swale	329

For the 'swCulvert' layer, there are 312 recorded data points. This layer has little to no recorded data. The field columns of Creek, Legal Drain, HUC 14, and HUC 08 contain the most data within them. The rest of the field columns have very little to no recorded data. Of all the supplied GIS information from the city, this layer contains the least amount of information.

Table 5.1.5: Stormwater Culverts

GIS Layer	*Quantity (EA.)*
swCulvert	312

The 'Greenwood swGravityMain' layer contains 13,976 features resulting in roughly 558,412 feet of gravity main pipe. Individual asset information is severely lacking. Of these assets, only some have material and diameter information. The field columns that do have recorded data include: Owned By, Managed By, Creek, HUC 14, and HUC 08. The last date that any of the assets were vacuumed cleaned is 12/31/1899. With the information available, the diameter of gravity pipes throughout the City ranges from 4" to 96" with 12" piping being the most abundant with nearly 59,208 feet followed by 15" piping at nearly 34,745 feet. The lack of information results in about 8,900 gravity main features within the GIS map summing to nearly 347,629.40 feet having unknown diameters.

Table 5.1.6: Stormwater Gravity Main

GIS Layer	Owned By	Managed By	#of Segments	Quantity (ft.)
Greenwood swGravityMain	City of Greenwood	City of Greenwood	9,003	351,347
	INDOT	Private	615	19,249
	Private	City of Greenwood	158	8,485
		Private	4,200	179,329

Table 5.1.7: Stormwater Gravity Main Diameter Breakdown

# of Features	Pipe Diameter (in.)	Total Pipe Length (ft.)
1	4″	1.58
1	6″	44.74
5	8″	147.17
5	10″	208.64
1,725	12″	59,208.41
2	14″	133.57
870	15″	34,744.73
3	16″	111.58
702	18″	29,743.38
4	20″	209.82
342	21″	15,932.52
559	24″	26,156.82
228	27″	10,909.92
1	28″	51.14
261	30″	12,501.57
1	32″	14.85
261	36″	13,239.59
59	42″	3,974.88
26	48″	1,709.21
13	54″	995.51
6	60″	696.26
1	96″	46.67
8,900	Unknown	347,629.40

5.2 Water Quality Best Management Practices (BMPs)

Within the 'swBMP' layer, there are 435 features. Much of the information in this layer relates to asset type, watershed classification, and location of asset. There are multiple fields related

to ownership of the assets, but these do not appear to be definitive in who is the owner and who is to manage them due to missing information. The table below breaks out the type of asset and the quantity of each. The most abundant BMP assets within the city are aqua swirls with a quantity of 119 followed by Stormceptors at a quantity of 95 structures.

Table 5.2.1: Summary of BMPs by Type and Quantity

GIS Layer	*Stormwater BMP Type*	*Quantity (EA.)*
swBMP	Aqua Swirl	119
	Bio Swale	7
	ADS	5
	Contech	9
	Downstream Defender	4
	Forebay	10
	Flo Guard	8
	Hydro International	5
	Stormceptor	95
	Sump	21
	Water Quality	11
	Dry Detention Pond	15
	Retention Pond	33
	Pave Drain	2
	Vortechs	1
	Unknown	90

5.3 Detention and Retention Ponds

The swDetentionPoint layer contains a total of 356 features. Outside of the Detention Type field, there is no information on individual assets. The fields that contain information are as follows: Owned By, Managed By, Detention Type, As-Built, Creek, HUC 14, and HUC 08. Below are two tables. The first table breaks down the quantity and type of each detention and retention asset by ownership and who manages the assets. The second table breaks down the quantity and type of each asset within the different watersheds.

Table 5.3.1: Stormwater Detention and Retention Points

GIS Layer	Owned By	Managed By	Asset Type	Quantity (EA.)
swDetentionPoint	City of Greenwood	City of Greenwood	Detention Pond	1
			Retention Pond	7
			Underground Detention	2
	Private	Private	Detention Pond	29
			Retention Pond	307
			Underground Detention	10

Table 5.3.2: Stormwater Detention and Retention Points by Watershed

Watershed	Asset Type	Quantity (EA)
Auburn	Retention Pond	19
East Grassy	Retention Pond	46
Fairview Creek	Detention Pond	3
	Retention Pond	13
Floyd Sheek	Detention Pond	2
	Retention Pond	10
Jennings	Retention Pond	2
Lee Park	Detention Pond	15
	Retention Pond	45
	Underground Detention	3
Lower Honey Creek	Retention Pond	14
New East Grassy-Floyd Sheek	Retention Pond	27
P R Griffith	Retention Pond	12
Pleasant Run Creek	Detention Pond	5
	Retention Pond	36
	Underground Detention	4

Scott Tile	Retention Pond	1
Shirley Tile	Retention Pond	1
Tracy East	Retention Pond	19
	Underground Detention	1
Tracy West	Detention Pond	2
	Retention Pond	39
	Underground Detention	2
Turkey Pen Creek	Detention Pond	1
	Retention Pond	18
	Underground Detention	2
Upper Honey Creek	Detention Pond	2
	Retention Pond	11
Villa Heights	Retention Pond	1

5.3.1 Subdivisions and Detention/Retention Pond Service Area

Based off the GIS layer "Greenwood Subs", there are a total of 437 subdivisions. Outside of the names recorded for most of the subdivisions, there is little information within the table of the GIS layer. Out of the 437 subdivisions, 166 of them contain at least one or more detention pond, retention pond, or underground detention. For BMPs, there are at least 111 subdivisions that contain one or more BMP. However, due to the GIS BMP layer lacking information, only 412 of the 435 BMP assets have been accounted for when trying to determine the number of subdivisions containing BMPs. Last, when trying to do more analyses of the subdivisions related to the number and type of assets within each subdivision, types of zoning, and other items, issue arose due to the lack of information within the GIS layers. Also, because subdivision boundary lines cross over into multiple zoning boundary lines it cannot be determined how many subdivisions are in each category of zoning.

6.0 STORMWATER MANAGEMENT GOALS

As the City of Greenwood continues to grow and develop, the Department of Stormwater Management will be challenged to provide the stormwater management needs of the City. The Department has the following stormwater management goals.

6.1 Watershed-Based Tracking

As explained in Section 3.0, the watershed delineations for the City have been updated and this information has been provided for inclusion in the GIS. Using CityWorks and ArcGIS Online reporting and analysis tools, the Department will be able to track and report issues, expenses and revenue on a watershed basis. This will enable the Department to make decisions with full understanding of the watershed impact and will allow for clearer communication with the Board of Directors, the Mayor's Office and the public.

6.2 Asset Management

According to the 2018 GASB data, there are nearly 210,000 feet of pipe in the City 50 years old or older. Another 140,000 feet of pipe will reach the 50-year threshold in the next 10 years. These pipes and the associated manholes and inlets pose the greatest risk of failure. In order to minimize risk and allocate the appropriate resources for system operation and maintenance, the City should embark upon a comprehensive stormwater asset management plan (AMP).

A stormwater AMP should include the following:

1. System Map
2. Inventory & Evaluation of Assets
3. Inspection, Repair and Maintenance Plan

Luckily, the Department already employs the tools necessary to maintain an effective AMP, namely ArcGIS and Cityworks. The System Map and asset inventory lives in ArcGIS. Section 5 of this plan summarizes the assets currently in GIS. As noted, the inventory is incomplete. As part of this Master Plan, Wessler Engineering reviewed 251 sets of Record Drawings and updated the assets in the GIS. There are 96 sets of Drawings still to be reviewed.

After completion of Record Drawing updates, assets should be physically inspected. Inspections should begin with all assets 50 years old or older. It is recommended that those inspections occur within the next 2 years. Assets between 40 and 50 years old should be inspected within 5 years. Assets 40 years and newer should be inspected as needed and based upon any other missing inventory data. For example, there are entire subdivisions without pipe diameters in the system map. Those pipes should be measured and assessed at the same time.

Condition Assessment can be entered into Cityworks at the time of inspection. Based on the condition, a Probability of Failure rating of 1 (improbable failure) through 5 (imminent

failure) will be assigned to each asset. Then factors such as location and drainage area served will be used to assign a Consequence of Failure Rating. Consequence of Failure ratings would range from 1 (insignificant disruption) to 5 (catastrophic disruption). Multiplying the Probability of Failure rating and the Conseqence of Failure rating gives the asset criticality. Cityworks can then identify assets based on criticality and the Department can create and implement its Repair and Maintenance Plan.

6.3 Full Utilization and Implementation of GIS-based Tools

In order to make watershed-based planning and robust asset management possible, the GIS system ands Cityworks must be supported, developed and implemented. The following actions are recommended:

- Update GIS system map to fill in missing data
- Add condition assessment, probability of failure, and consequence of failure fields into GIS
- Include revenue data in Cityworks PLL
- Work with Cityworks and/or consultants to create revenue and expenditure reports
- Track Asset Value in Cityworks as new infrastructure is installed
- Transfer existing asset valuation data into Cityworks
- Implement ArcGIS Insights data analysis tools

7.0 CAPITAL IMPROVEMENT PROJECTS

The City of Greenwood Department of Stormwater Management 5-year Capital Plan is included in Appendix B. It should be updated if and when the asset inspections identify additional maintenance needs, particularly in assets nearing or exceeding their useful life.

Non-maintenance related capital outlies include:

1. $500,000/year for Public Private Partnership Projects. A typical year may include two pond rehabilitation projects, one BMP project, and two local drainage projects, such as culvert or inlet replacement.
2. $200,000 for Nature Center improvements in 2021.
3. $2.5M for Bridge replacement in 2022.
4. $2M for regional stormwater (detention and water quality) facilities in 2023 and 2024.
5. $750,000/year 2021 through 2023 for Downtown redevelopment stormwater (detention and water quality) and drainage improvements.

8.0 REFERENCES

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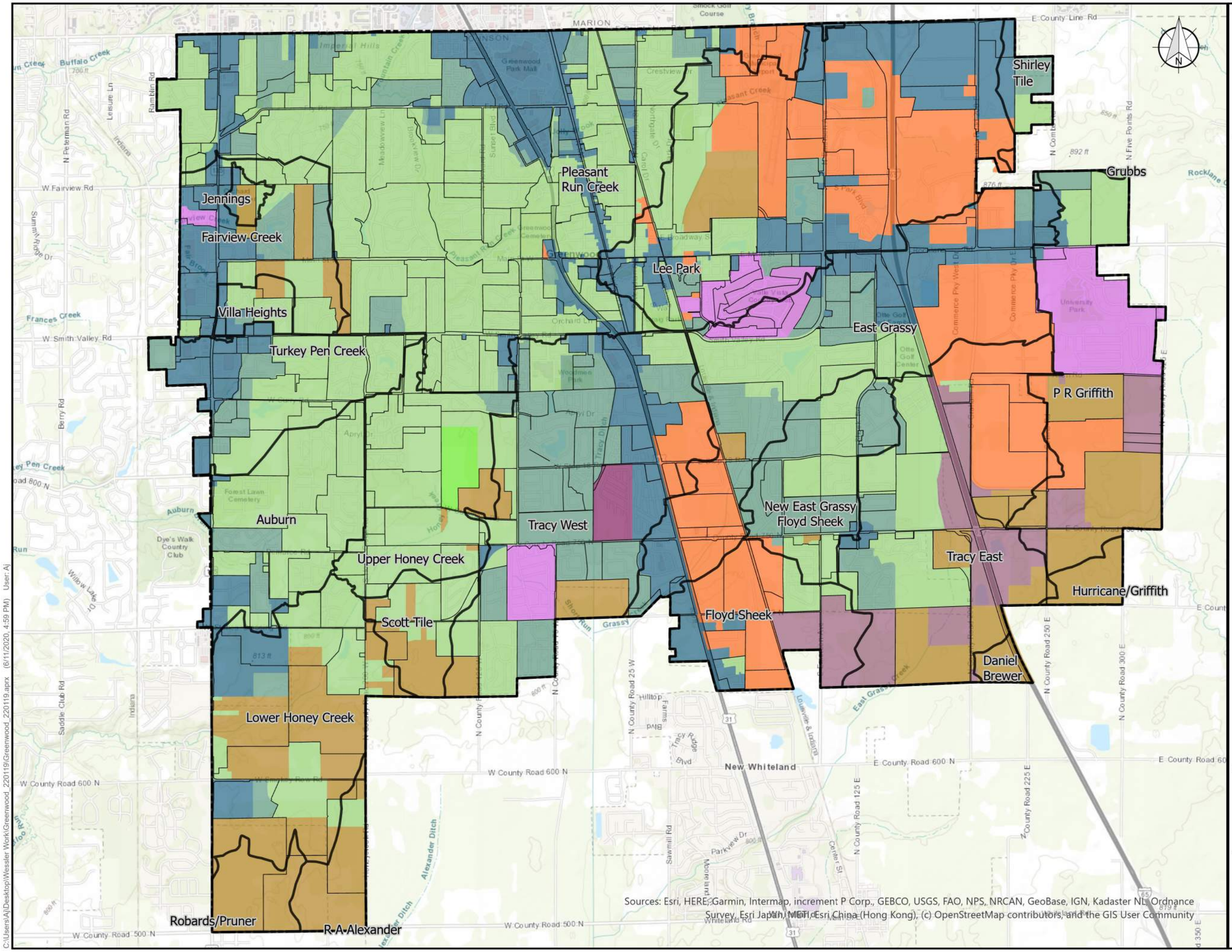
Appendix A – Exhibits and Figures



WESSLER ENGINEERING

More than a Project™

Legend

- Municipal Boundaries
- Municpal Subdivisions
- Municipal Watersheds

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Mobile Home Park
- Recreational Open Space
- Suburban Fringe

0 2,500 5,000 FT

FIGURE 2.1

Greenwood Land Use

Greenwood, Indiana
Watersheds

June 2020
220119-01-001

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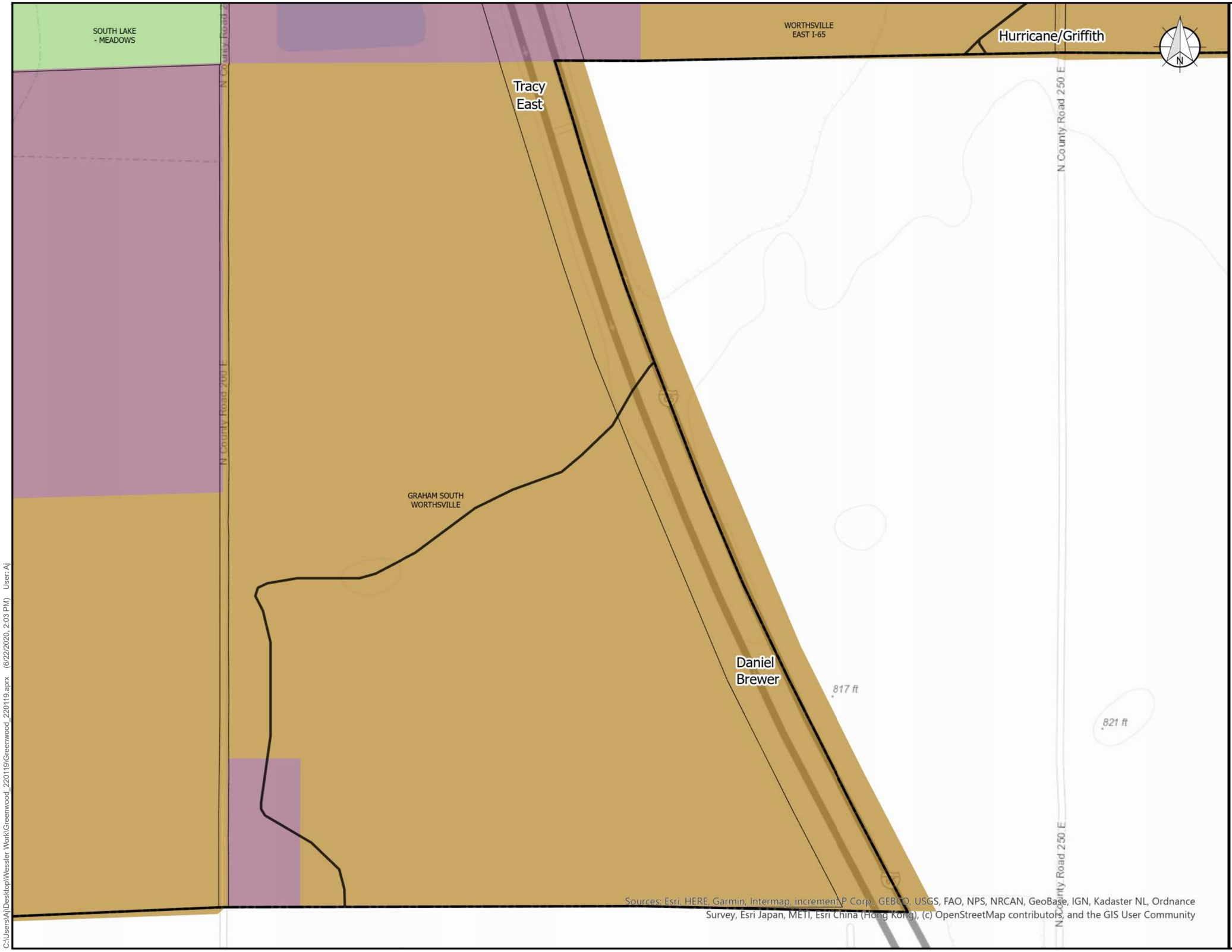

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Single Family Residential
- Suburban Fringe

0 155 310 620 FT

FIGURE 2.1.1

Watershed:
Daniel Brewer

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

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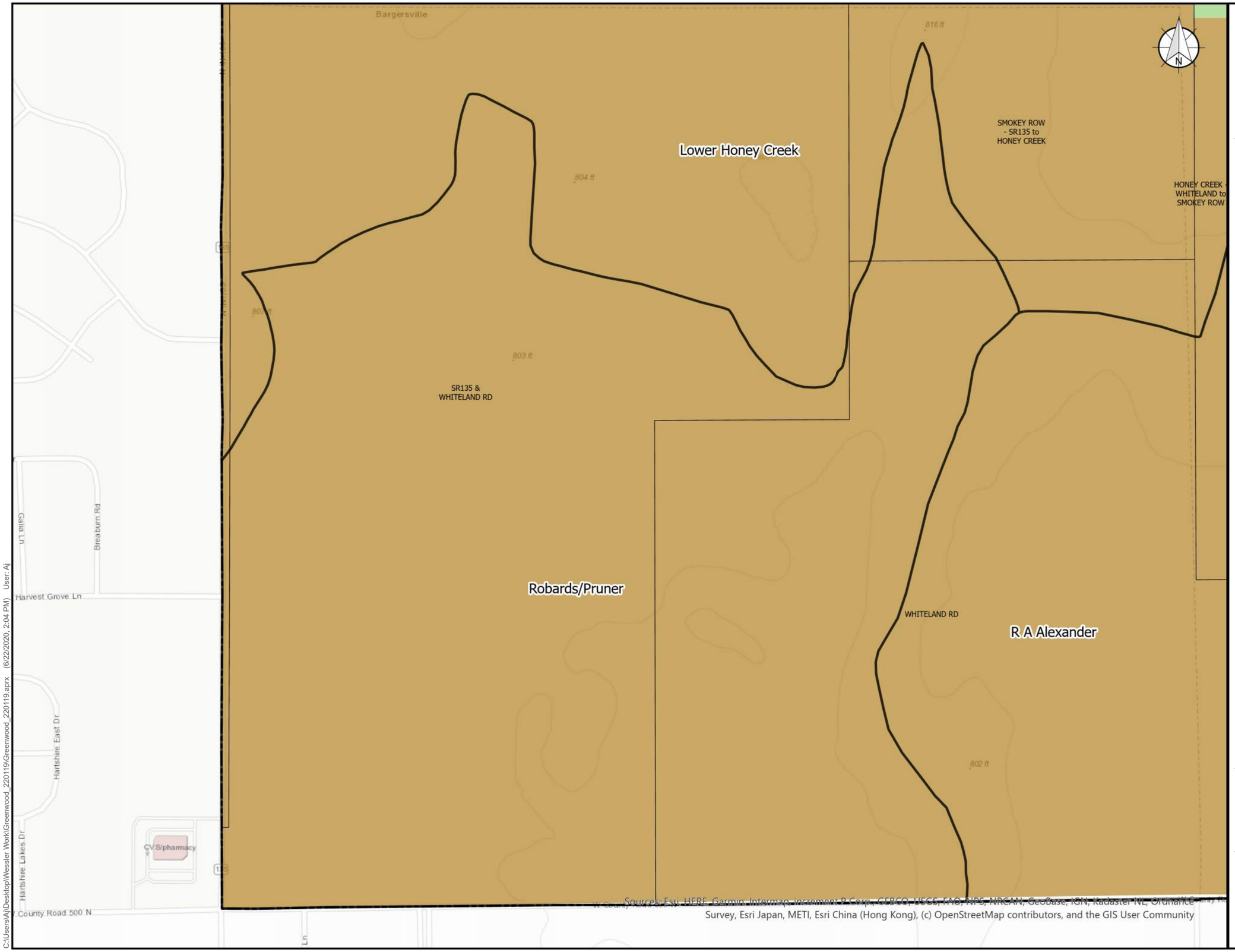

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WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Single Family Residential

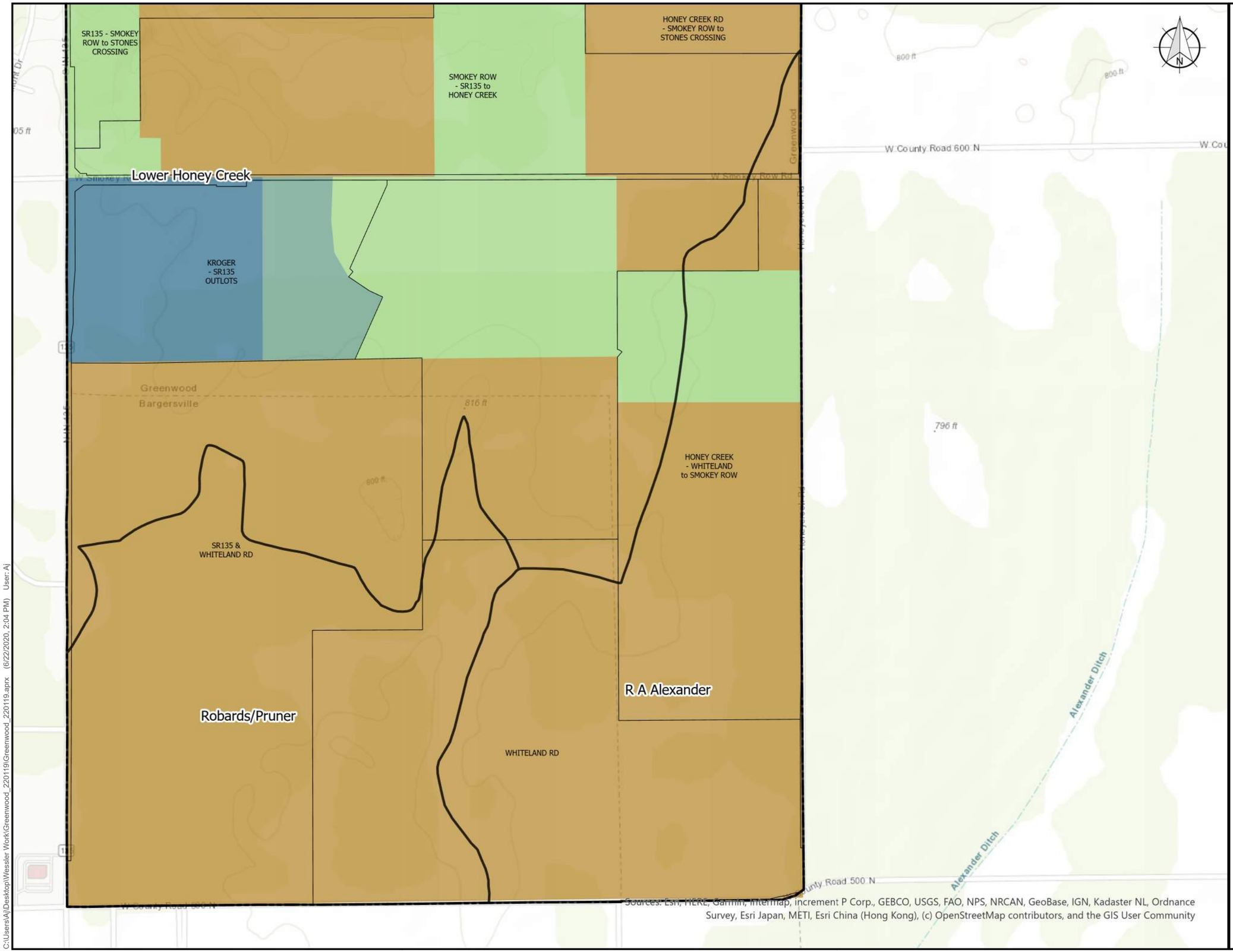
0 205 410 820 FT

FIGURE 2.1.2

Watershed:
Robards/Pruner

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Single Family Residential
- Multiple Family Residential

0 350 700 1,400 FT

FIGURE 2.1.3

Watershed:
R A Alexander

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

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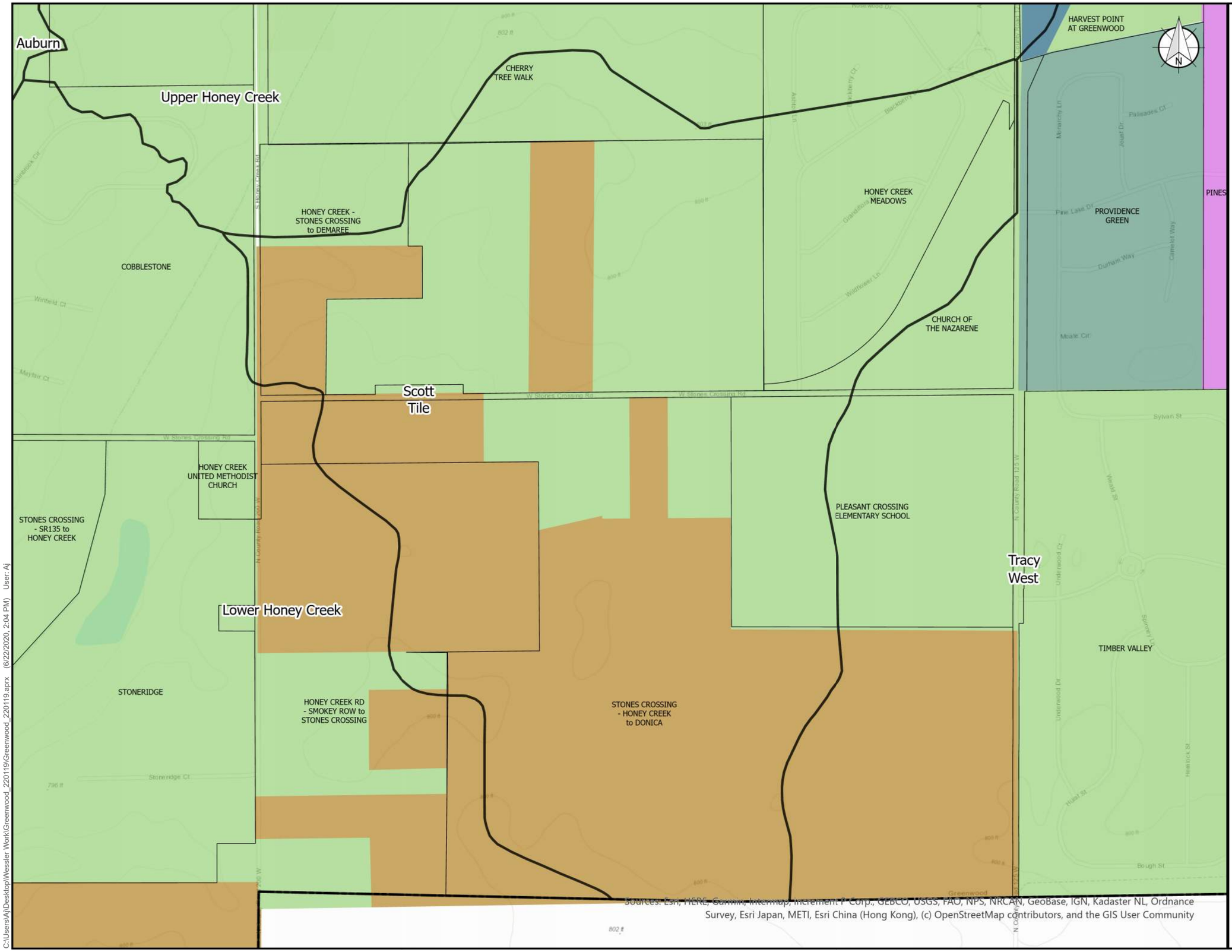

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WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential

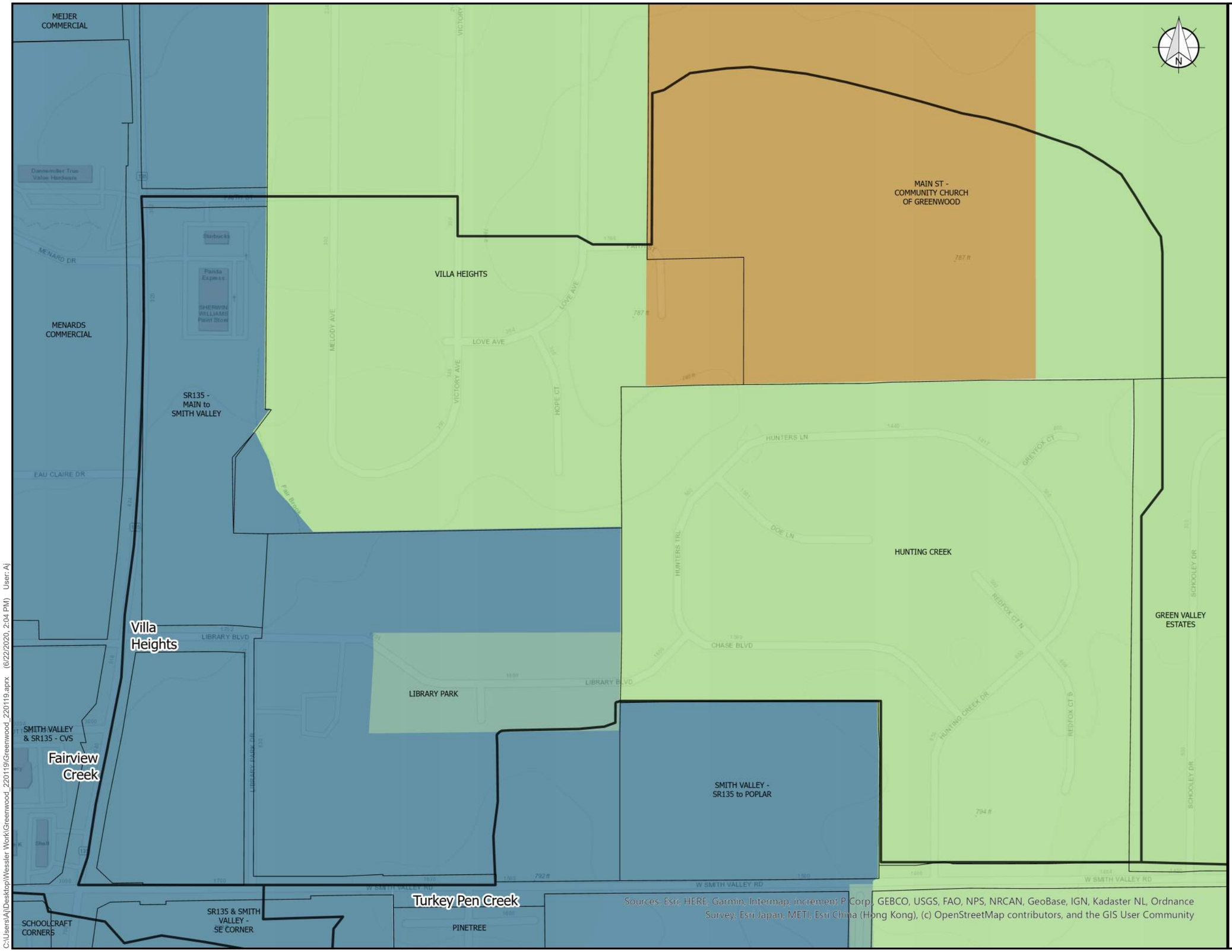
0 250 500 1,000 FT

FIGURE 2.1.4

Watershed: Scott Tile

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Single Family Residential
- Multiple Family Residential

0 125 250 500 FT

FIGURE 2.1.5

Watershed: Villa Heights

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

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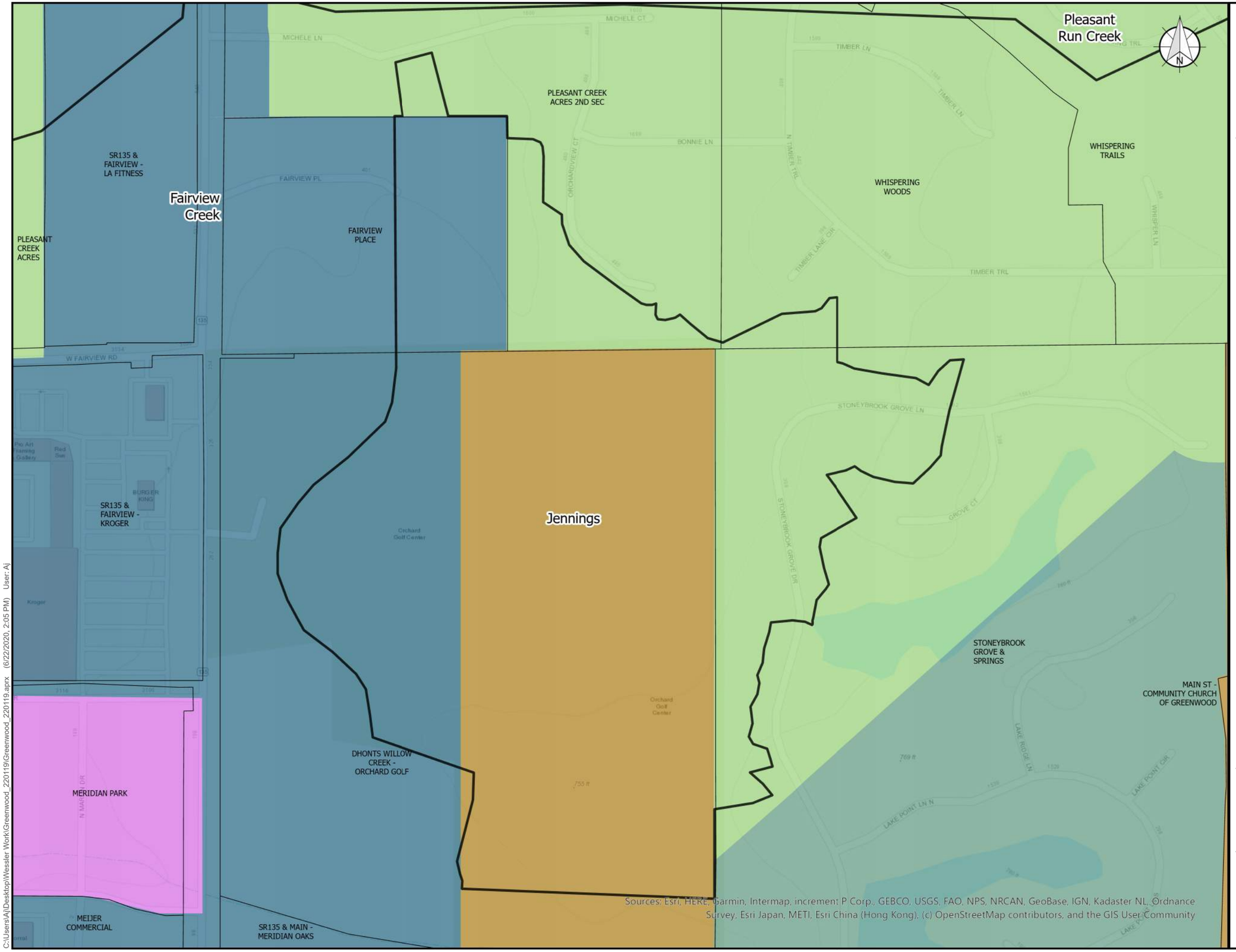

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential

0 125 250 500 FT

FIGURE 2.1.6

Watershed: Jennings

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

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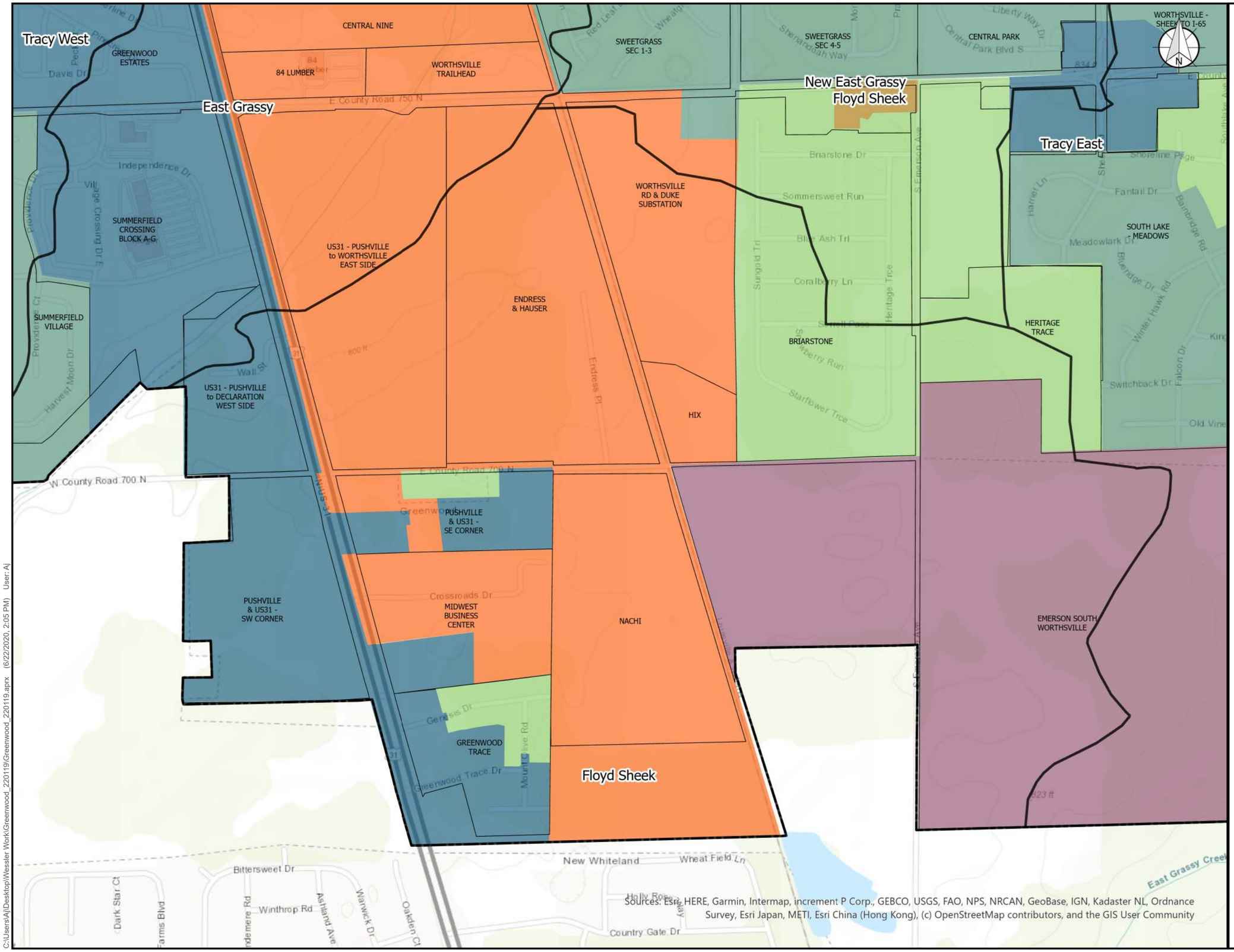

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Single Family Residential
- Multiple Family Residential
- Suburban Fringe

0 345 690 1,380 FT

FIGURE 2.1.7

Watershed: Floyd Sheek

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

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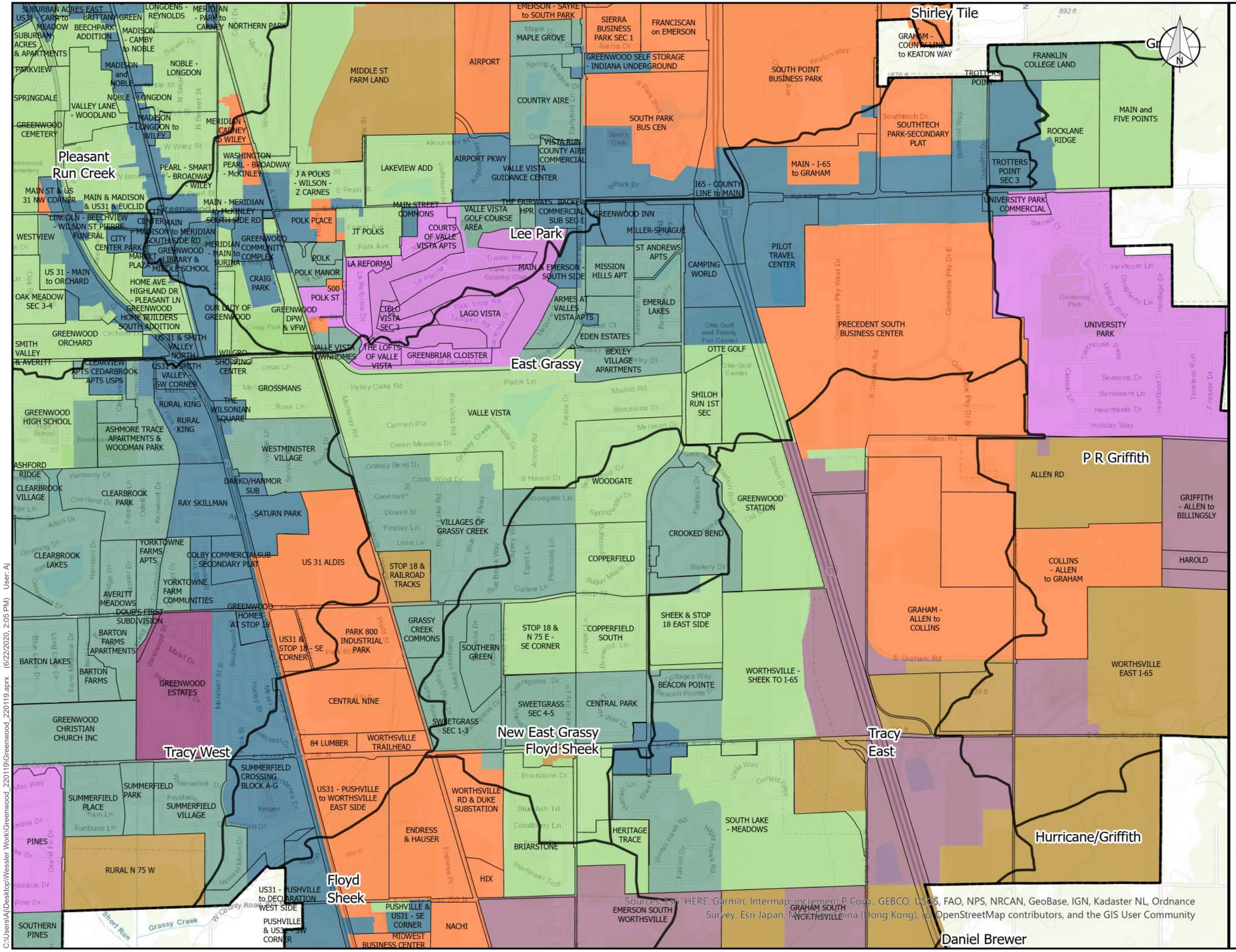

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WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Mobile Home Park
- Suburban Fringe

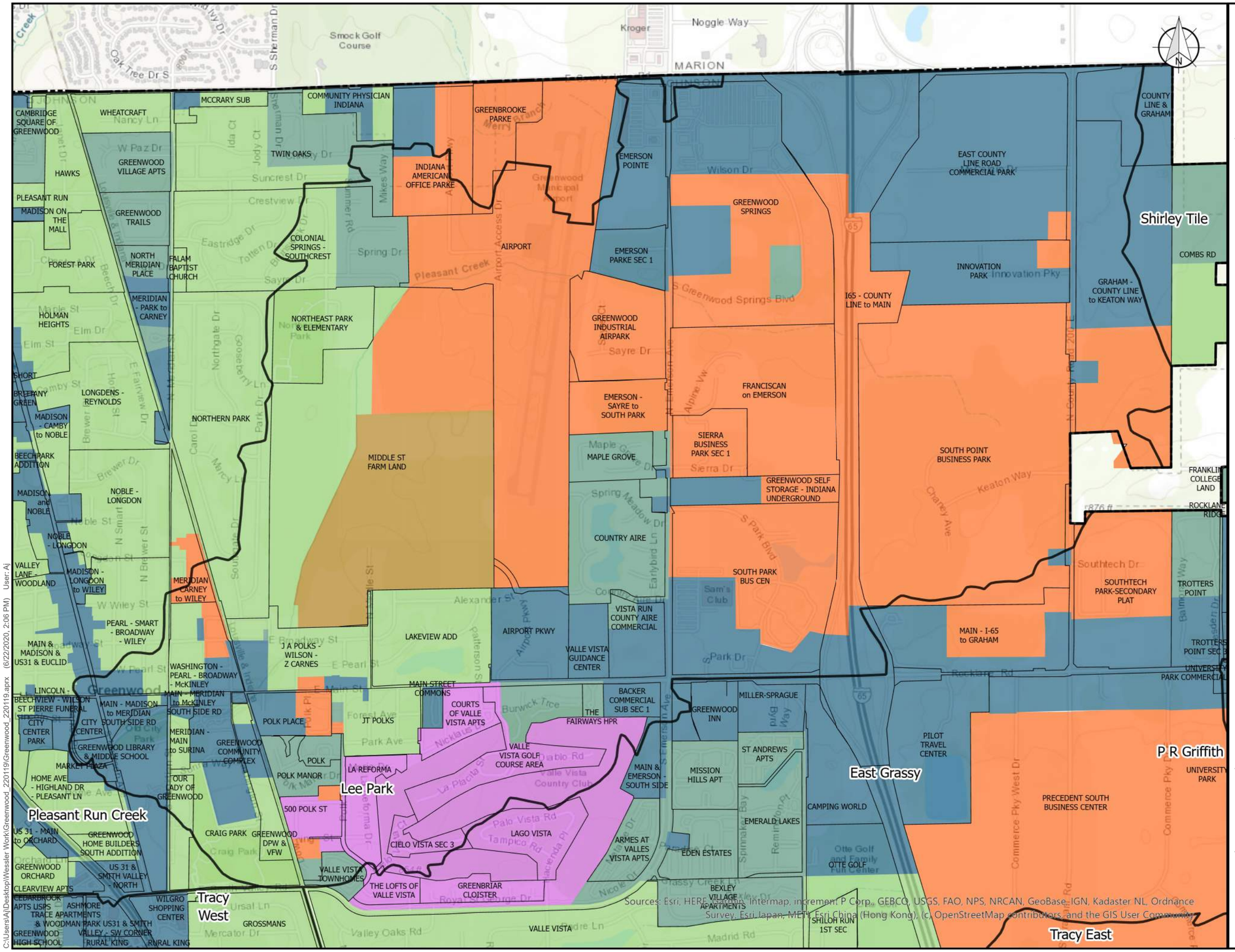
0 500 1,000 2,000 FT

FIGURE 2.1.8

Watershed: East Grassy

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001



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WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential

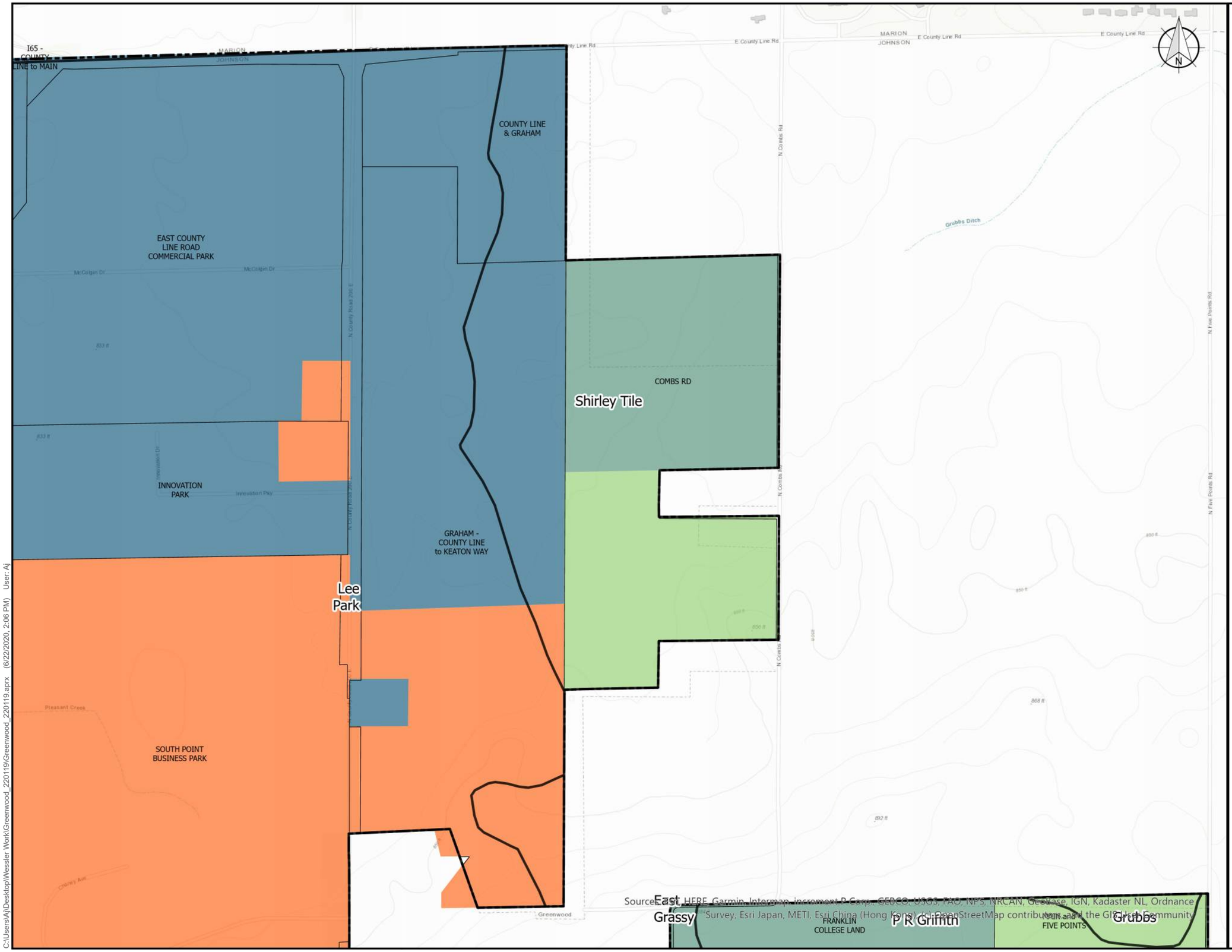
0 500 1,000 2,000 FT

FIGURE 2.1.9

Watershed: Lee Park

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Commercial
- Industrial
- Single Family Residential
- Multiple Family Residential

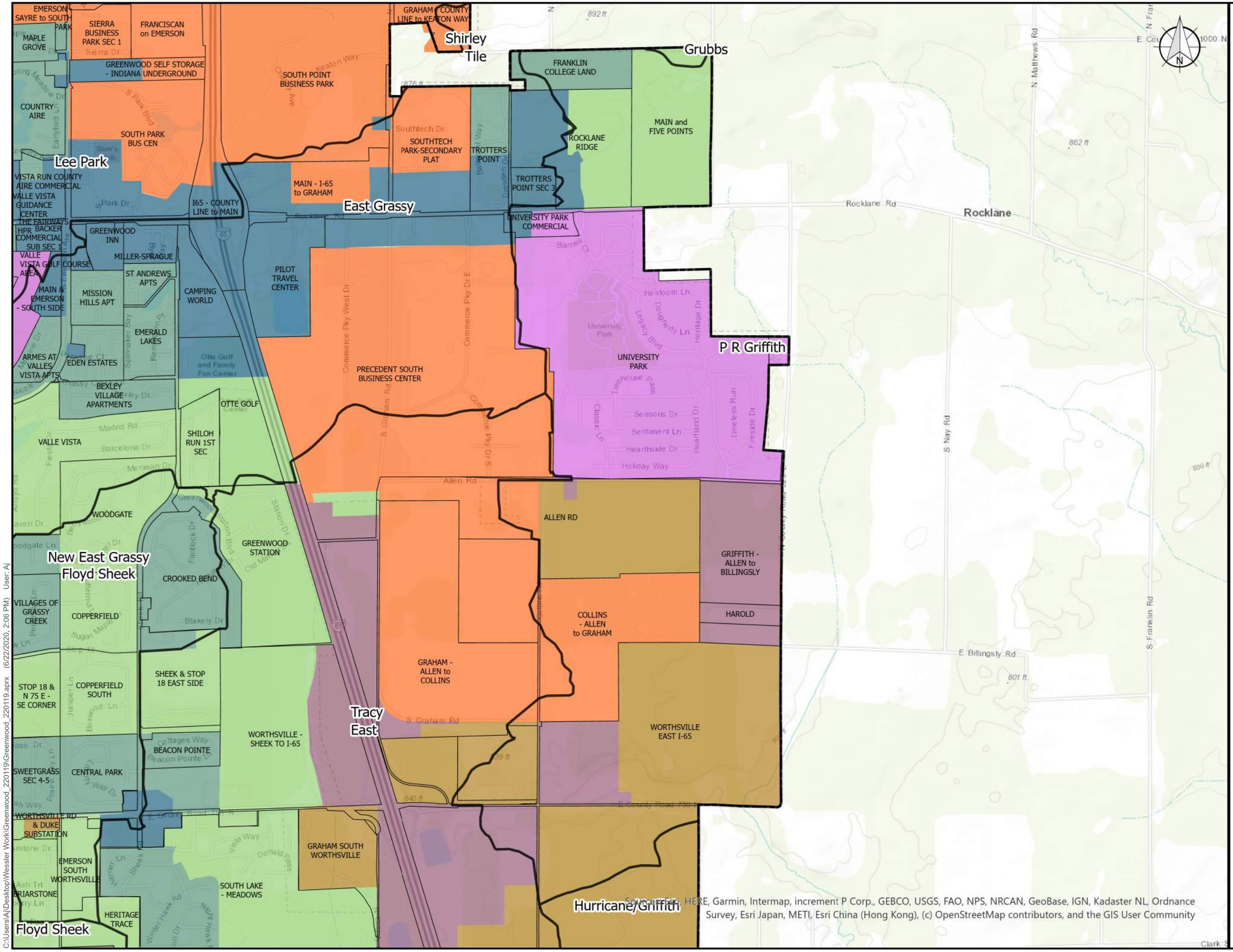
0 300 600 1,200 FT

FIGURE 2.1.10

Watershed: Shirley Tile

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Suburban Fringe

0 500 1,000 2,000 FT

FIGURE 2.1.11

Watershed: P R Griffith

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

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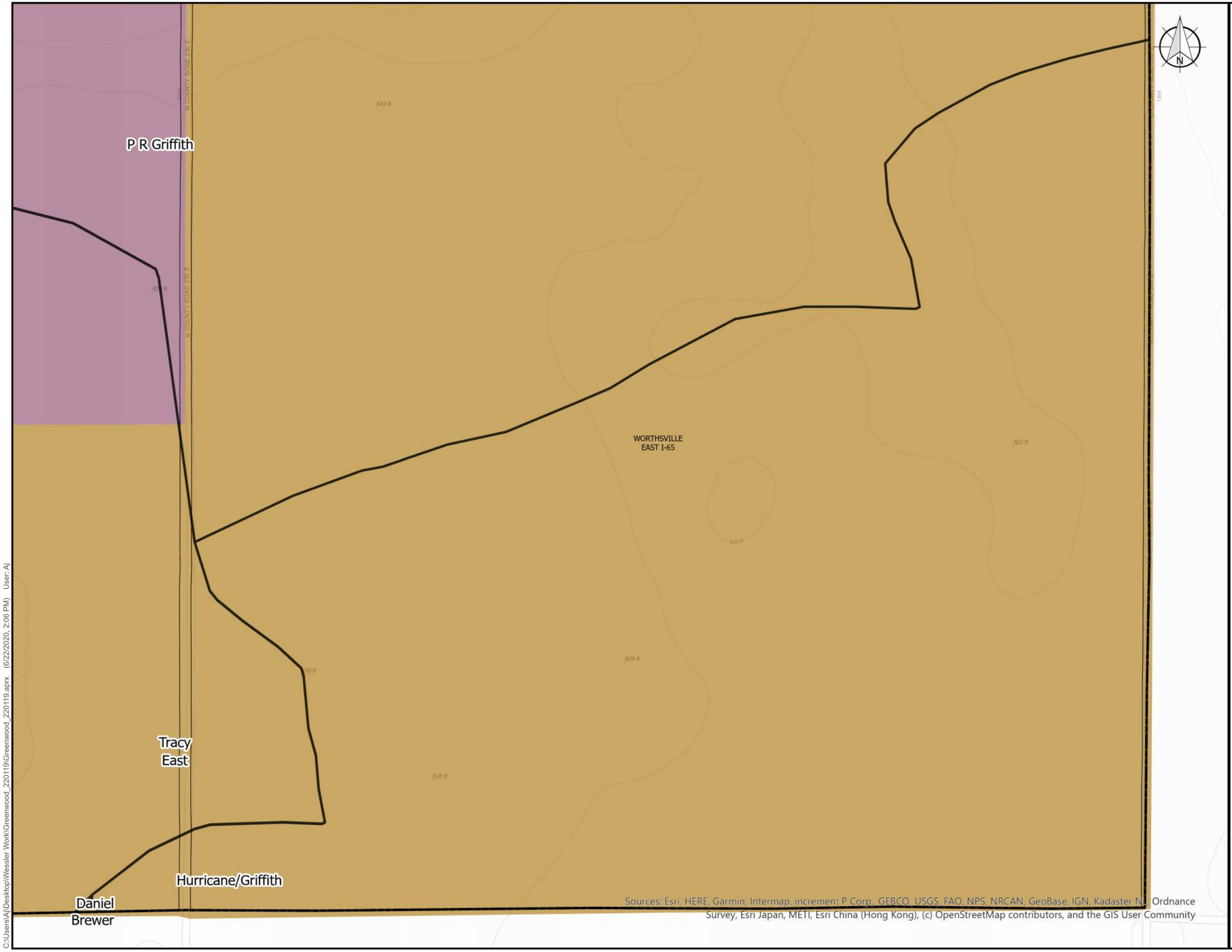

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WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Suburban Fringe

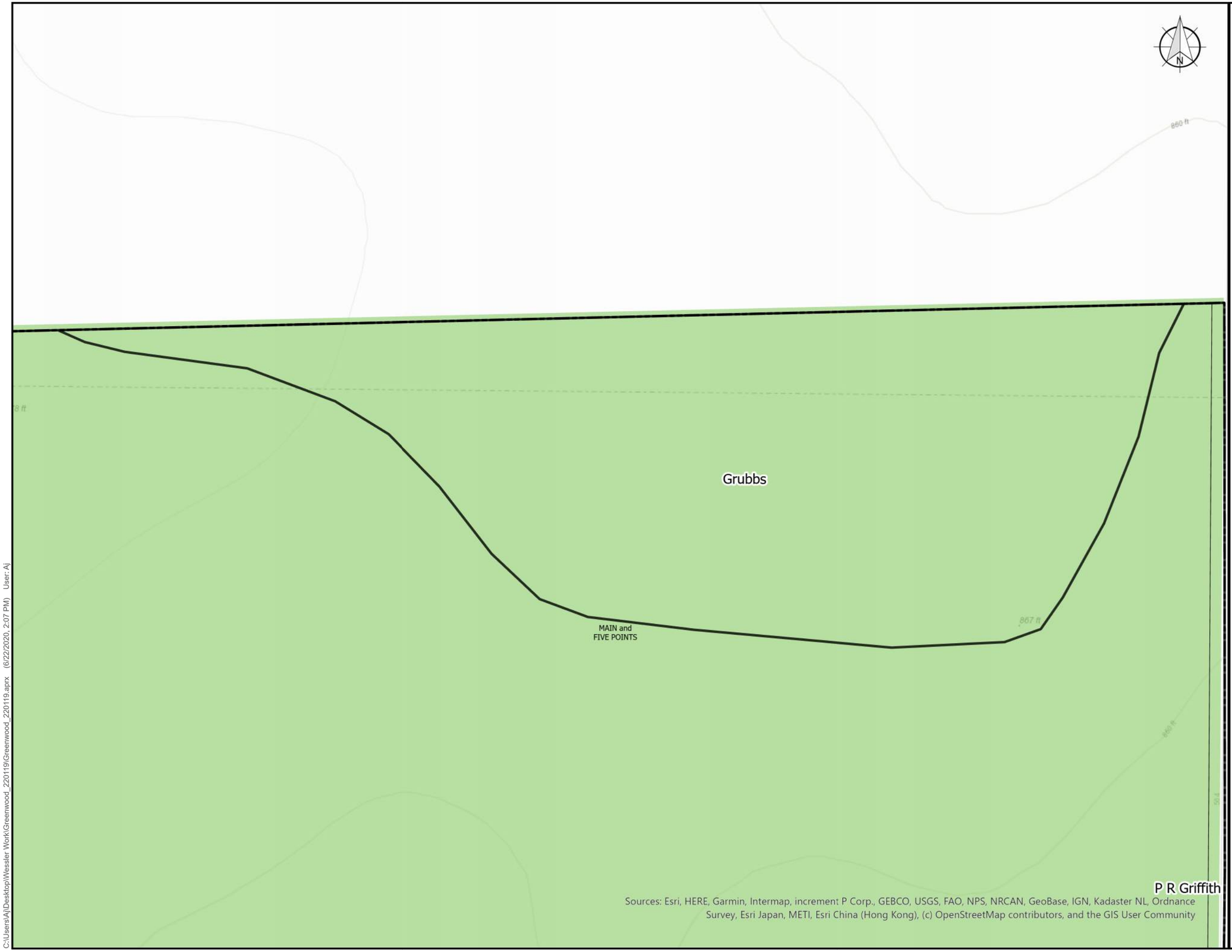
0 135 270 540 FT

FIGURE 2.1.12

Watershed:
Hurricane/Griffith

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Single Family Residential

0 45 90 180 FT

FIGURE 2.1.13

Watershed: Grubbs

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

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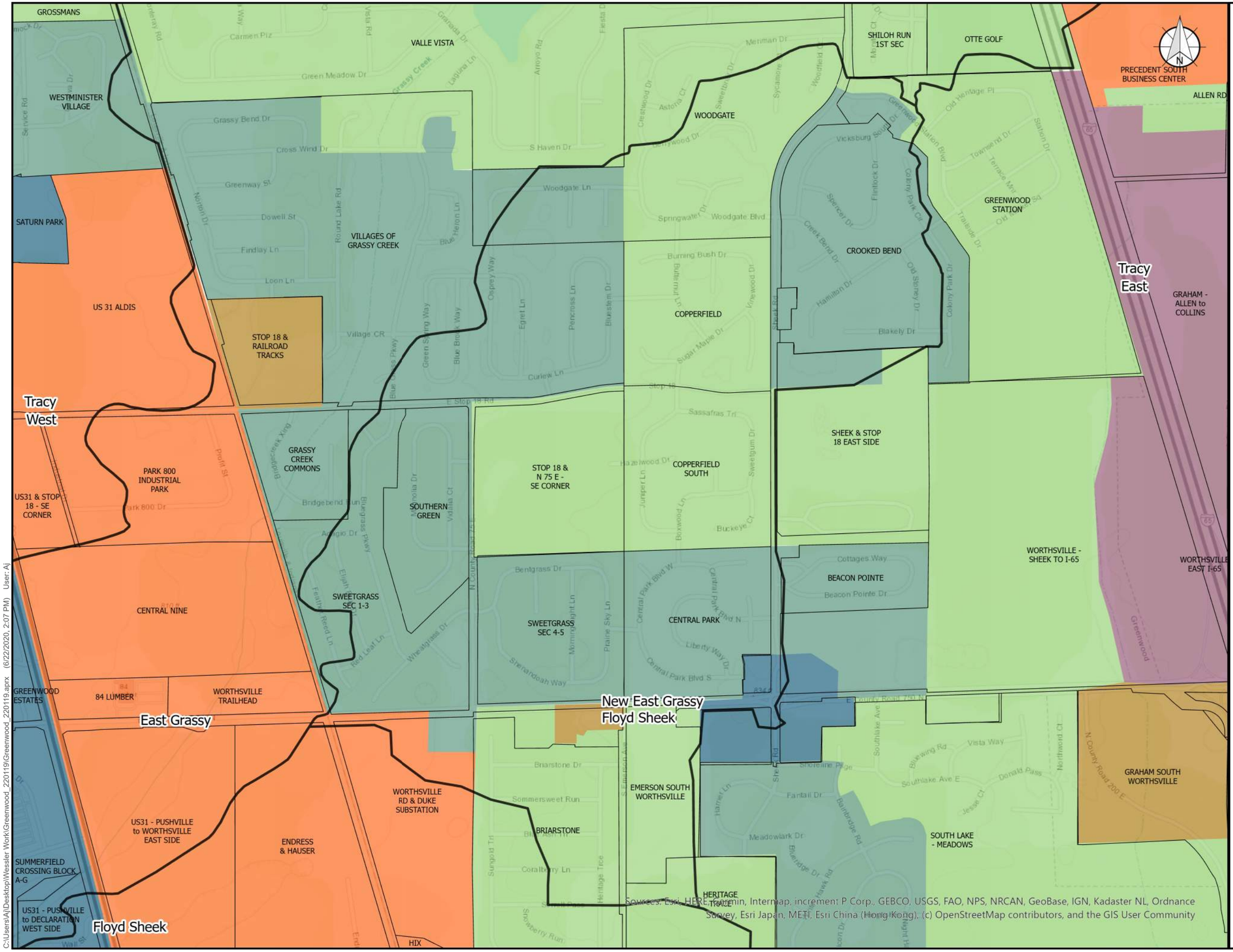

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WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Single Family Residential
- Multiple Family Residential
- Suburban Fringe

0 420 840 1,680 FT

FIGURE 2.1.14

Watershed:
New East Grassy-Floyd Sheek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Mobile Home Park
- Recreational Open Space

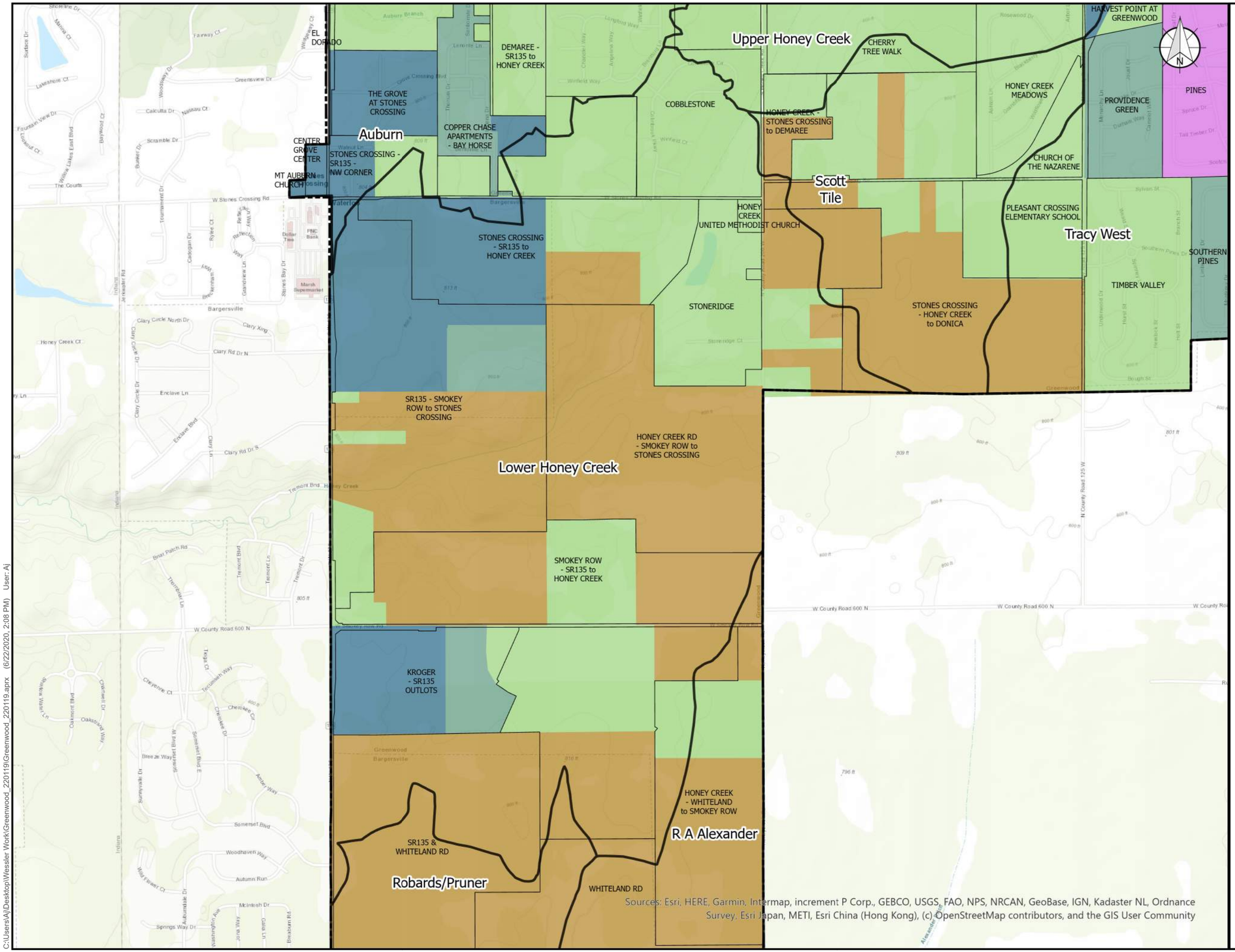
0 500 1,000 2,000 FT

FIGURE 2.1.15

Watershed:
Upper Honey Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential

0 500 1,000 2,000 FT

FIGURE 2.1.16

Watershed:
Lower Honey Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

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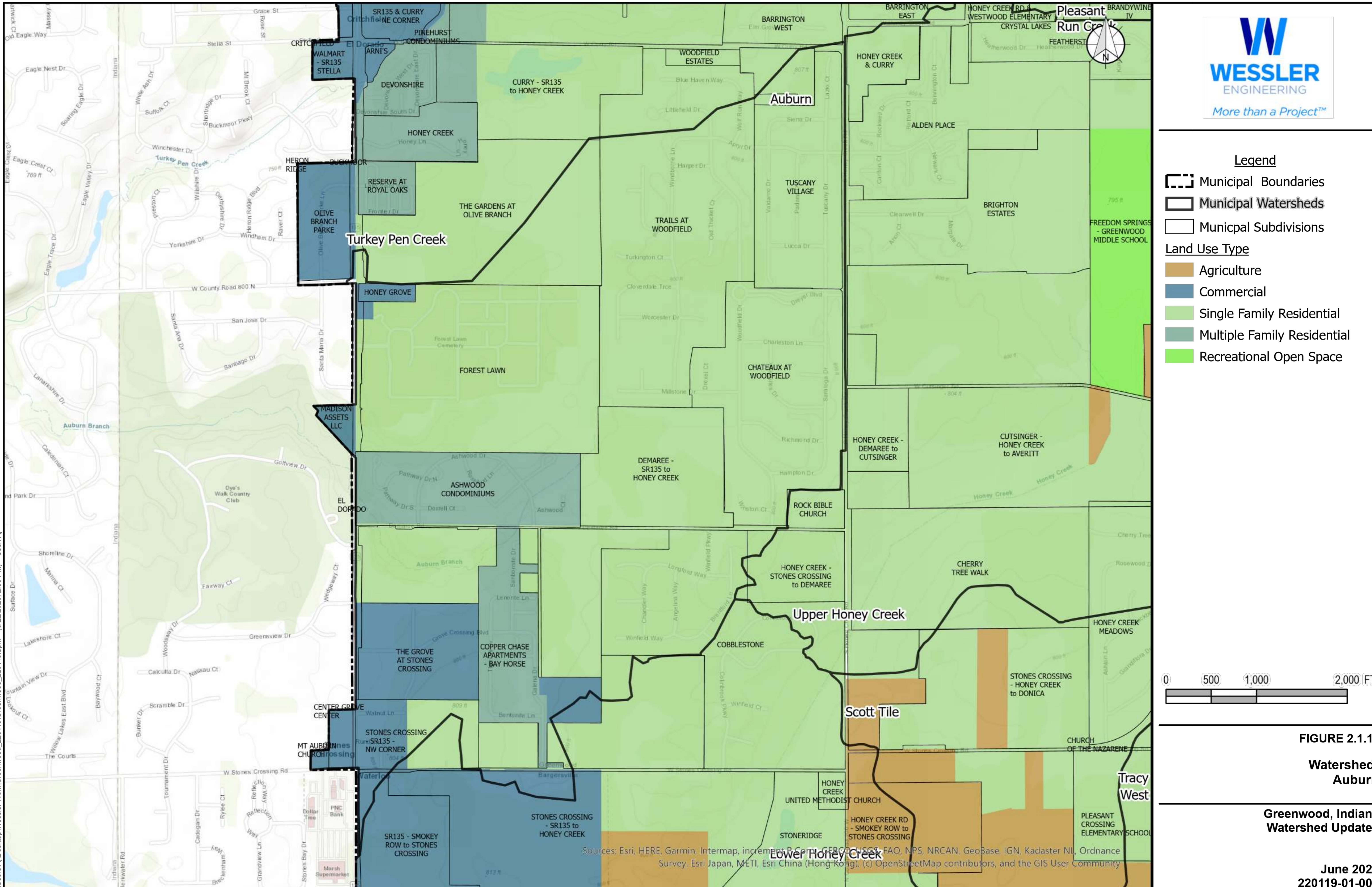
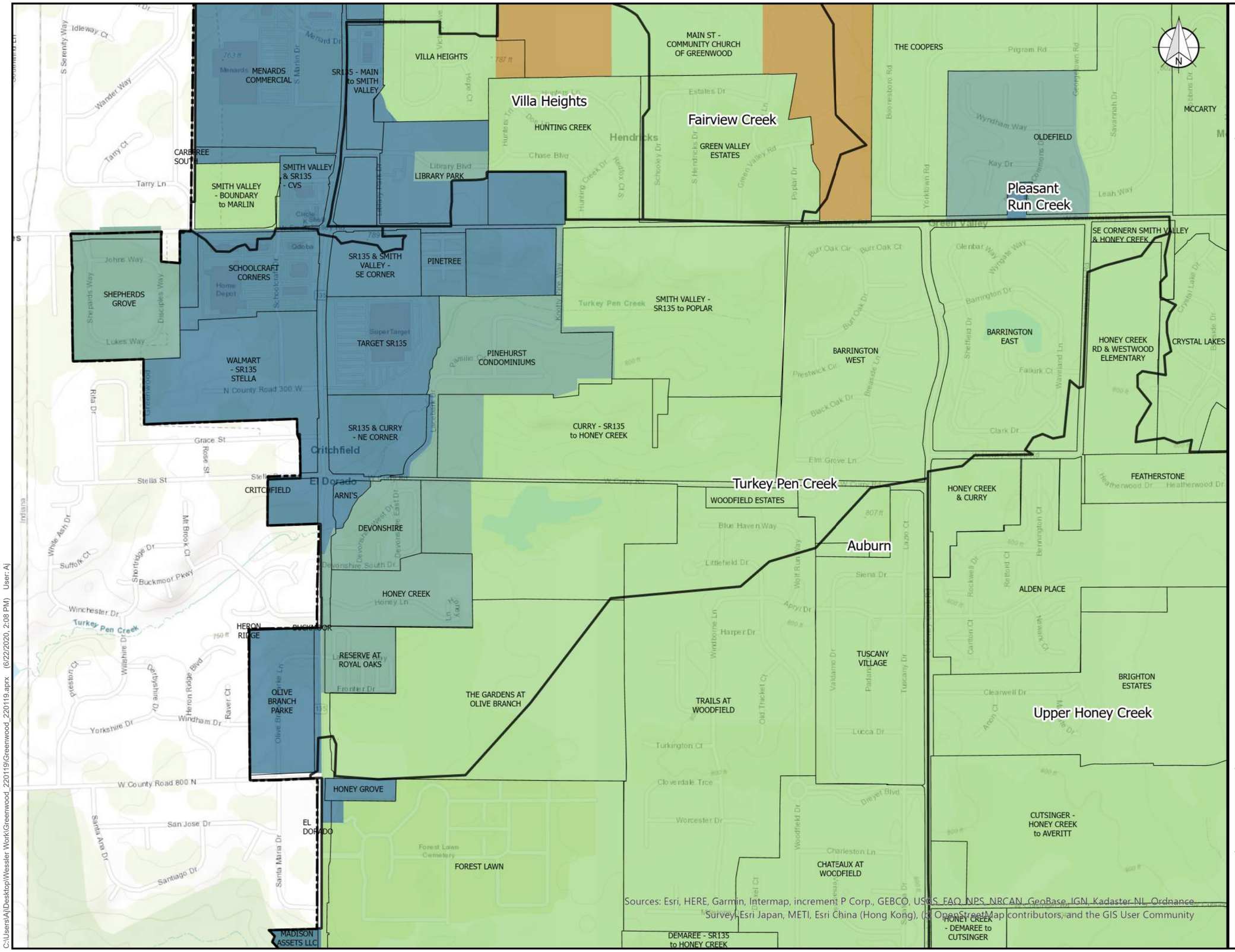


FIGURE 2.1.17

Watershed: Auburn

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Single Family Residential
- Multiple Family Residential

0 425 850 1,700 FT

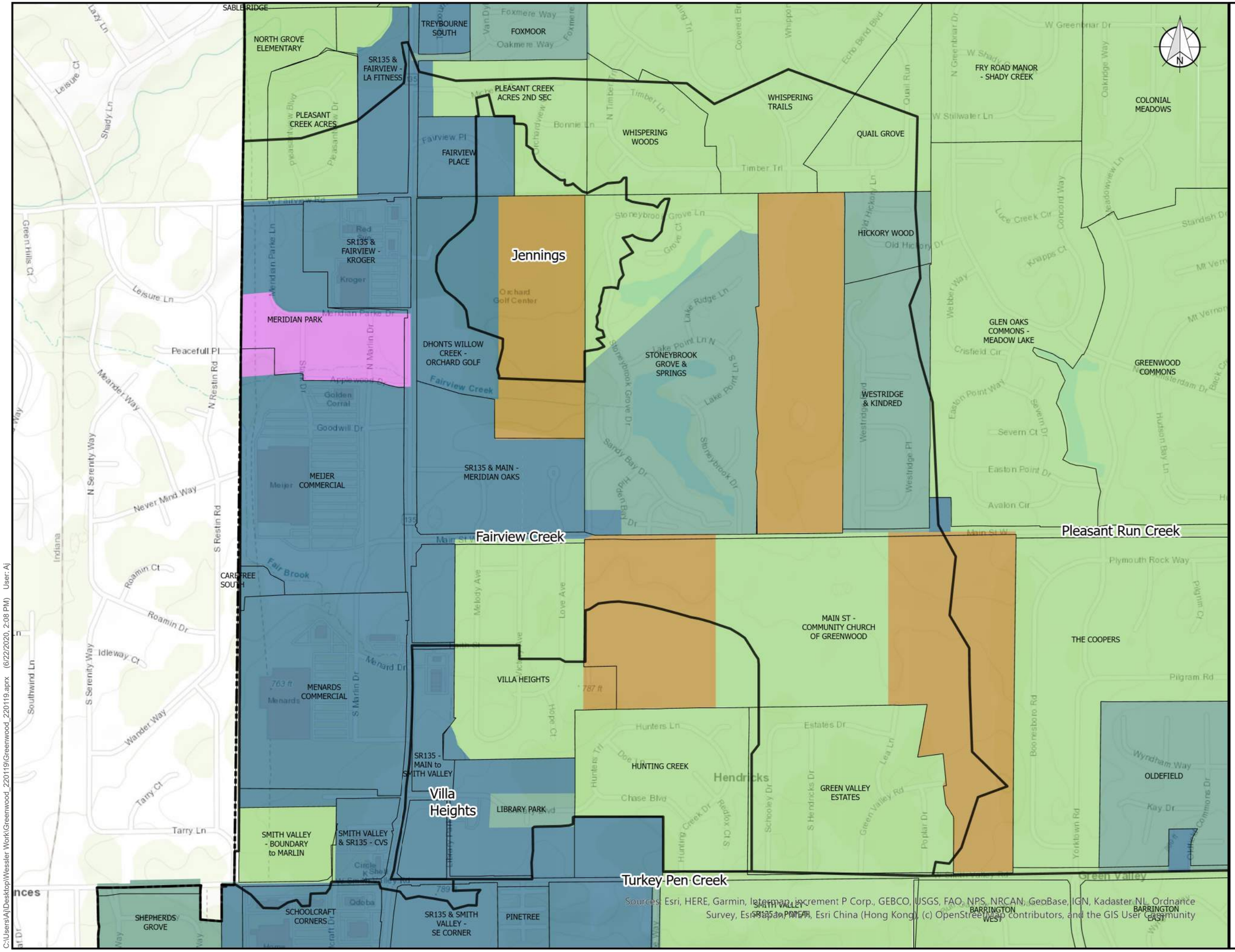
FIGURE 2.1.18

Watershed: Turkey Pen Creek

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/22/2020, 2:08 PM) User: AJ



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential

0 370 740 1,480 FT

FIGURE 2.1.19

Watershed: Fairview Creek

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/22/2020, 2:08 PM) User: AJ

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Mobile Home Park
- Recreational Open Space

0 1,000 2,000 4,000 FT

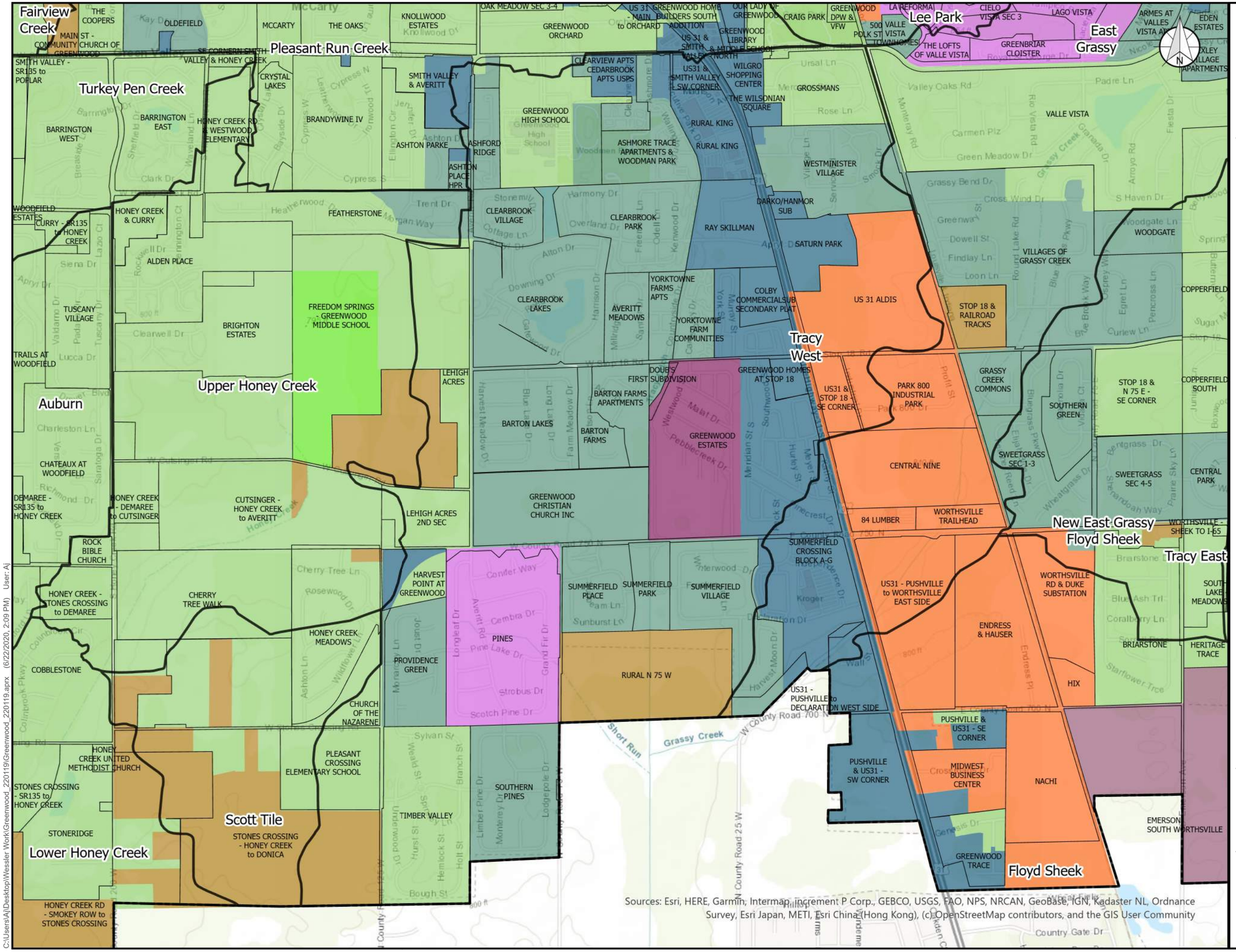
FIGURE 2.1.20

Watershed:
Pleasant Run Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

Pleasant Run Creek
Jennings
Fairview Creek
Villa Heights
Hendricks
Turkey Pen Creek
Upper Honey Creek
Auburn
Spring Hill
McCarty
Tracy West
Lee Park
East Grassy
New East Grassy
Floyd Sheek
Tracy East
Imperial Hills
Critchfield
El Dorado
Frances



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/22/2020, 2:09 PM) User: Aj

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Mobile Home Park
- Recreational Open Space
- Suburban Fringe

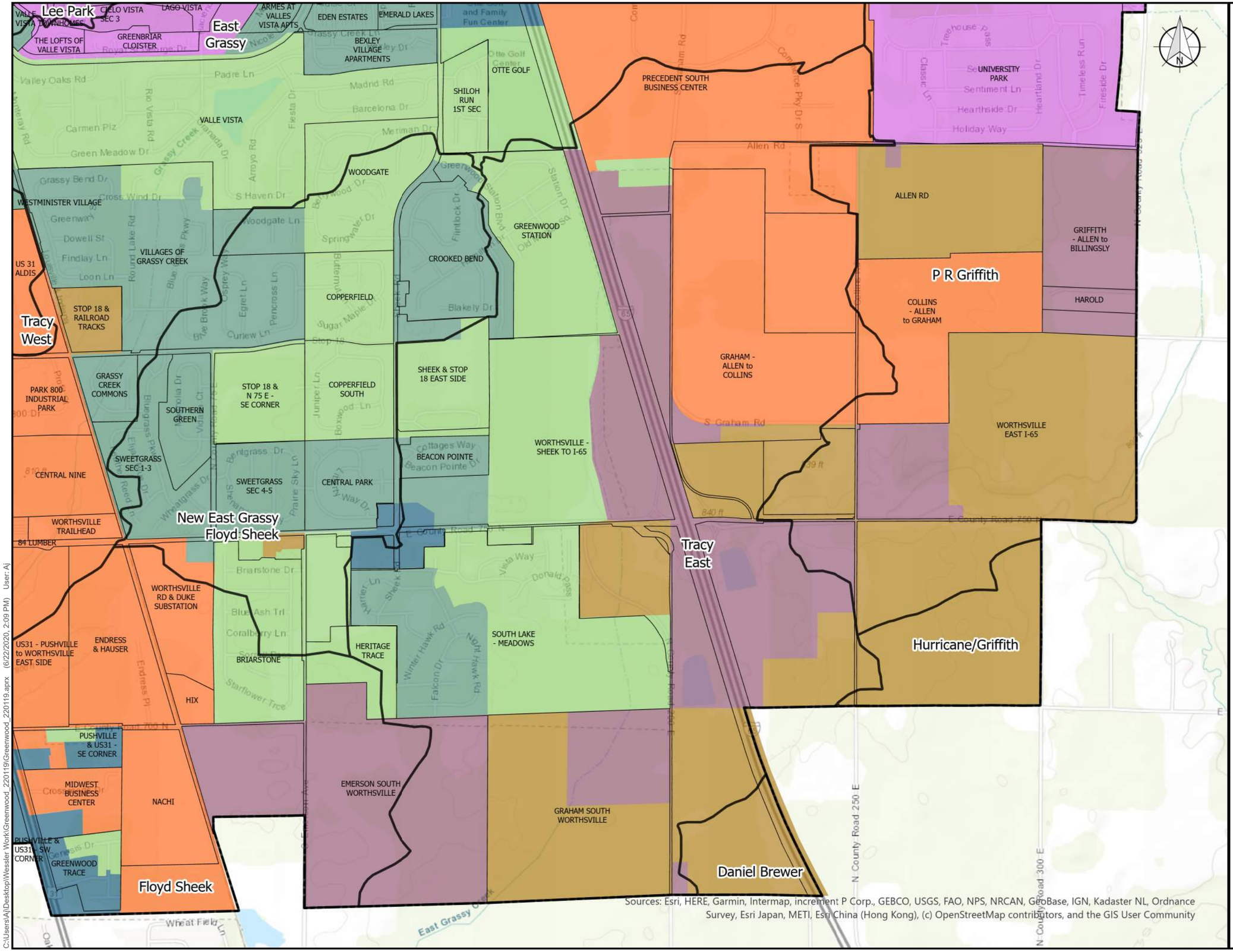
0 500 1,000 2,000 FT

FIGURE 2.1.21

Watershed: Tracy West

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Municipal Watersheds
- Municpal Subdivisions

Land Use Type

- Agriculture
- Commercial
- Industrial
- Planned Unit Development
- Single Family Residential
- Multiple Family Residential
- Suburban Fringe

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

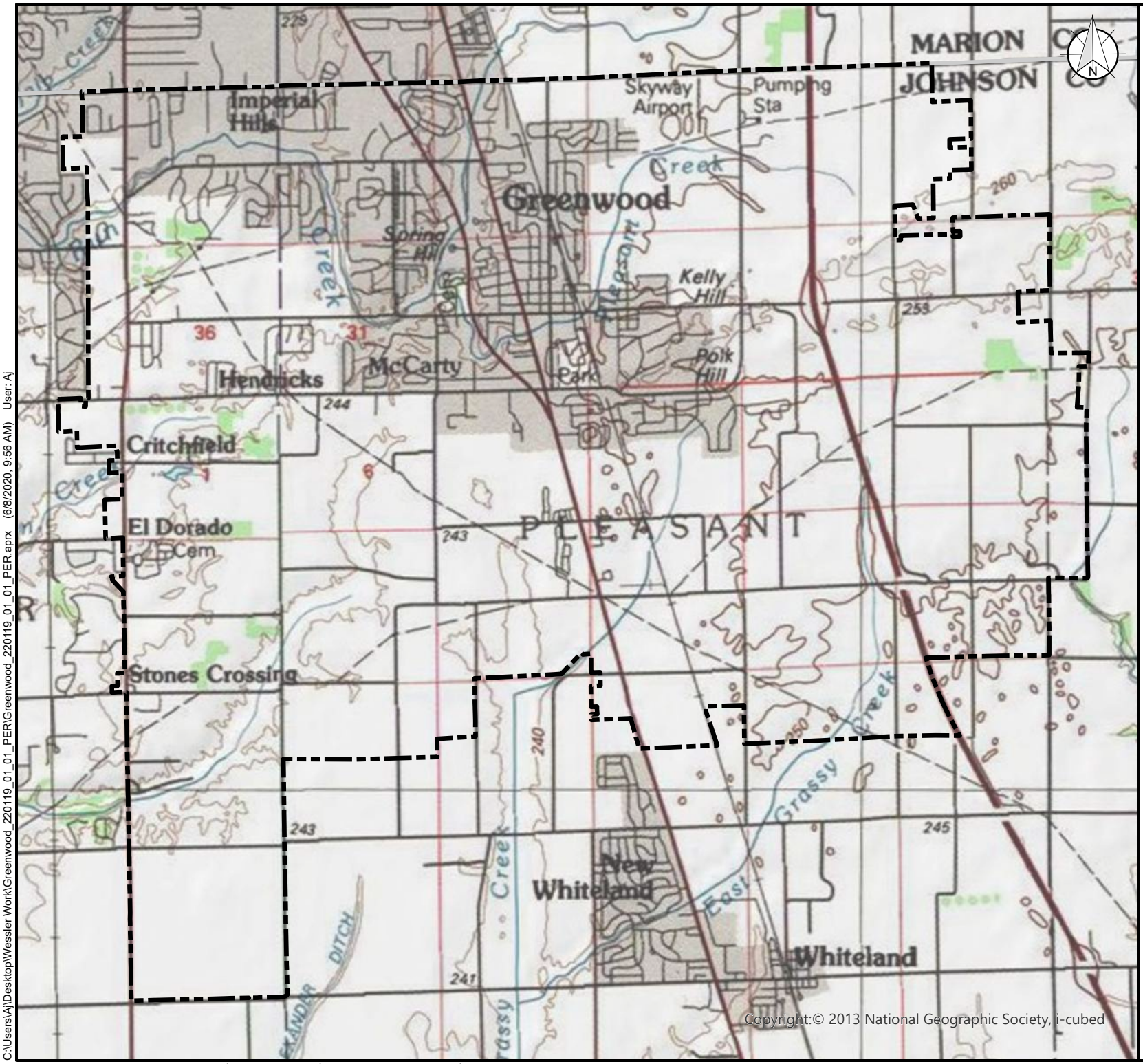
FIGURE 2.1.22

Watershed: Tracy East

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/22/2020, 2:09 PM) User: AJ



WESSLER ENGINEERING
More than a Project™

Legend

Municipal Boundaries

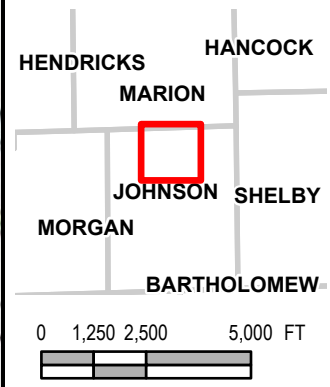


FIGURE 2.2.1

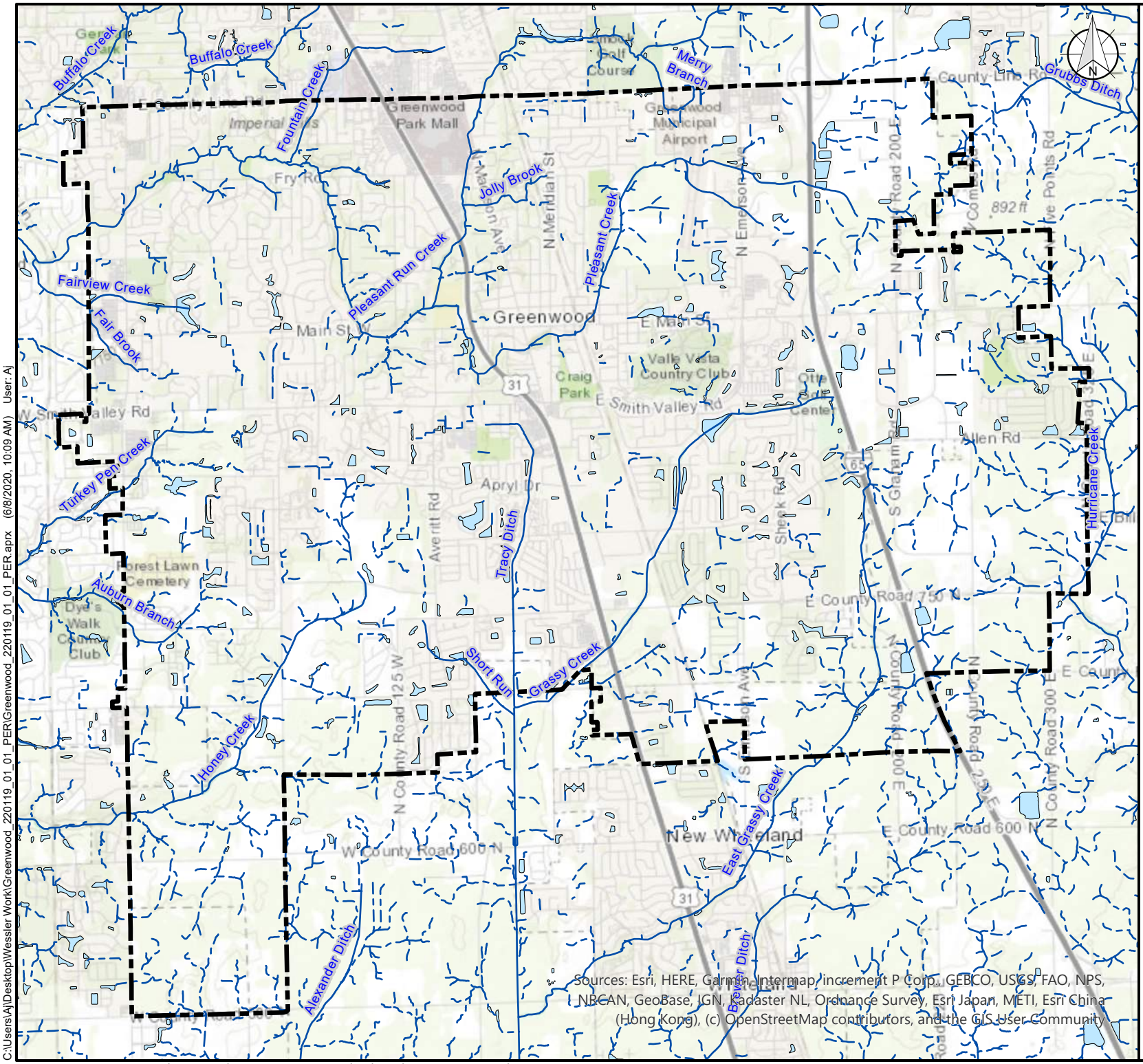
USGS Topographic Map

Stormwater Master Plan
City of Greenwood
Greenwood, Indiana

June 2020
220119.01.01

Map Data Source: ArcGIS Online Map Server | Map Data Date: December 2009

C:\Users\AjlDesktop\Wessler Work\Greenwood_220119_01_01_PER\Greenwood_220119_01_01_PER.aprx (6/8/2020, 9:56 AM) User: Aj



C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119_01_01_PER\Greenwood_220119_01_01_PER.aprx (6/8/2020, 10:09 AM) User: Aj

Map Data Source: Indiana Map | Map Data Date: Wetlands and Historic WL, October 2014

WESSLER ENGINEERING

More than a Project™

Legend

- Waterbody Discrete (NHD)
- Flowline Classified (NHD)
- Flowline Unclassified (NHD)
- Municipal Boundaries

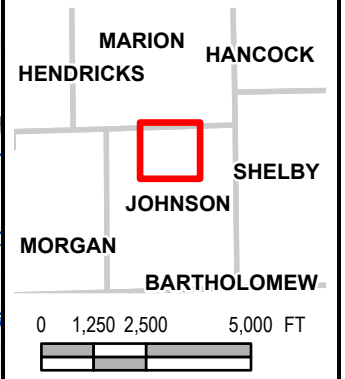
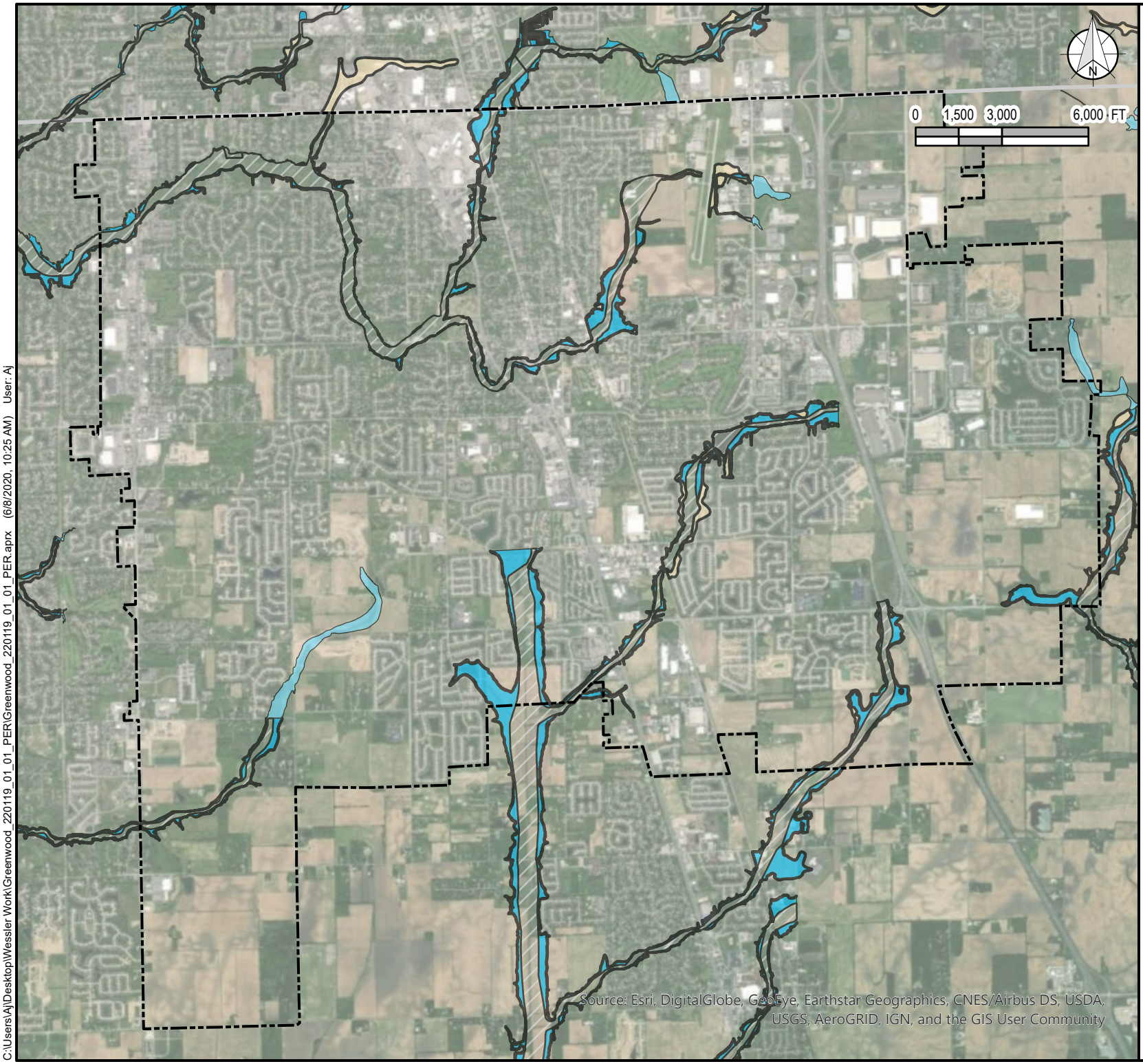


FIGURE 2.2.2

Surface Water Map

Stormwater Master Plan
City of Greenwood
Greenwood, Indiana

June 2020
220119.01.01



WESSLER ENGINEERING

More than a Project™

Legend

Flood Hazard, Current

- A
- AE
- AE, FLOODWAY
- AH
- AO
- X, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD
- X, AREA WITH REDUCED FLOOD RISK DUE TO LEVEE
- Municipal Boundaries

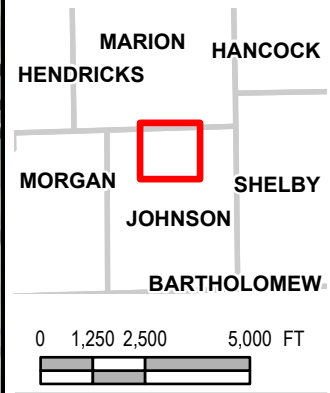


FIGURE 2.2.3

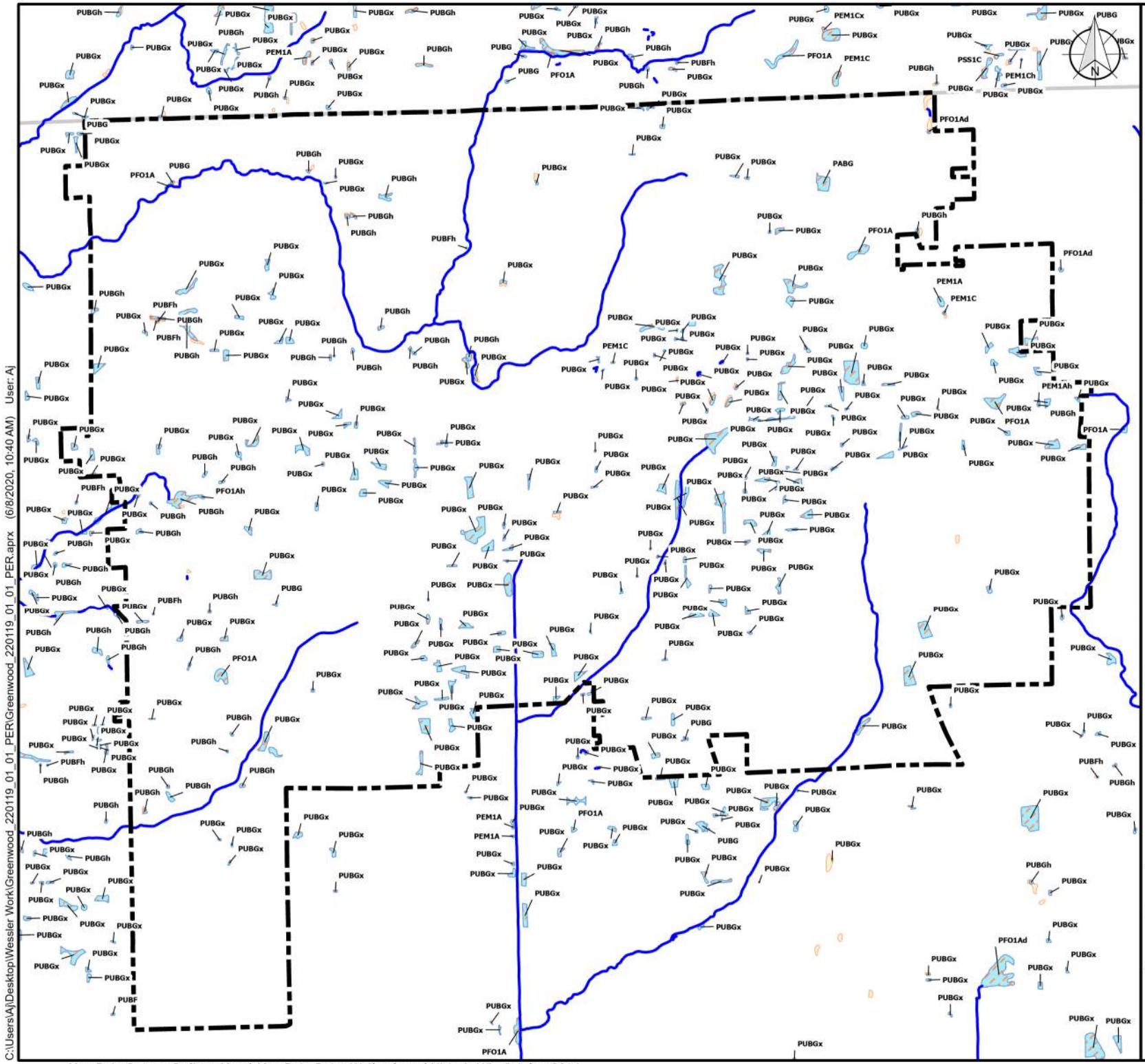
Floodplain Map

Stormwater Master Plan
City of Greenwood
Greenwood, Indiana

June 2020
220119.01.01

C:\Users\AjDesktop\Wessler Work\Greenwood_220119_01_01_PER\Greenwood_220119_01_01_PER.aprx (6/8/2020, 10:25 AM) User: Aj

Map Data Source: Indiana Map | Map Data Date: August 2018



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WESSLER ENGINEERING

More than a Project™

Legend

- Wetlands NWI Lines (USFWS)
- Wetlands NWI (USFWS)
- Historic Wetlands NWI (USFWS)
- Counties
- Municipal Boundaries

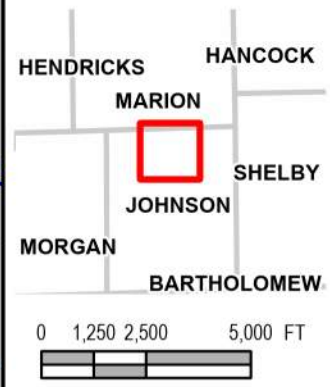


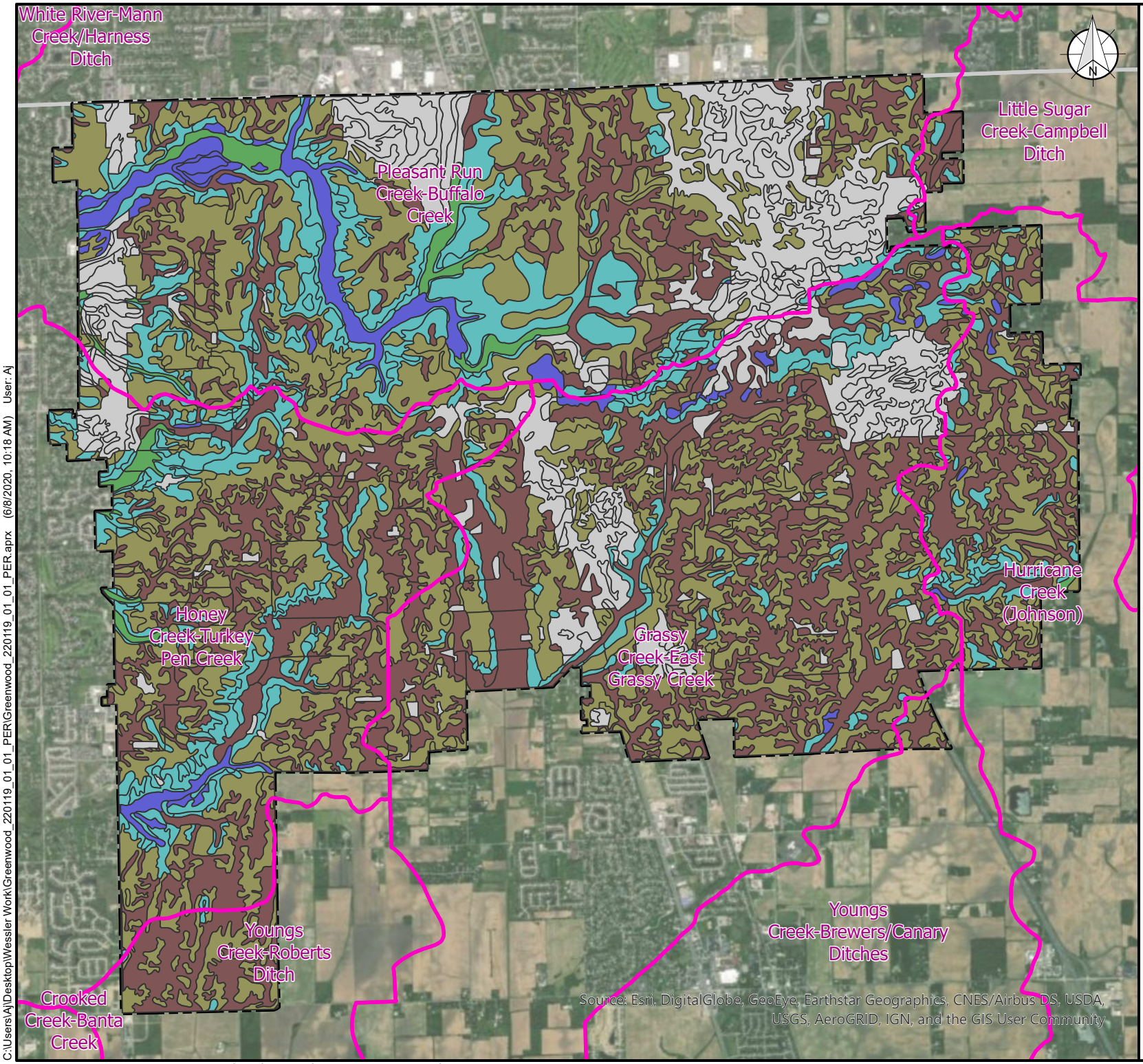
FIGURE 2.2.4

National Wetlands Inventory Map

Stormwater Master Plan
City of Greenwood
Greenwood, Indiana

June 2020
220119.01.01

Map Data Source: Indiana Map | Map Data Date: Wetlands and Historic WL, October 2014



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- HUC 14

Soil Rating

- A/D
- B
- B/D
- C
- C/D
- <Null>

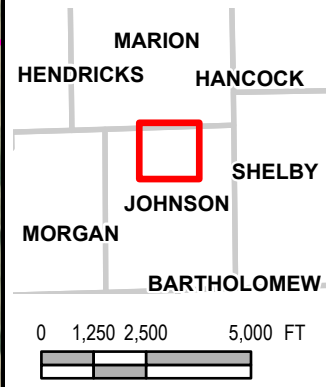


FIGURE 2.2.5

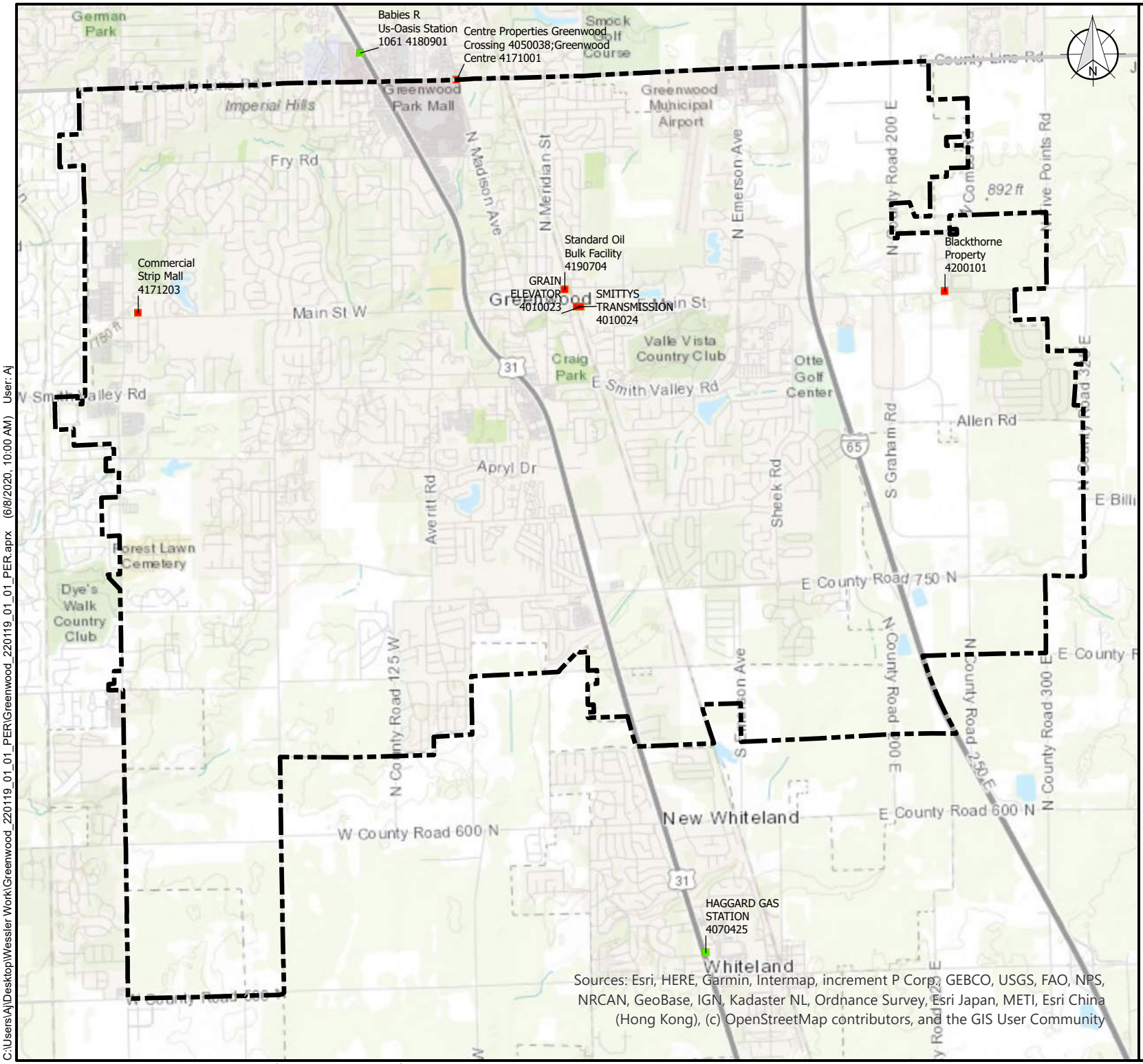
Hydrologic Soil Group Map

Stormwater Master Plan
City of Greenwood
Greenwood, Indiana

June 2020
220119.01.01

Map Data Source: NRCS Web Soil Survey | Map Data Date: October 2017

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119_01_01_PER\Greenwood_220119_01_01_PER.aprx (6/8/2020, 10:18 AM) User: AJ



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries

Brownfields

- Active
- Inactive

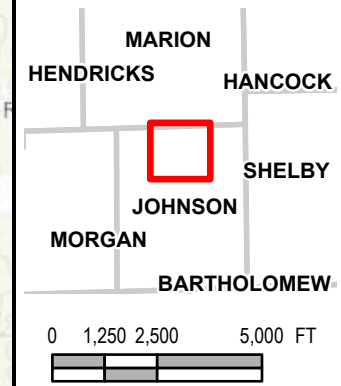


FIGURE 2.2.6

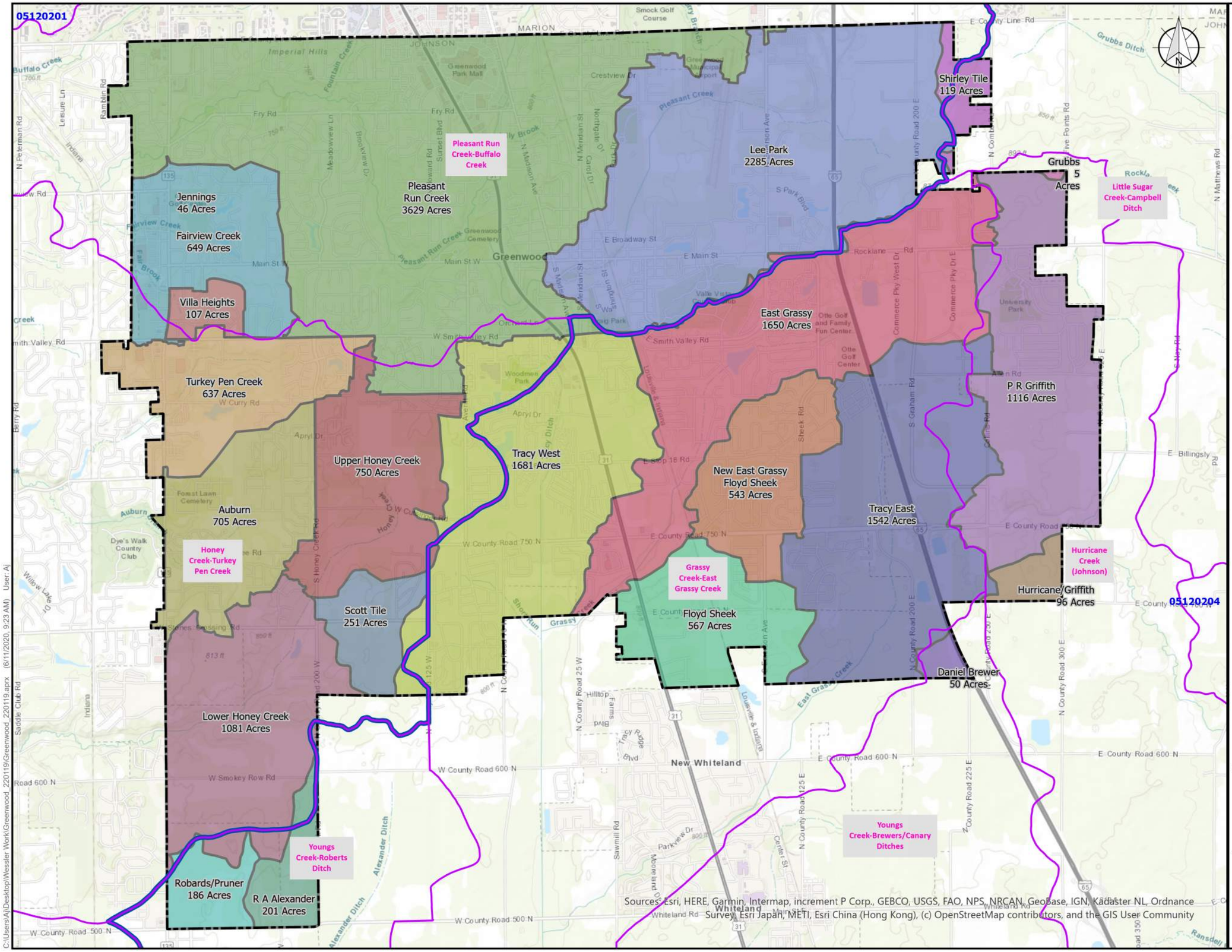
Brownfield Sites

Stormwater Master Plan
City of Greenwood
Greenwood, Indiana

June 2020
220119.01.01

C:\Users\AjDesktop\Wessler Work\Greenwood_220119_01_01_PER\Greenwood_220119_01_01_PER.aprx (6/8/2020, 10:00 AM) User: Aj

Map Data Source: InDNR Map Server | Map Data Date: April 2018



WESSLER ENGINEERING

More than a Project™

Legend

- Watershed HUC14
- Watershed HUC08
- Municipal Boundaries

Watershed Name

- Auburn
- Daniel Brewer
- East Grassy
- Fairview Creek
- Floyd Sheek
- Grubbs
- Hurricane/Griffith
- Jennings
- Lee Park
- Lower Honey Creek
- New East Grassy-Floyd Sheek
- P R Griffith
- Pleasant Run Creek
- R A Alexander
- Robards/Pruner
- Scott Tile
- Shirley Tile
- Tracy East
- Tracy West
- Turkey Pen Creek
- Upper Honey Creek
- Villa Heights

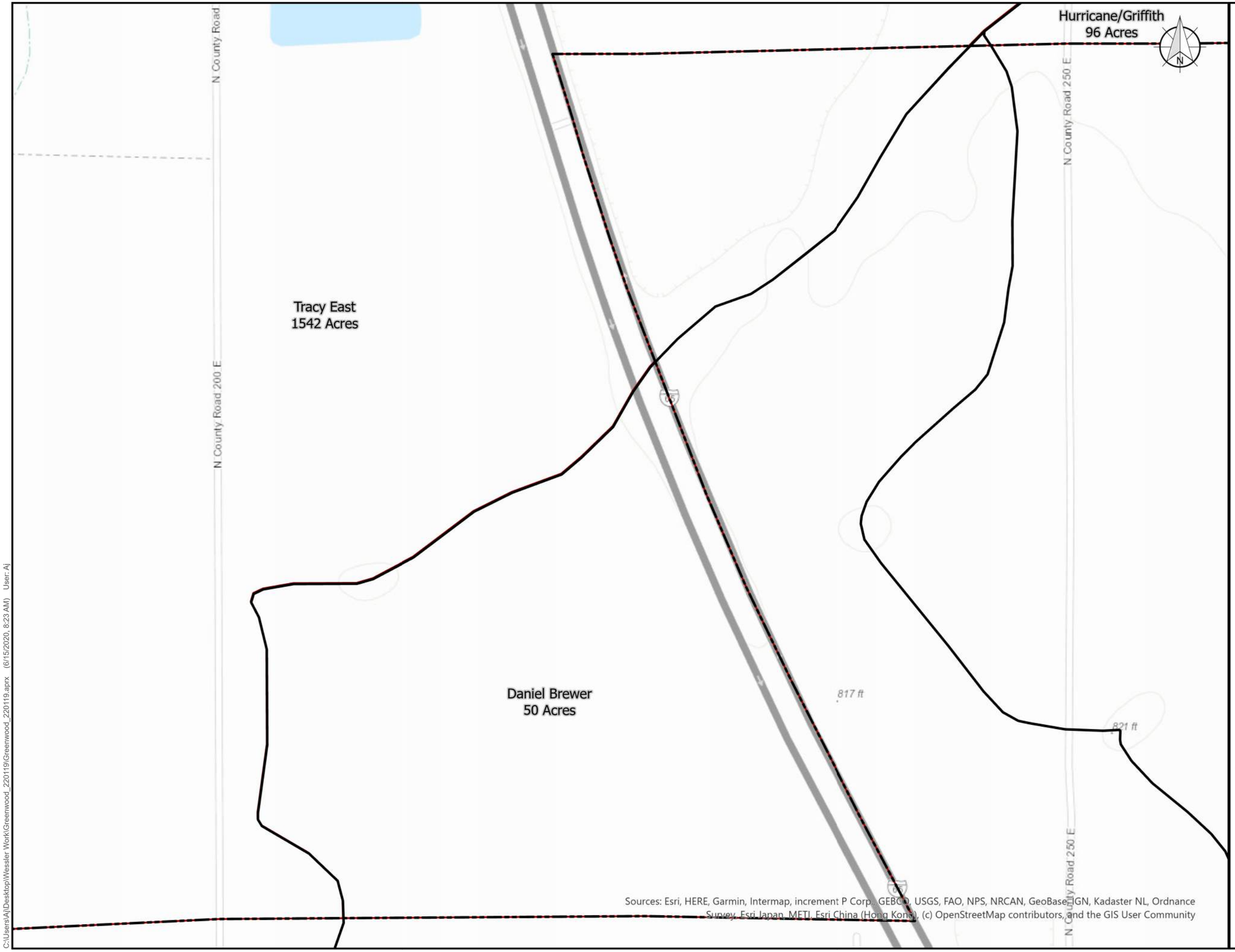
0 2,500 5,000 FT

FIGURE 3.1

Greenwood Primary Watersheds

Greenwood, Indiana Watersheds

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 200 400 800 FT

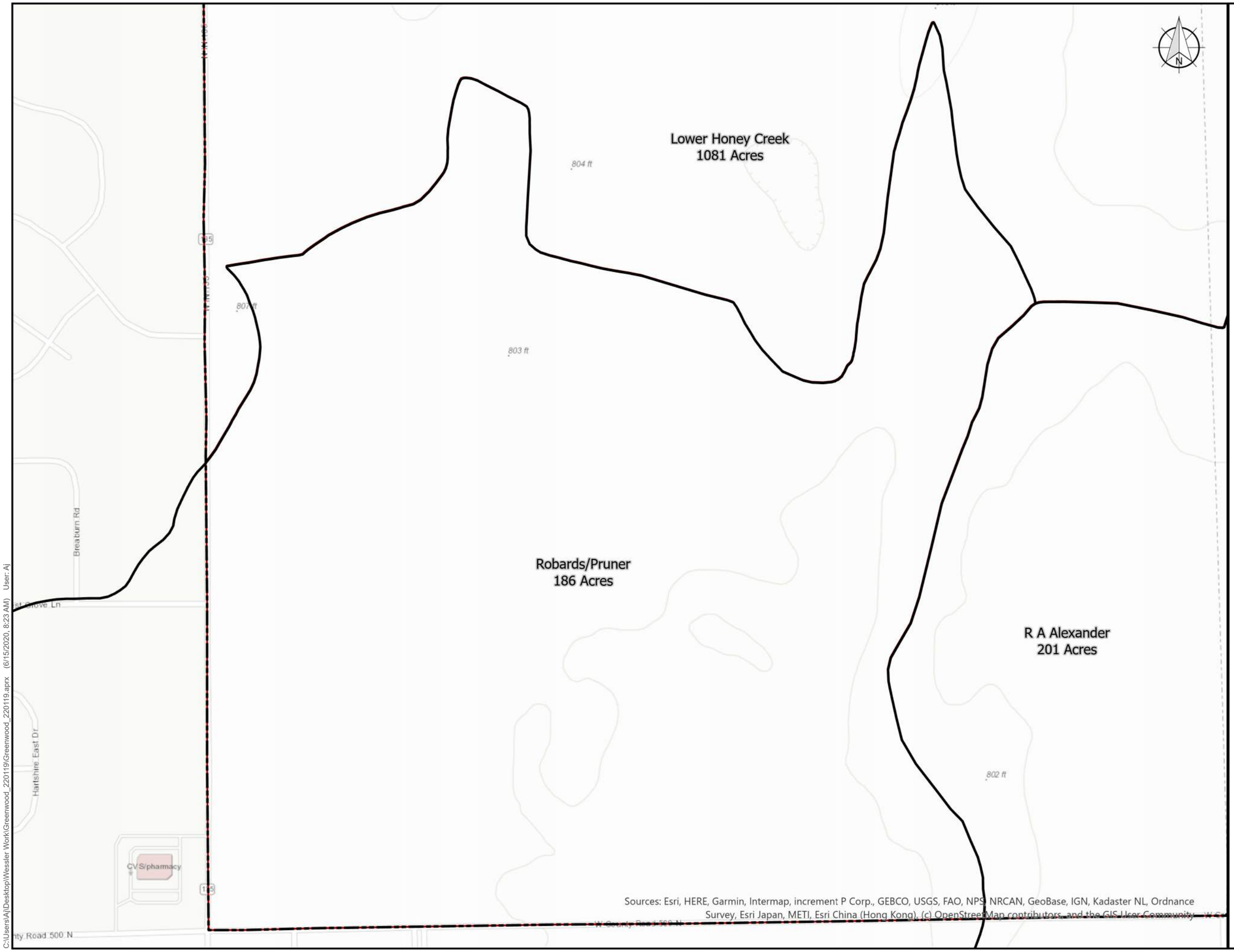
FIGURE 3.1.1

Watershed:
Daniel Brewer

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:23 AM) User: Aj



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 245 490 980 FT

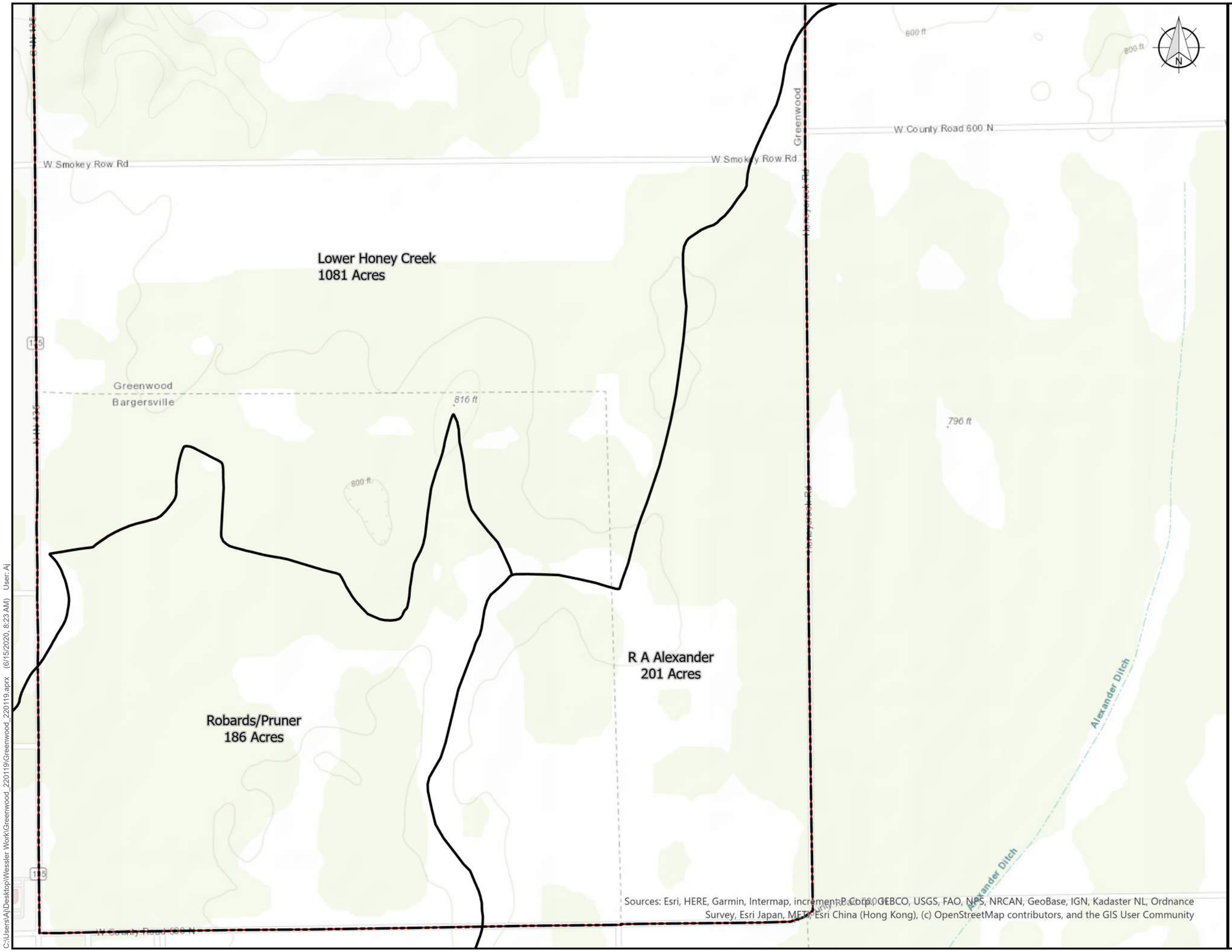
FIGURE 3.1.2

Watershed:
Robards/Pruner

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:23 AM) User: Aj



C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:23 AM) User: Aj

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

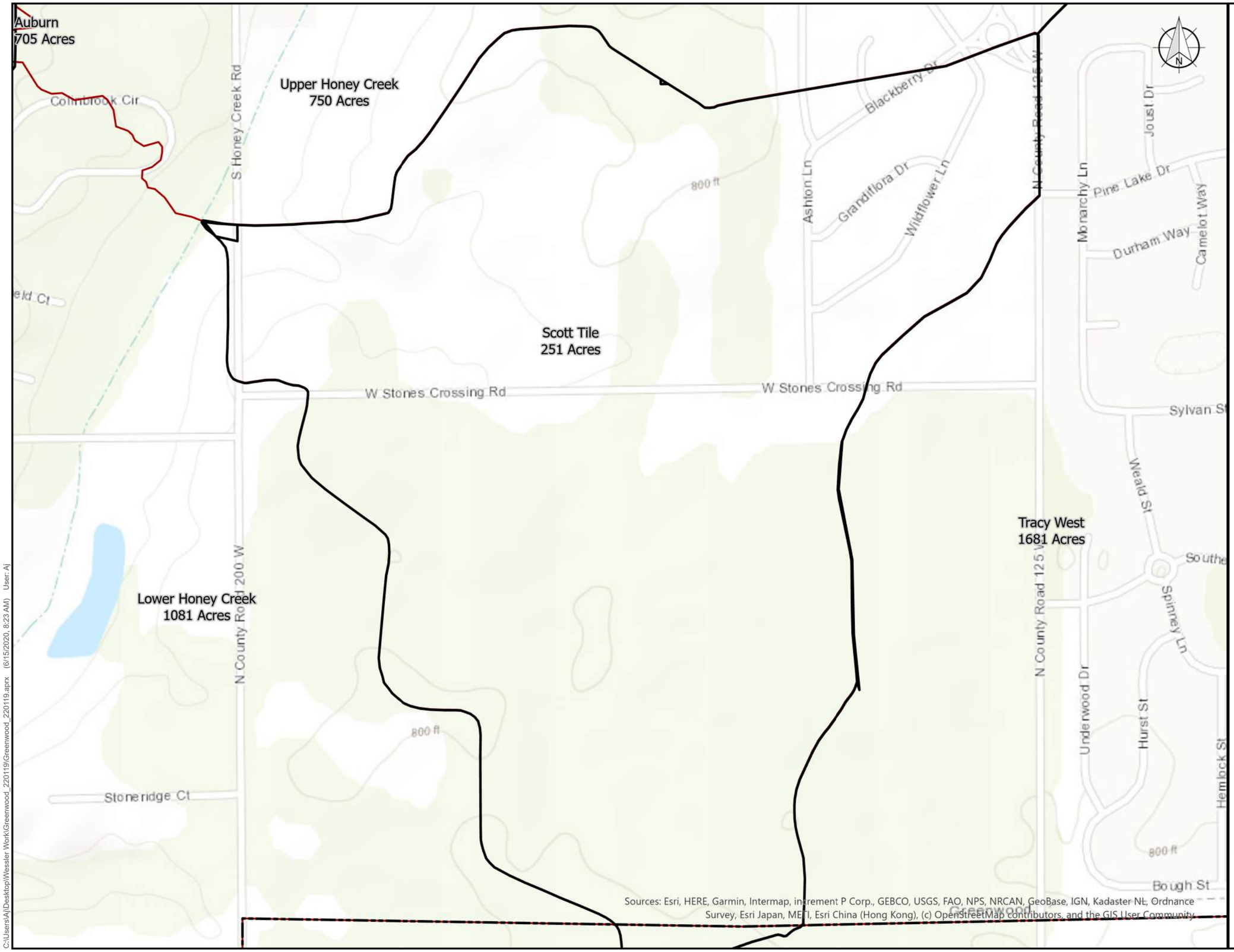
0 435 870 1,740 FT

FIGURE 3.1.3

Watershed:
R A Alexander

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 310 620 1,240 FT

FIGURE 3.1.4

Watershed: Scott Tile

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:23 AM) User: Aj

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\AI\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:23 AM) User: Aj

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

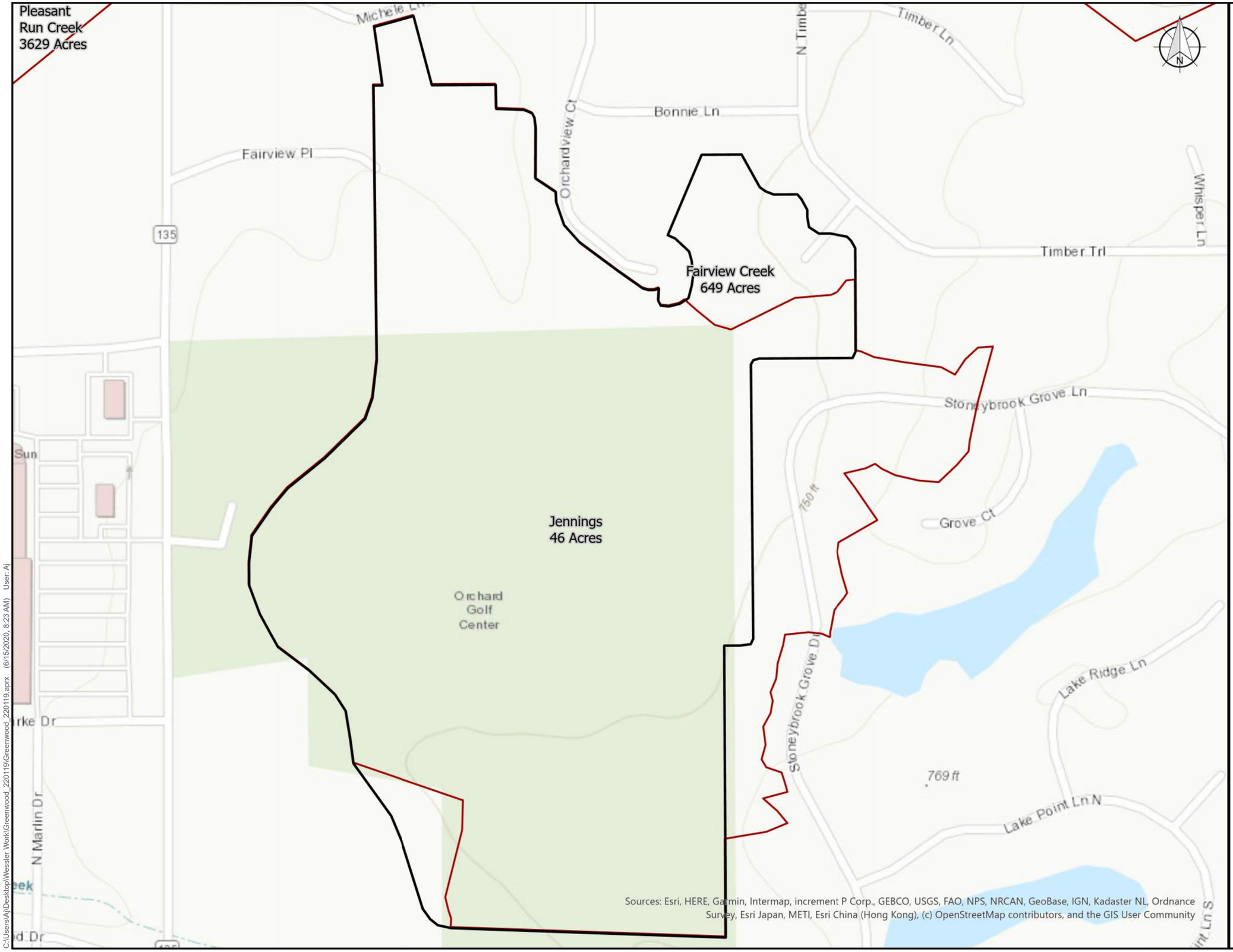
0 155 310 620 FT

FIGURE 3.1.5

Watershed:
Villa Heights

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 155 310 620 FT

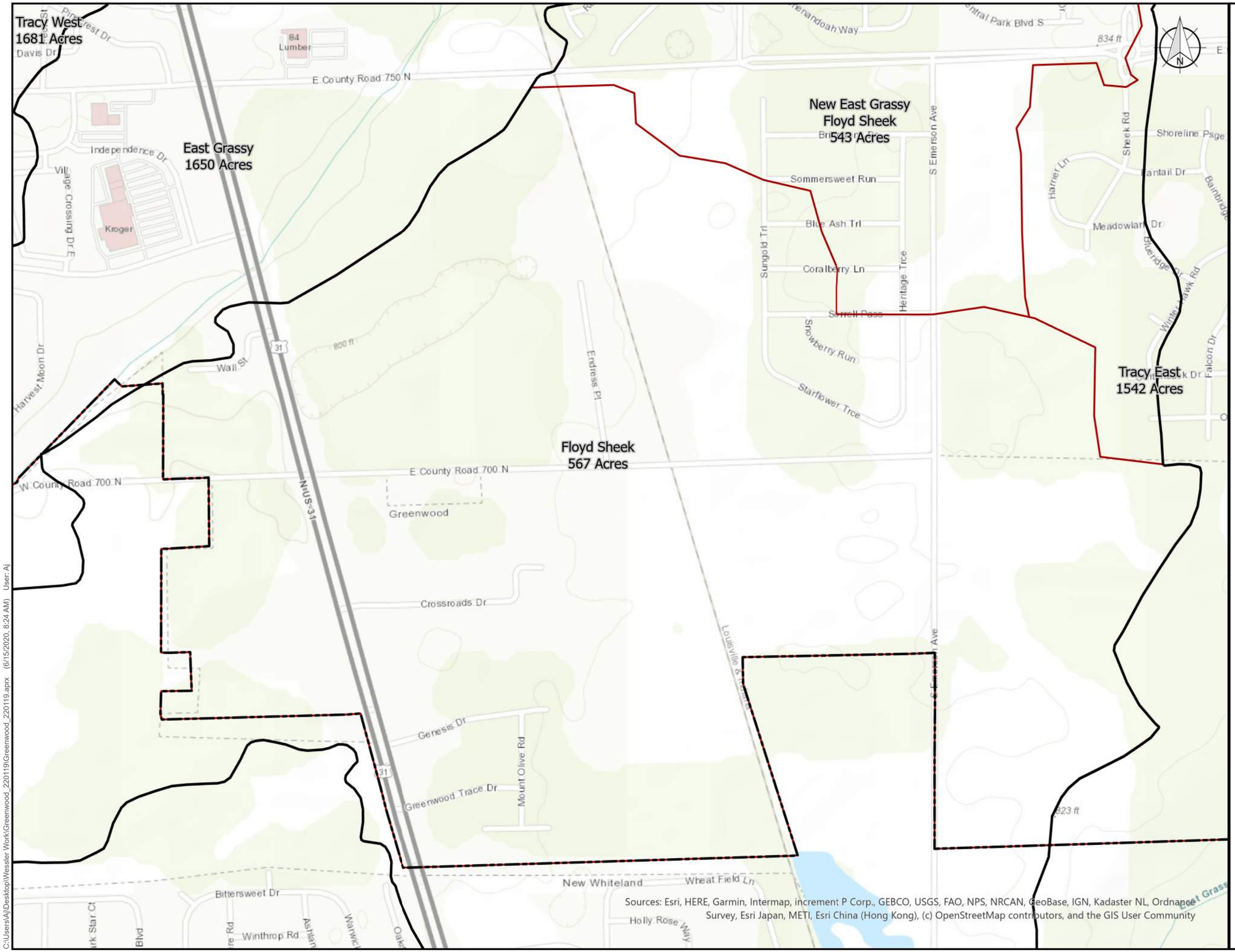
FIGURE 3.1.6

Watershed: Jennings

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:23 AM) User: AJ



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:24 AM) User: AJ

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

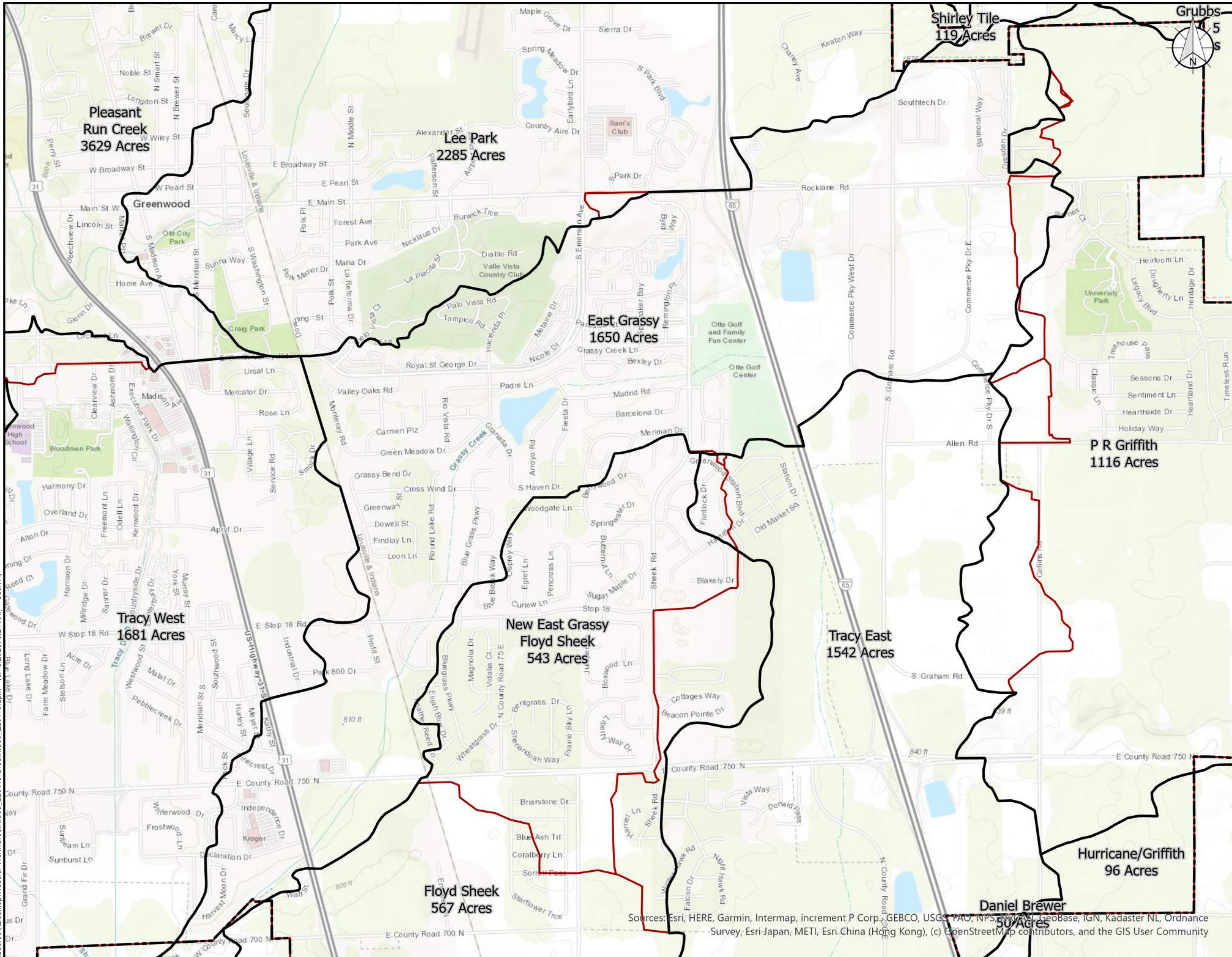
0 425 850 1,700 FT

FIGURE 3.1.7

Watershed:
Floyd Sheek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 1,000 2,000 4,000 FT

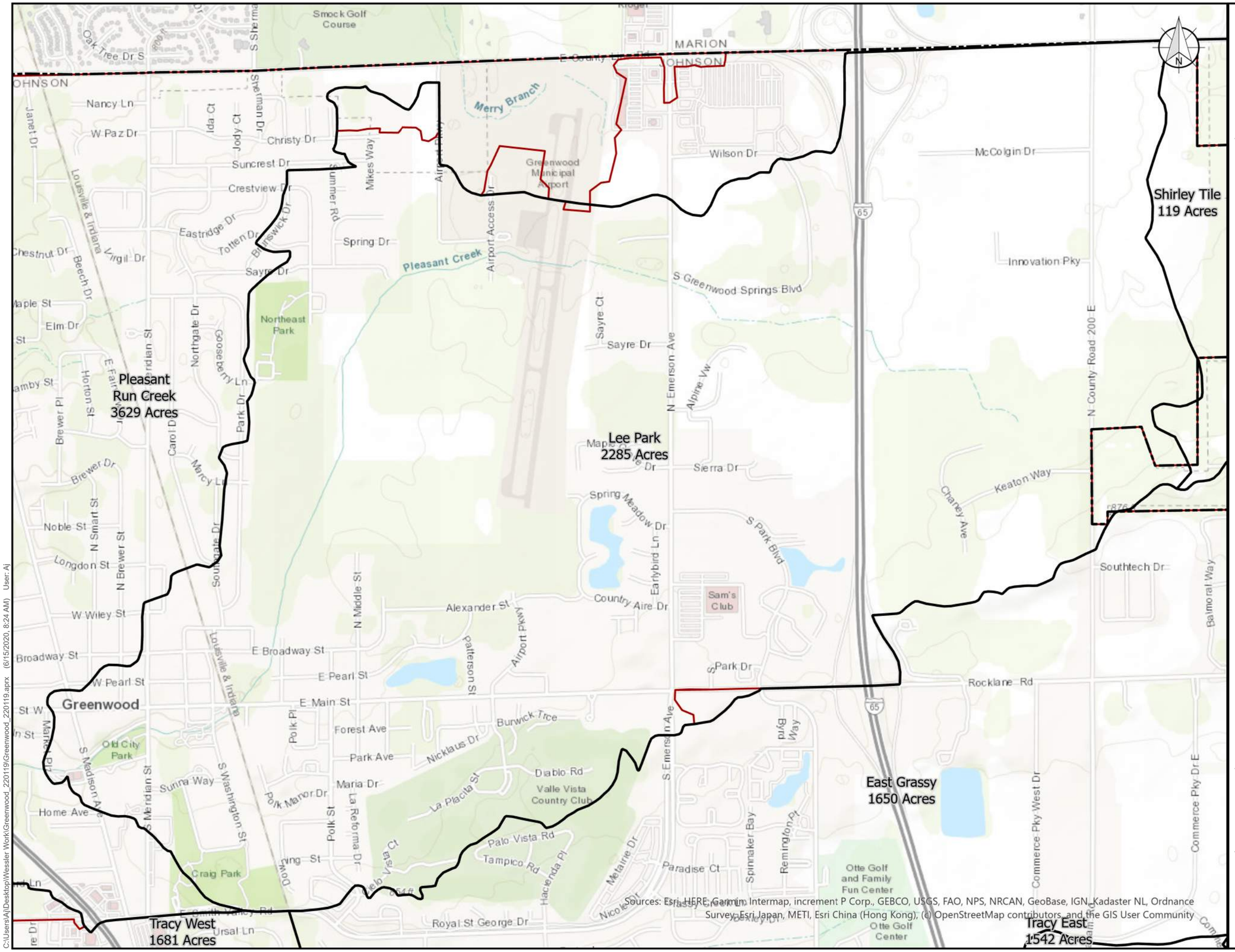
FIGURE 3.1.8

Watershed: East Grassy

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:24 AM) User: Aj



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 500 1,000 2,000 FT

FIGURE 3.1.9

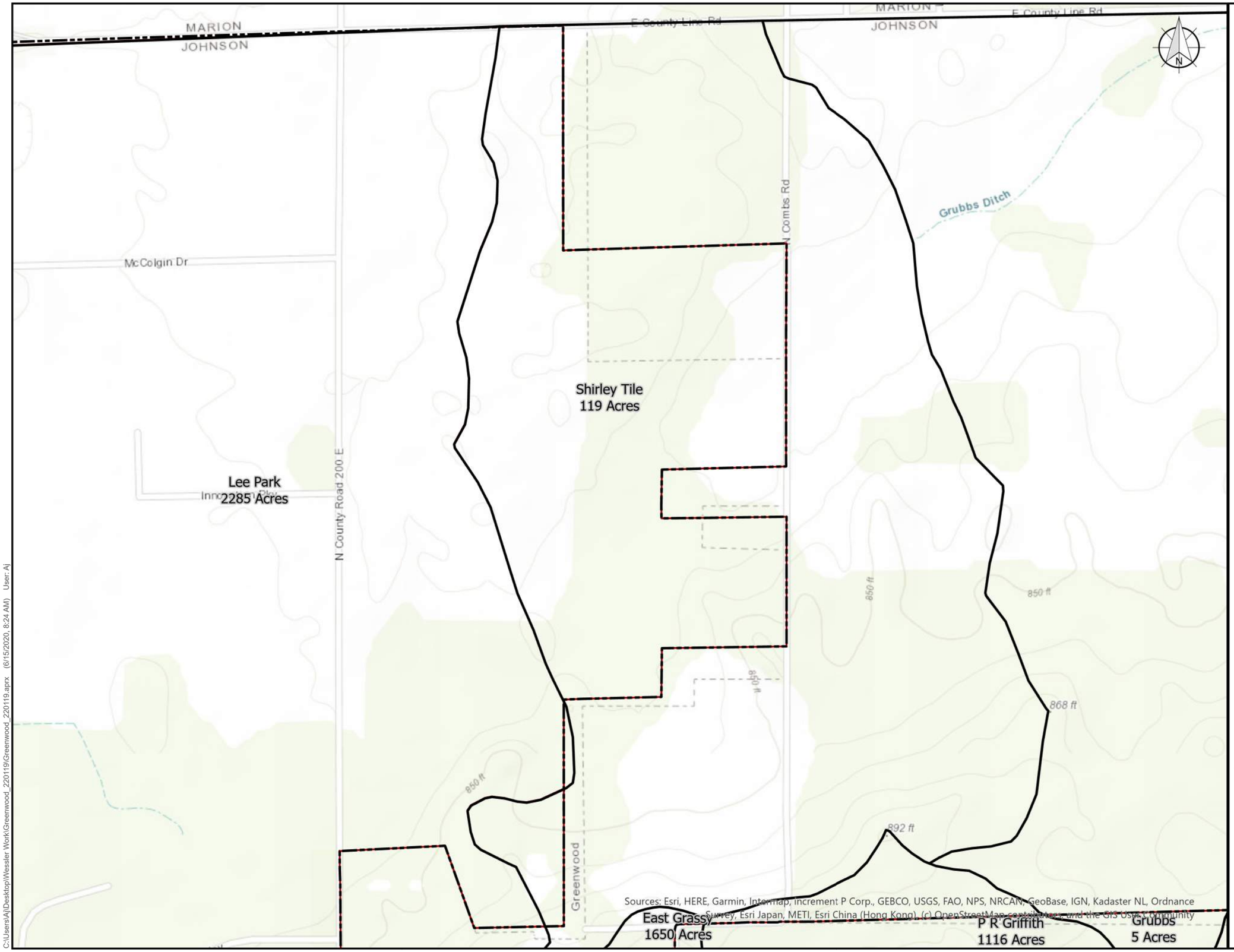
Watershed: Lee Park

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:24 AM) User: Aj



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 370 740 1,480 FT

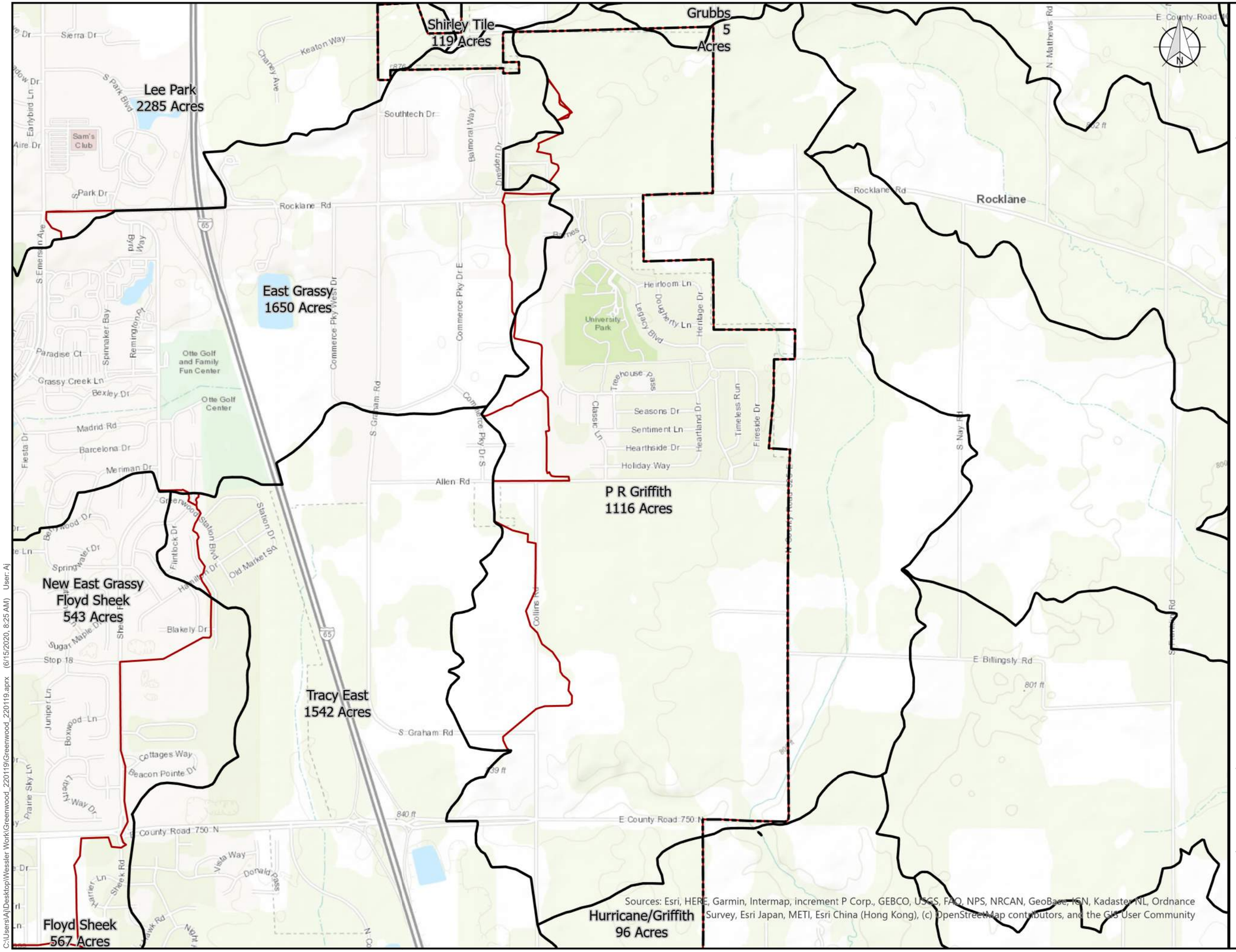
FIGURE 3.1.10

Watershed:
Shirley Tile

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:24 AM) User: Aj



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:25 AM) User: Aj

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

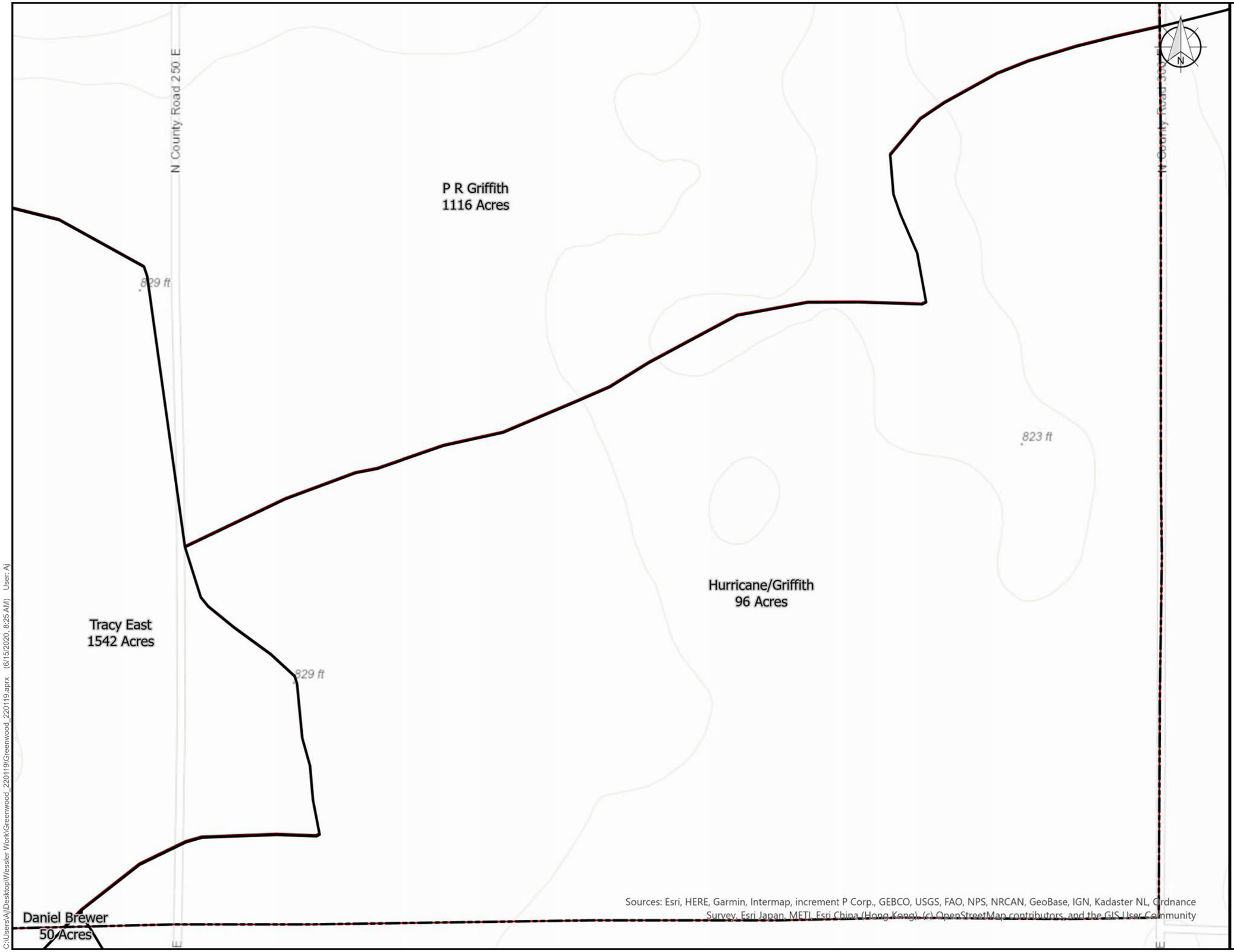
0 500 1,000 2,000 FT

FIGURE 3.1.11

Watershed:
P R Griffith

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 170 340 680 FT

FIGURE 3.1.12

Watershed:
Hurricane/Griffith

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

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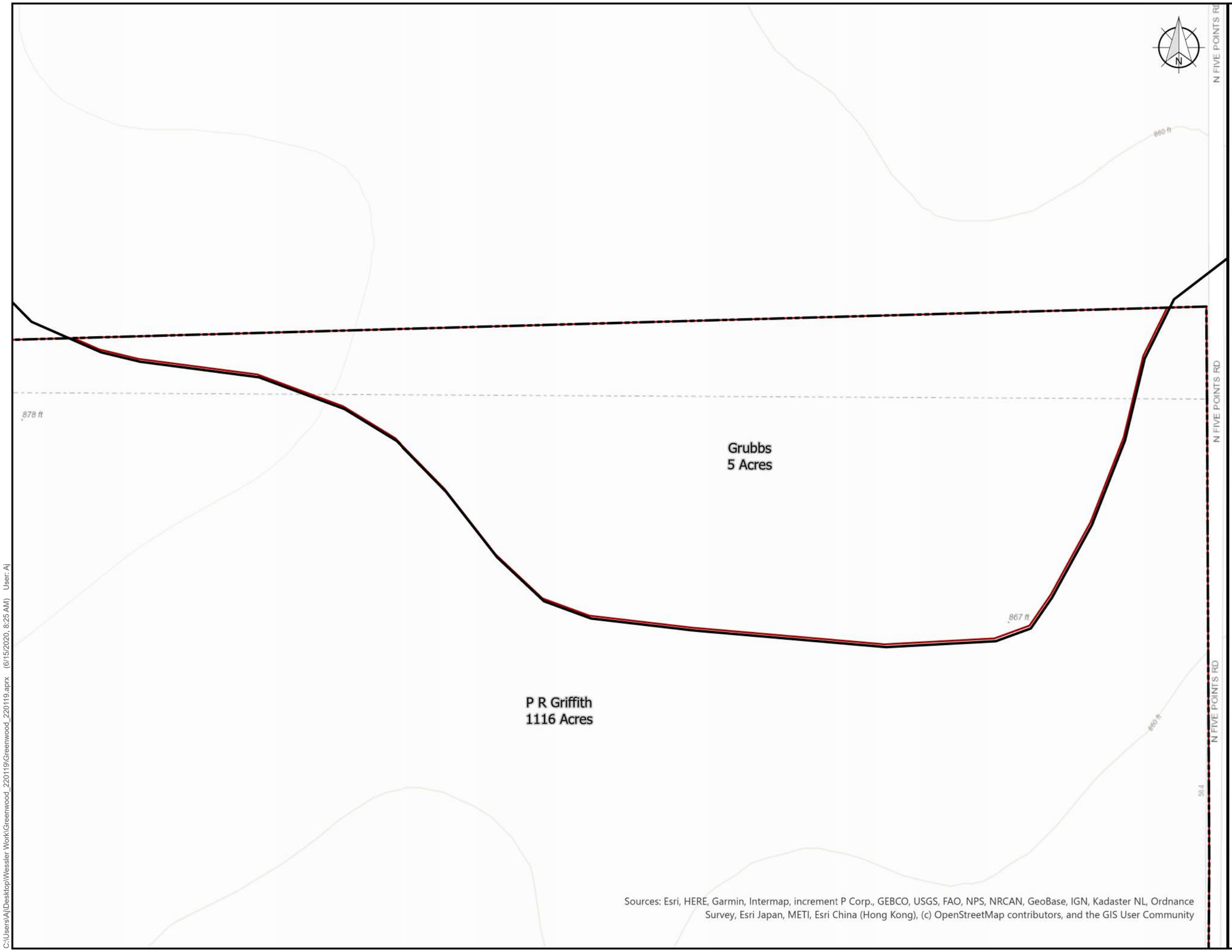


WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 62.5 125 250 FT

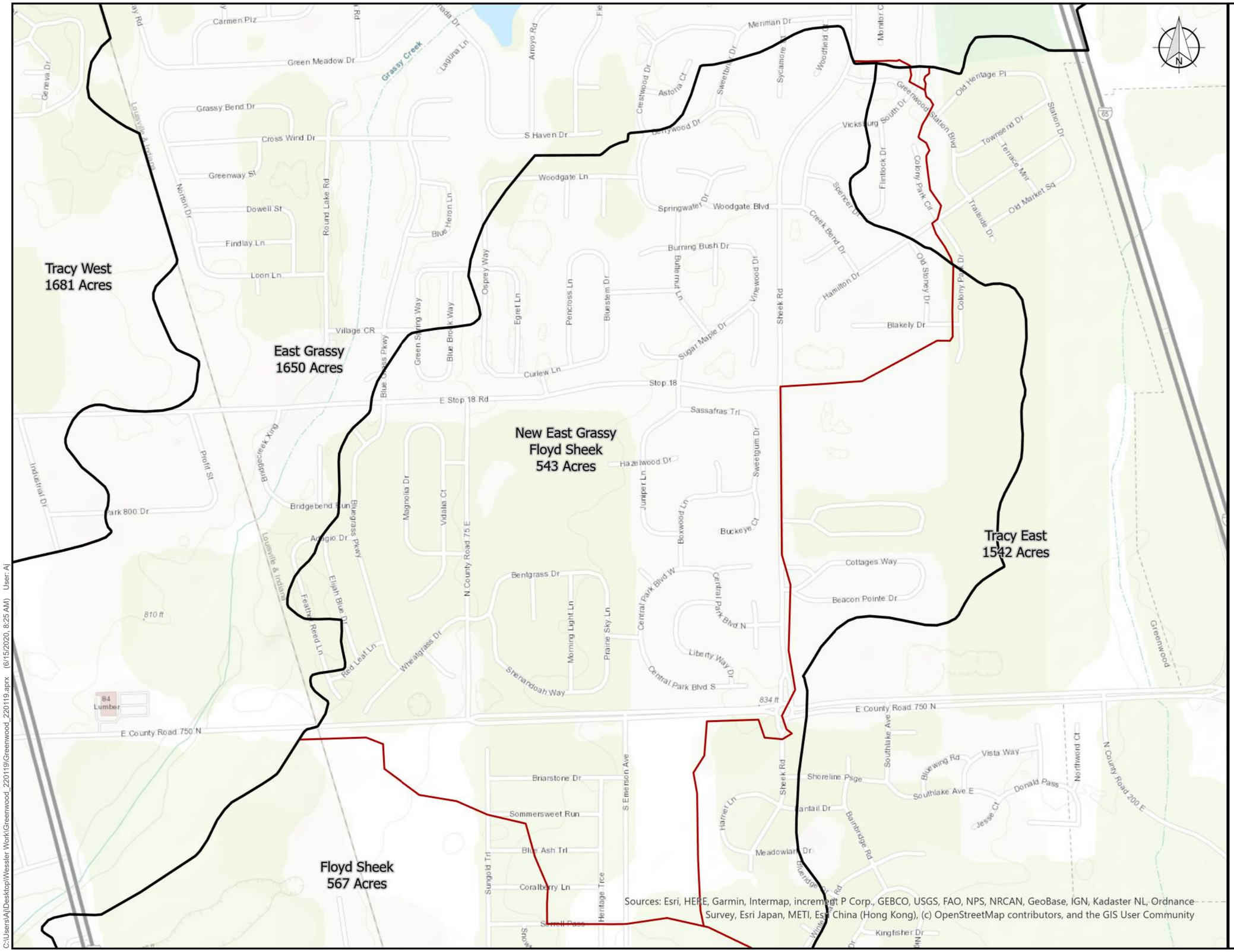
FIGURE 3.1.13

Watershed: Grubbs

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:25 AM) User: Aj



C:\Users\AI\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:25 AM) User: Ai

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

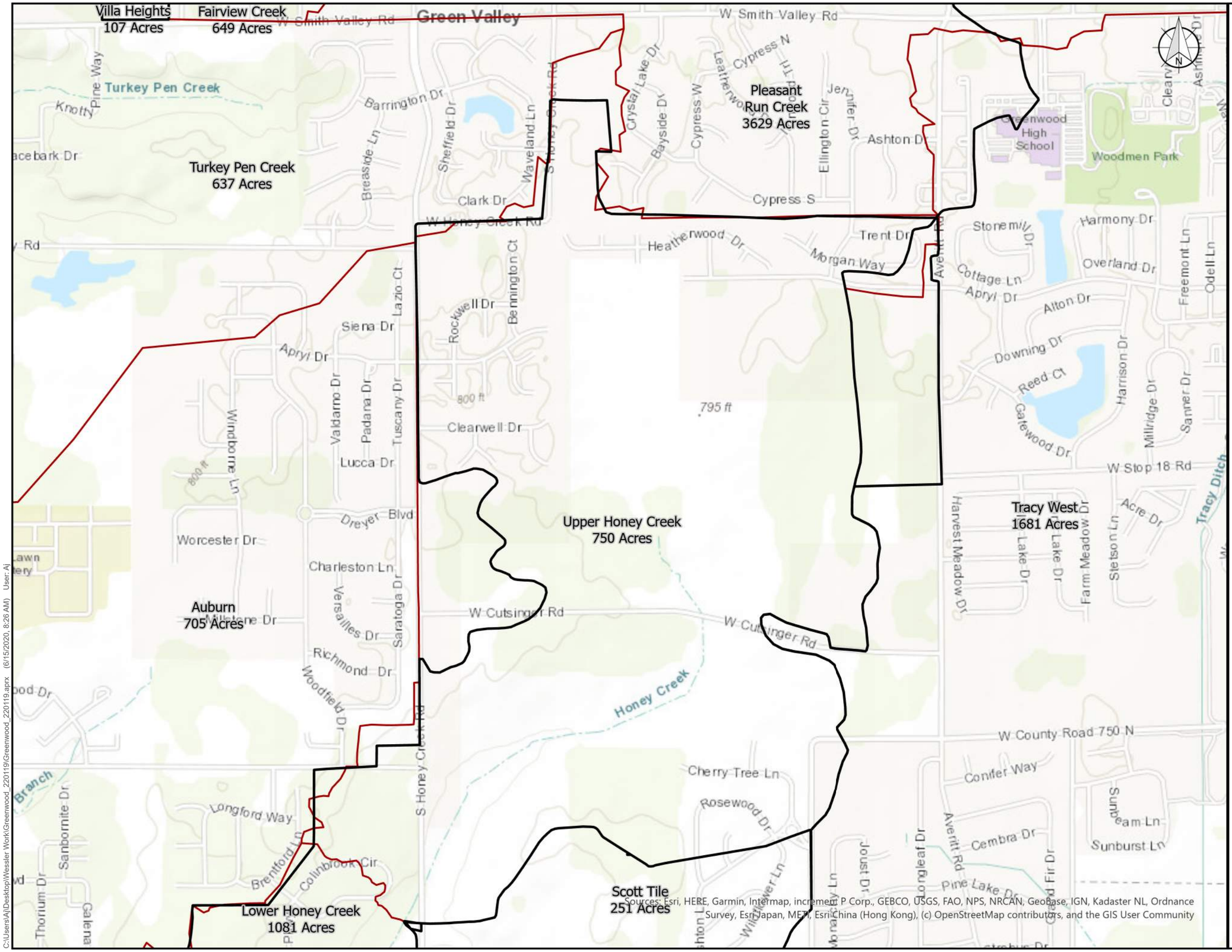
0 500 1,000 2,000 FT

FIGURE 3.1.14

Watershed:
New East Grassy-Floyd Sheek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

FIGURE 3.1.15

Watershed:
Upper Honey Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:26 AM) User: AJ

Upper Honey Creek
750 Acres

Auburn
705 Acres

Scott Tile
251 Acres

Tracy West
1681 Acres

Stones Crossing

Waterloo

Lower Honey Creek
1081 Acres

Robards/Pruner
186 Acres

R A Alexander
201 Acres

Greensview Dr
Grove Crossing Blvd
Calcutta Dr
Willow Lakes East Blvd
The Courts
Bunker Dr
Cadogan Dr
Jerkwater Rd
Stones Bay Dr
Clary Xing
Clary Rd Dr N
Enclave Xing
Enclave Ln
Clary Circle Dr
Enclave Blvd
Clary Rd Dr S
Tremont Blvd
Tremont Dr
Thornbriar Ln
Cheyenne Ct
Cherokee Cir
Chartwell Dr
Sunnyvale Dr
Amber Way
Somerset Blvd
Woodhaven Way
Autumn Run
McIntosh Dr
Wild Flower Ct
Indiana
Sanborn Dr
Canna Dr
Brentford Ln
Colinbrook Cir
Colinbrook Pkwy
W Stones Crossing Rd
W Smokey Row Rd
W County Road 600 N
W County Road 600 N
N County Road 125 W
N County Road 200 W
Ashton Ln
Wildflower Ln
Monarchy Ln
Joist Dr
Sylvan St
Branch St
Spinney Ln
Hurst St
Hemlock St
Holt St
Bough St
Underwood Dr
Honeycreek Rd
Alexandria Ditch
800 ft
813 ft
805 ft
816 ft
135
135

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

WESSLER ENGINEERING
More than a Project™

Legend
- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 500 1,000 2,000 FT

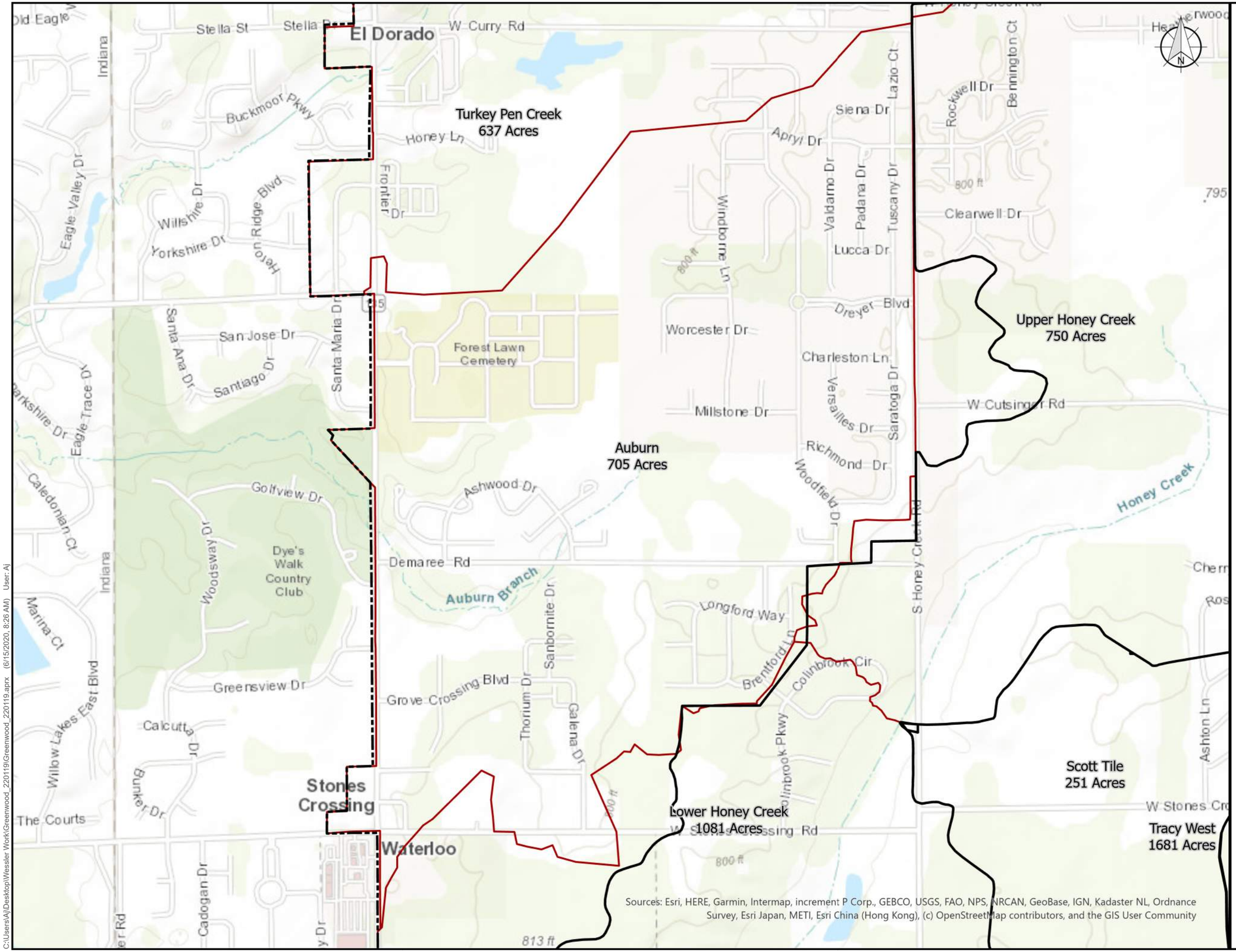
FIGURE 3.1.16

Watershed:
Lower Honey Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:26 AM) User: AJ



C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:26 AM) User: AJ

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

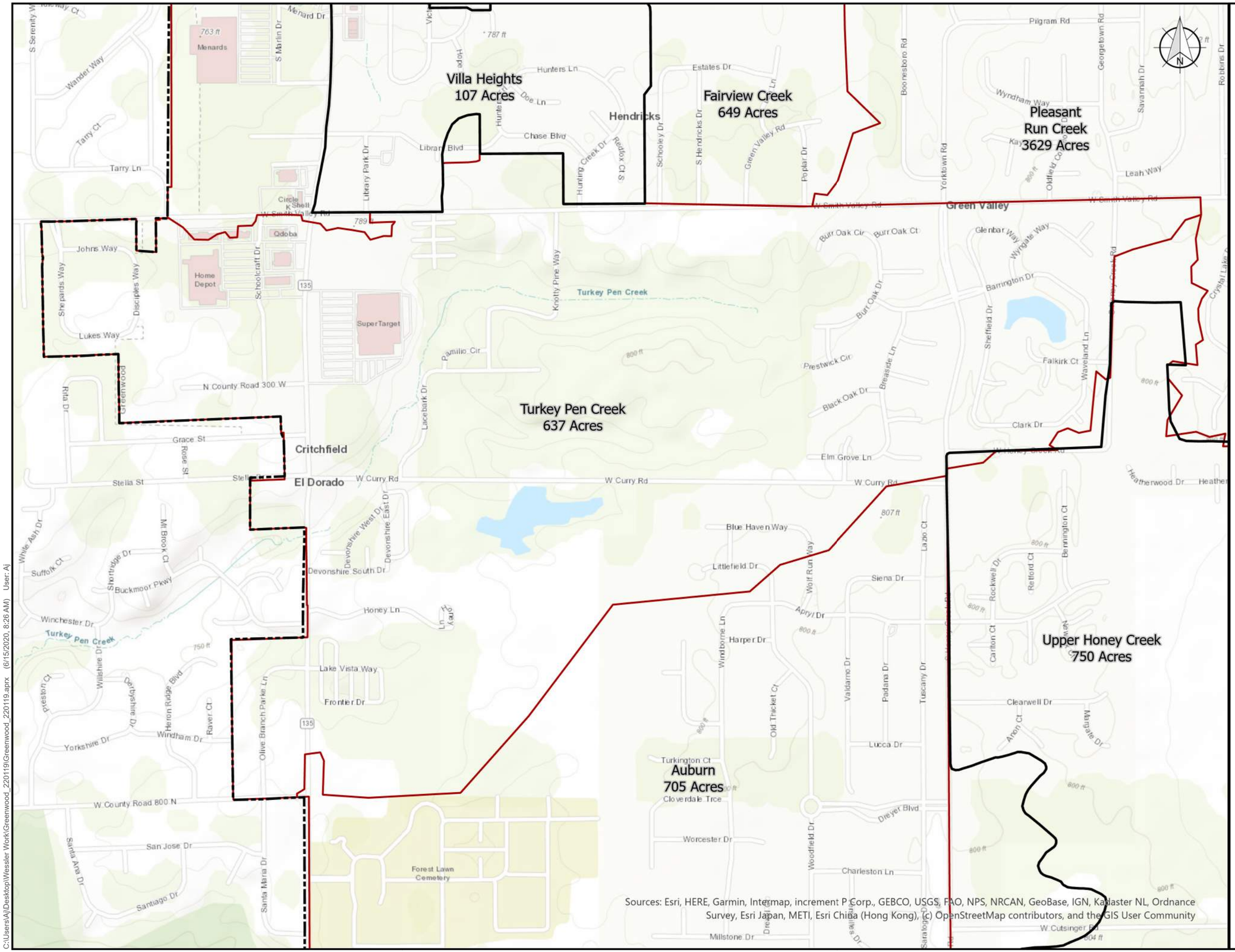
0 500 1,000 2,000 FT

FIGURE 3.1.17

Watershed: Auburn

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 500 1,000 2,000 FT

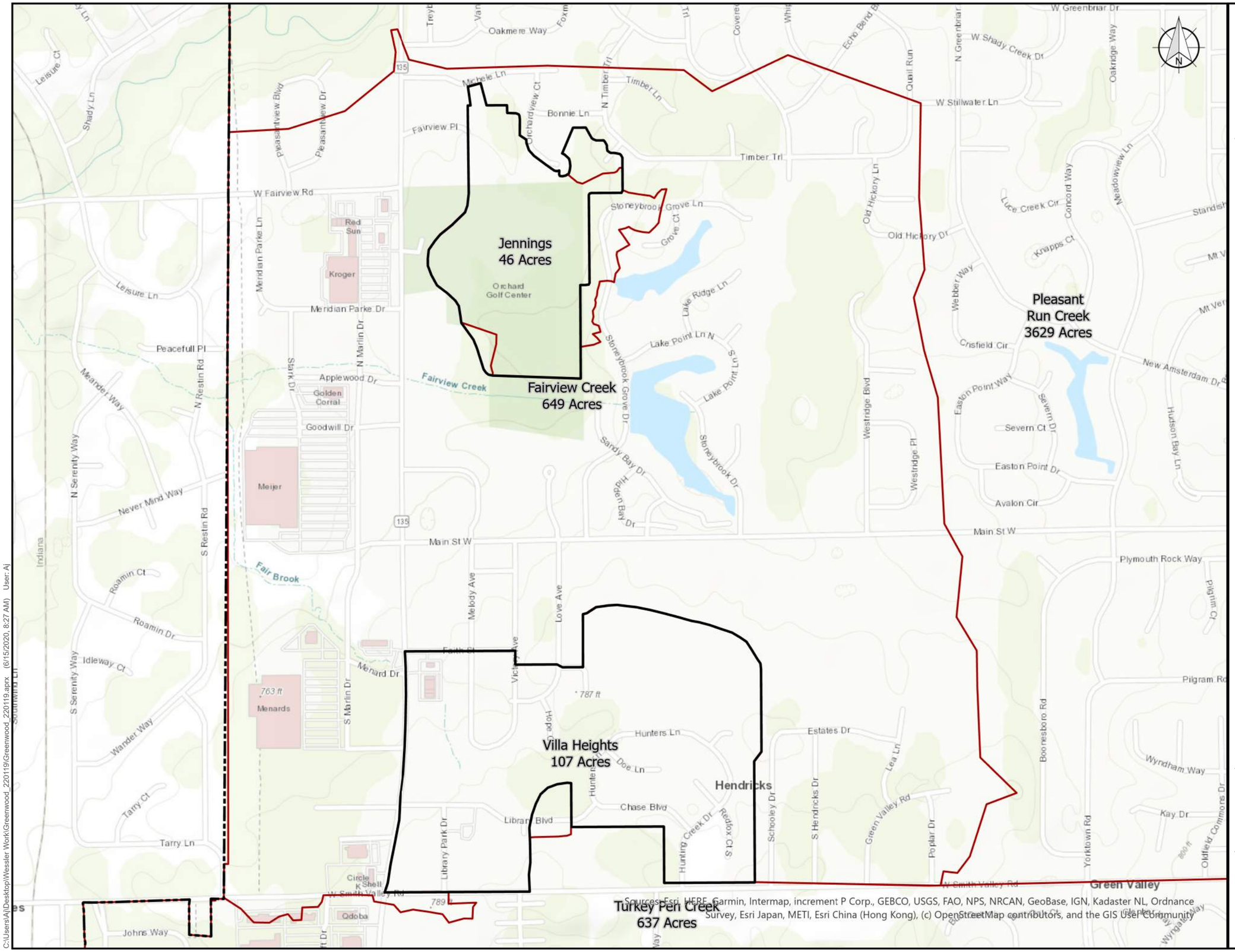
FIGURE 3.1.18

Watershed:
Turkey Pen Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:26 AM) User: Aj



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 470 940 1,880 FT

FIGURE 3.1.19

Watershed:
Fairview Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:27 AM) User: Aj

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 1,290 2,580 5,160 FT

FIGURE 3.1.20

Watershed:
Pleasant Run Creek

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

Jennings
46 Acres

Fairview Creek
649 Acres

Villa Heights
107 Acres

Turkey Pen Creek
637 Acres

Auburn
705 Acres

Upper Honey Creek
750 Acres

Pleasant
Run Creek
3629 Acres

Tracy West
1681 Acres

East Grassy
1650 Acres

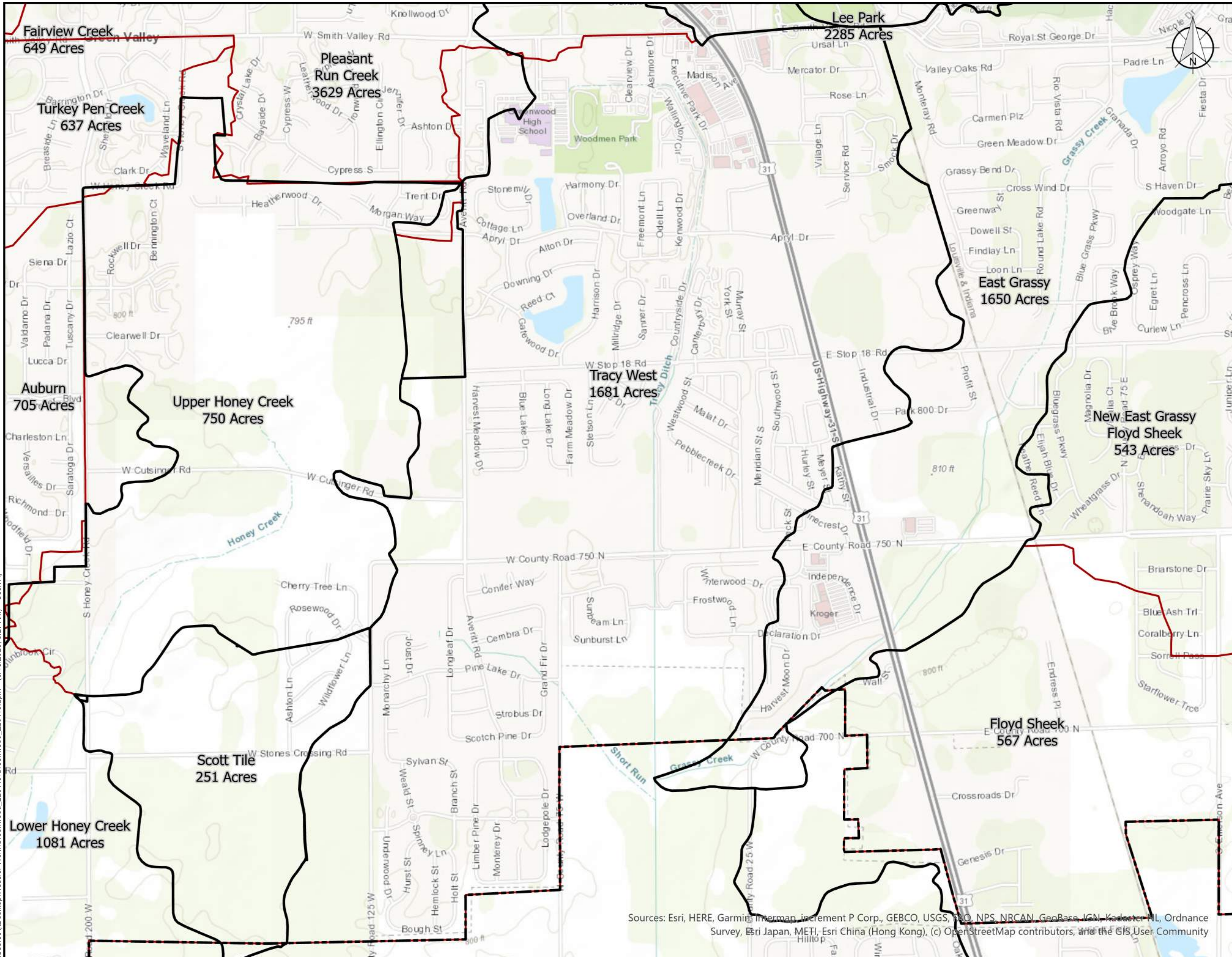
Lee Park
2285 Acres

New East Grassy
Floyd Sheek
543 Acres

Tracy East
1542 Acres

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\AI\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:27 AM) User: Aj



WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 500 1,000 2,000 FT

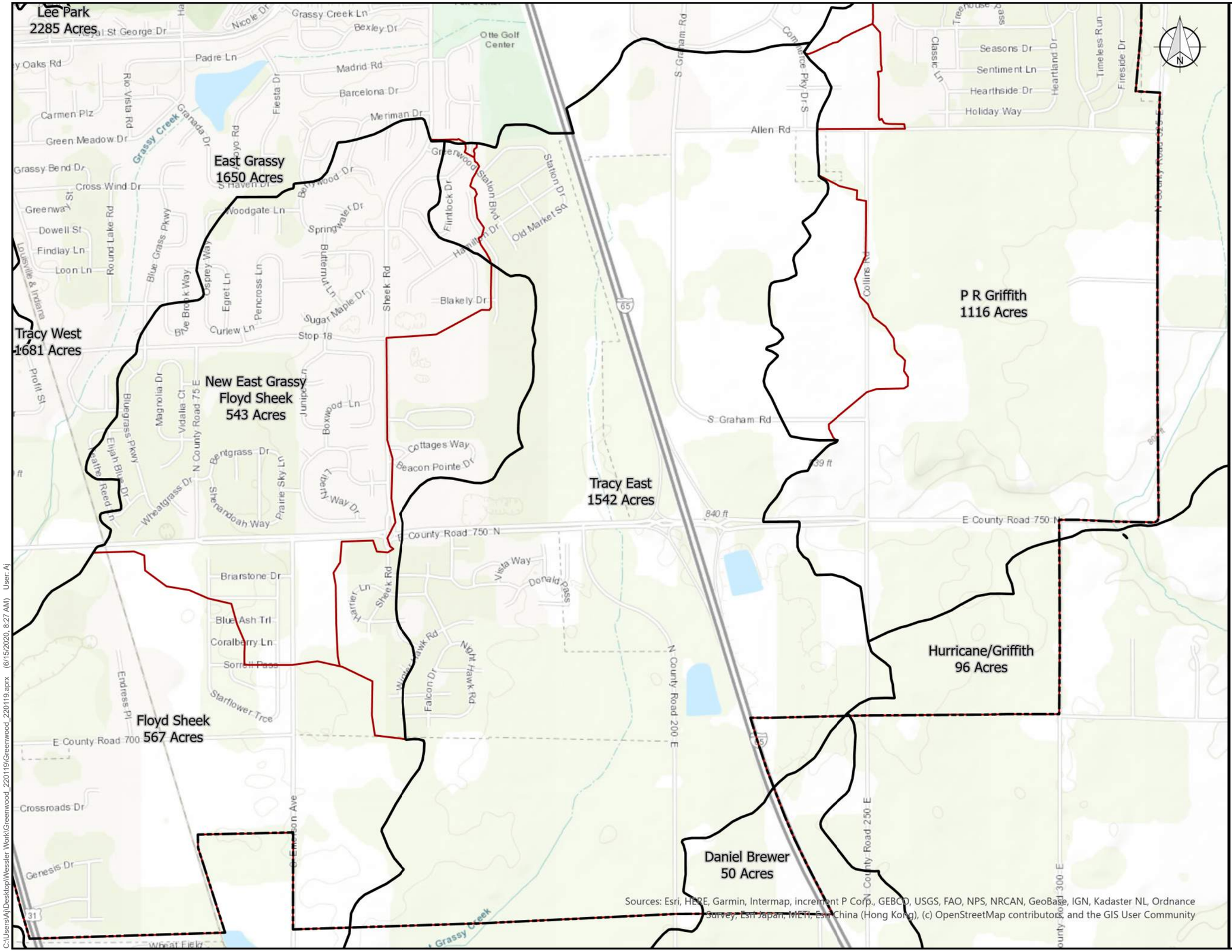
FIGURE 3.1.21

Watershed: Tracy West

Greenwood, Indiana Watershed Updates

June 2020
220119-01-001

C:\Users\Aj\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:27 AM) User: Aj



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

C:\Users\AJ\Desktop\Wessler Work\Greenwood_220119\Greenwood_220119.aprx (6/15/2020, 8:27 AM) User: AJ

WESSLER ENGINEERING
More than a Project™

Legend

- Municipal Boundaries
- Johnson County Watersheds
- Adjusted Watersheds

0 500 1,000 2,000 FT

FIGURE 3.1.22

Watershed:
Tracy East

Greenwood, Indiana
Watershed Updates

June 2020
220119-01-001

Appendix B – 5-year Capital Plan

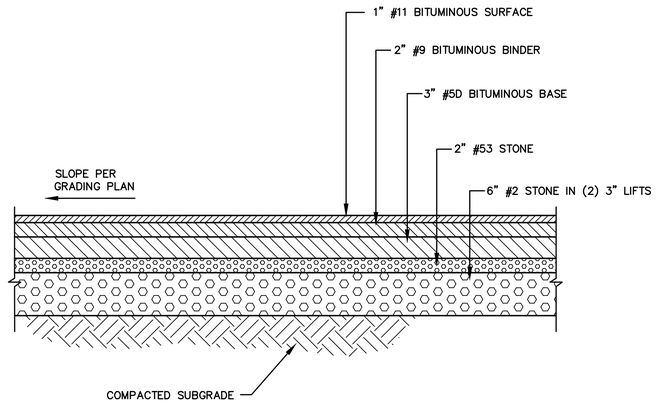
City of Greenwood Department of Stormwater Management
5-year Capital Plan

Fund	2020	2021	2022	2023	2024	2025
Personal Services						
Salaries and Wages	$ 981,919.00	$ 1,001,560.00	$ 1,021,590.00	$ 1,042,020.00	$ 1,062,860.00	$ 1,084,120.00
Employee Benefits	$ 411,096.00	$ 419,320.00	$ 427,710.00	$ 436,260.00	$ 444,990.00	$ 453,890.00
Supplies						
Office Supplies	$ 2,000.00	$ 2,040.00	$ 2,080.00	$ 2,120.00	$ 2,160.00	$ 2,200.00
Operating Supplies	$ 19,000.00	$ 19,000.00	$ 20,000.00	$ 20,000.00	$ 21,000.00	$ 21,000.00
Repair and Maintenance Supplies	$ 40,000.00	$ 44,000.00	$ 48,400.00	$ 53,240.00	$ 58,560.00	$ 64,420.00
Other Supplies	$ 55,800.00	$ 6,000.00	$ 7,000.00	$ 8,000.00	$ 9,000.00	$ 10,000.00
Other Services						
Professional Services	$ 515,500.00	$ 300,000.00	$ 450,000.00	$ 450,000.00	$ 450,000.00	$ 300,000.00
Communications & Transportation	$ 10,500.00	$ 10,700.00	$ 11,000.00	$ 11,400.00	$ 12,000.00	$ 12,700.00
Printing and Advertising	$ 8,500.00	$ 8,500.00	$ 8,500.00	$ 9,000.00	$ 9,000.00	$ 9,000.00
Insurance	$ 9,000.00	$ 9,900.00	$ 10,890.00	$ 11,980.00	$ 13,180.00	$ 14,500.00
Utility Services	$ 7,000.00	$ 14,000.00	$ 14,420.00	$ 14,850.00	$ 15,300.00	$ 15,760.00
Repairs and Maintenance	$ 396,590.00	$ 400,000.00	$ 440,000.00	$ 484,000.00	$ 532,400.00	$ 585,640.00
Rentals	$ 20,000.00	$ 20,000.00	$ 20,000.00	$ 22,000.00	$ 22,000.00	$ 22,000.00
Debt Service	$ 531,646.00					
Other Services and Charges	$ 132,500.00	$ 145,750.00	$ 160,330.00	$ 176,360.00	$ 194,000.00	$ 213,400.00
Capital Outlays						
Land	$ 700,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00	$ 100,000.00
Infrastructure	$ 500,000.00	$ 1,450,000.00	$ 3,750,000.00	$ 3,250,000.00	$ 2,500,000.00	$ 500,000.00
Machinery and Equipment	$ 250,000.00	$ 250,000.00	$ 300,000.00	$ 325,000.00	$ 75,000.00	$ 75,000.00
TOTAL	**$ 4,591,051.00**	**$ 4,200,770.00**	**$ 6,791,920.00**	**$ 6,416,230.00**	**$ 5,521,450.00**	**$ 3,483,630.00**

Capital Improvements Goals:

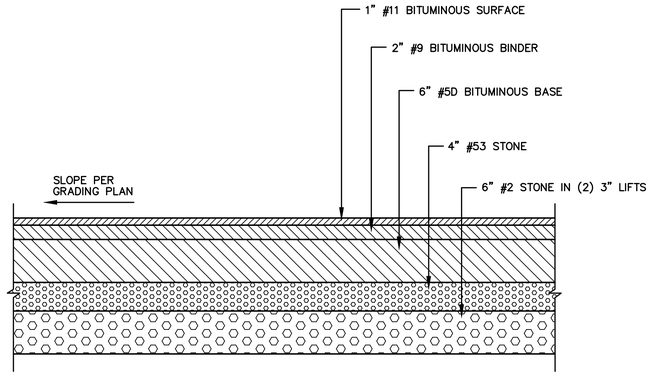
1) Full funding of P4 based on 2 pond projects, 1 of water quality BMP project, and 2 drainage improvement (e.g drive culverts) project each year
2) $200,000 for Nature Center Improvements in 2021
3) 2 Regional Detention projects 2023 - 2024
4) Downtown drainage Infrastructure, $750k per year, 2021-2023
5) Bridge Project in 2022

Appendix C – Standard Details



TYPICAL PAVEMENT SECTION DETAIL – RESIDENTIAL

NO SCALE

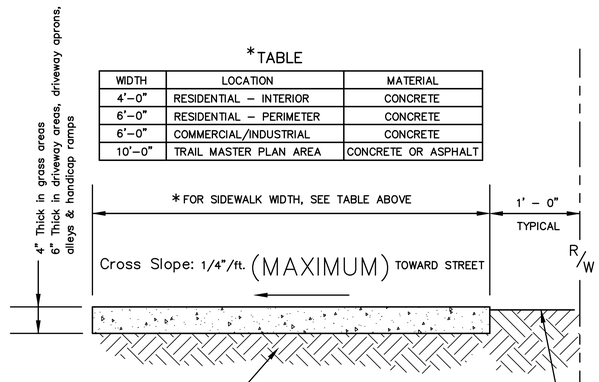


TYPICAL PAVEMENT SECTION DETAIL – COMMERCIAL/INDUSTRIAL

NO SCALE

*TABLE

WIDTH	LOCATION	MATERIAL
4'–0"	RESIDENTIAL – INTERIOR	CONCRETE
6'–0"	RESIDENTIAL – PERIMETER	CONCRETE
6'–0"	COMMERCIAL/INDUSTRIAL	CONCRETE
10'–0"	TRAIL MASTER PLAN AREA	CONCRETE OR ASPHALT



NOTES:

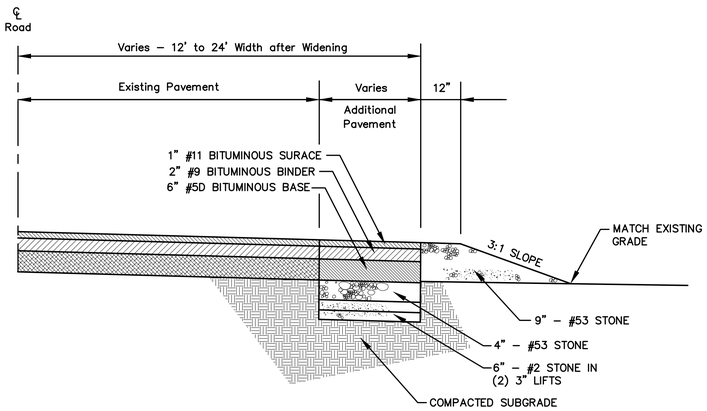
CONCRETE SHALL BE CLASS "A", 6 BAG MIX

ONCE THE APPROVED CROSS SLOPE INSPECTION OF THE FORMS FOR THE SIDEWALK IS COMPLETE, PRIOR TO THE ACTUAL CONSTRUCTION OF THE SIDEWALK, THE DEVELOPER AND THE SIDEWALK CONTRACTOR ARE STILL RESPONSIBLE FOR INSTALLING THE FINISHED (COMPLETED) SIDEWALK WITH THE PROPER CROSS SLOPE AND PER ALL AMERICANS WITH DISABILITIES ACT (ADA) REQUIREMENTS

APPROVAL FROM THE CITY SHALL BE OBTAINED PRIOR TO CONCRETE THAT WILL BE INSTALLED USING COLD WEATHER PRACTICES. NO EXCEPTIONS WILL BE ALLOWED

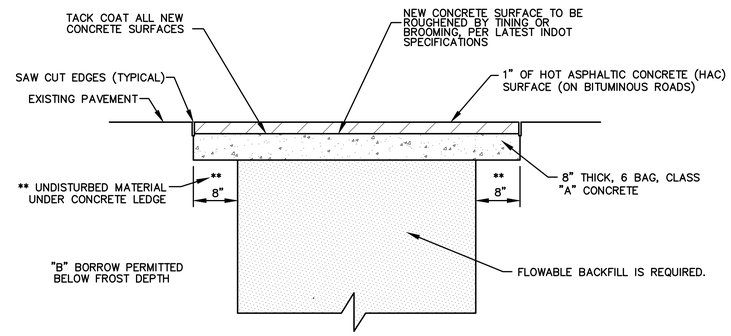
SIDEWALK DETAIL

NO SCALE



PAVEMENT WIDENING DETAIL

NO SCALE

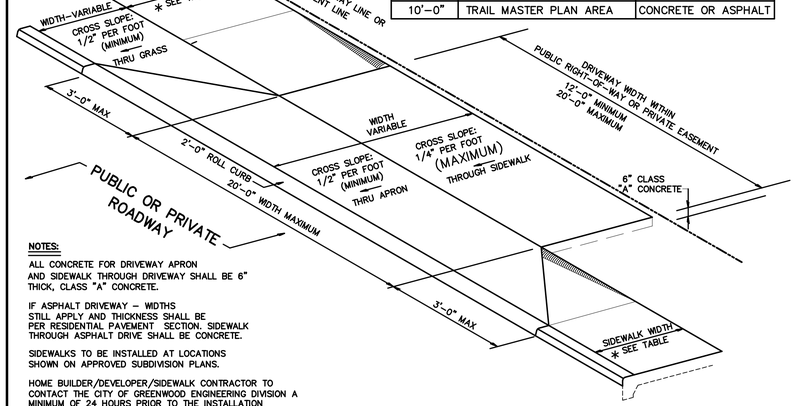


STANDARD UTILITY STREET CUT REPAIR AND BACKFILL DETAIL

NO SCALE

*TABLE

WIDTH	LOCATION	MATERIAL
4'–0"	RESIDENTIAL – INTERIOR	CONCRETE
6'–0"	RESIDENTIAL – PERIMETER	CONCRETE
6'–0"	COMMERCIAL/INDUSTRIAL	CONCRETE
10'–0"	TRAIL MASTER PLAN AREA	CONCRETE OR ASPHALT



NOTES:

ALL CONCRETE FOR DRIVEWAY APRON AND SIDEWALK THROUGH DRIVEWAY SHALL BE 6" THICK, CLASS "A" CONCRETE.

IF ASPHALT DRIVEWAY – WIDTHS STILL APPLY AND THICKNESS SHALL BE PER RESIDENTIAL PAVEMENT SECTION. SIDEWALK THROUGH ASPHALT DRIVE SHALL BE CONCRETE.

SIDEWALKS TO BE INSTALLED AT LOCATIONS SHOWN ON APPROVED SUBDIVISION PLANS.

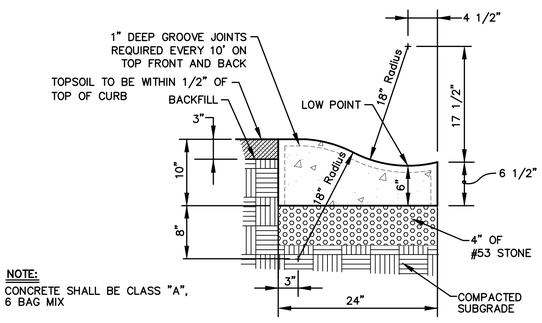
HOME BUILDER/DEVELOPER/SIDEWALK CONTRACTOR TO CONTACT THE CITY OF GREENWOOD ENGINEERING DIVISION A MINIMUM OF 24 HOURS PRIOR TO THE INSTALLATION OF ANY SIDEWALKS OR APRONS FOR EACH RESIDENCE OR COMMON AREA. TELEPHONE 317–887–5230 TO SCHEDULE INSPECTION OF SIDEWALK FORMS.

ONCE THE APPROVED CROSS SLOPE INSPECTION OF THE FORMS FOR THE SIDEWALK IS COMPLETE, PRIOR TO THE ACTUAL CONSTRUCTION OF THE SIDEWALK, THE DEVELOPER AND THE SIDEWALK CONTRACTOR ARE STILL RESPONSIBLE FOR INSTALLING THE FINISHED (COMPLETED) SIDEWALK WITH THE PROPER CROSS SLOPE AND PER ALL AMERICANS WITH DISABILITIES ACT (ADA) REQUIREMENTS

APPROVAL FROM THE CITY SHALL BE OBTAINED PRIOR TO CONCRETE THAT WILL BE INSTALLED USING COLD WEATHER PRACTICES. NO EXCEPTIONS WILL BE ALLOWED

TYPICAL CONCRETE DRIVE APPROACH DETAIL – RESIDENTIAL

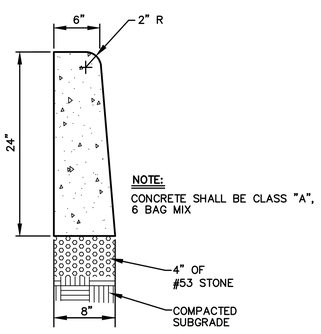
NO SCALE



NOTE:
CONCRETE SHALL BE CLASS "A", 6 BAG MIX

2'–0" CONCRETE ROLL CURB & GUTTER DETAIL

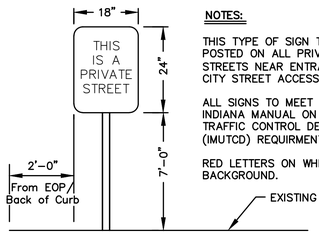
NO SCALE



NOTE:
CONCRETE SHALL BE CLASS "A", 6 BAG MIX

6" CONCRETE CURB DETAIL

NO SCALE



NOTES:

THIS TYPE OF SIGN TO BE POSTED ON ALL PRIVATE STREETS NEAR ENTRANCE(S) TO CITY STREET ACCESS.

ALL SIGNS TO MEET THE LATEST INDIANA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (IMUTCD) REQUIRMENTS

RED LETTERS ON WHITE BACKGROUND.

PRIVATE STREET SIGNAGE DETAIL

NO SCALE

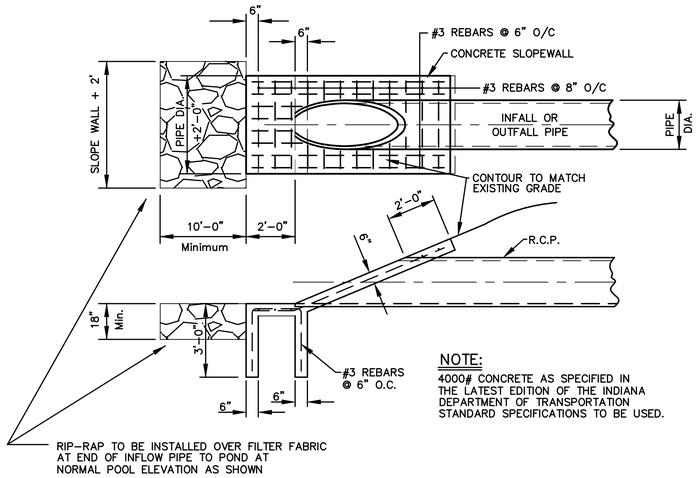
REVISION	DATE	BY
Per City Engineering Department	5/10/02	GLA
City Engineering Division	02/2013	pdp

PROJECT

TITLE
ROADWAY DETAILS– SHEET 2

CITY OF GREENWOOD, INDIANA
ENGINEERING DIVISION
225 South Emerson Avenue
Greenwood, Indiana 46143
Telephone: (317) 887–5230

Z:/ENGINEERING COMMON FILES/STANDARD DETAIL SHEETS/ROAD DETAILS SHEET2.DWG

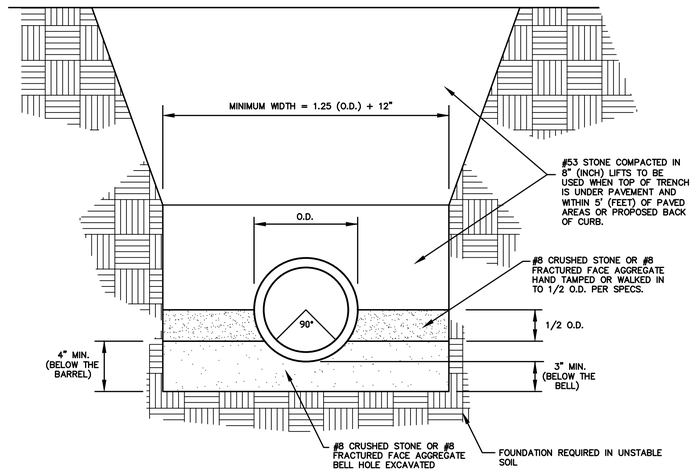


NOTE:
4000# CONCRETE AS SPECIFIED IN THE LATEST EDITION OF THE INDIANA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS TO BE USED.

CONCRETE SLOPEWALL DETAIL

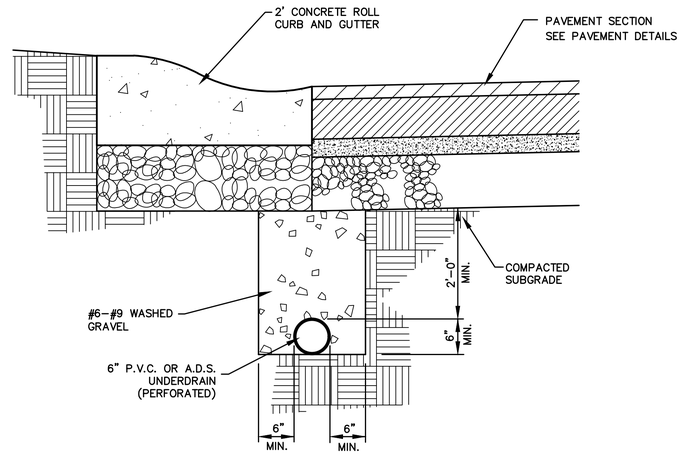
NO SCALE

NOTE:
SIDE SLOPES OF TRENCH TO BE CONSTRUCTED BY CONTRACTOR PER LATEST OSHA REQUIREMENTS



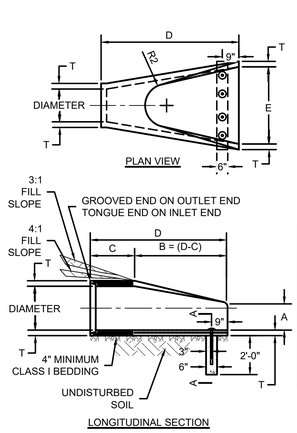
RIGID PIPE BEDDING DETAIL (CONCRETE PIPE)

NO SCALE



6" CURB UNDERDRAIN DETAIL

NO SCALE



DIA	T (MIN)	A*	C*	D*	E*	R_1	R_2	APPROX WEIGHT
12"	2"	5"	51"	74"	24"	10.125"	9"	800
15"	2.25"	7"	48"	75"	30"	12.5"	11"	1100
18"	2.5"	11"	49"	74"	36"	15.5"	12"	1300
21"	2.75"	11"	42"	75"	42"	16.125"	13"	1500
24"	3"	12"	32"	75"	48"	16.375"	14"	1800
27"	3.25"	13"	29"	75"	54"	18.563"	14.5"	2100
30"	3.5"	14"	22"	75"	60"	18.5"	15"	2400
33"	3.75"	15"	42"	99"	66"	23.75"	17.5"	4100
36"	4"	17"	37"	99"	72"	24.625"	20"	4200
* TOLERANCE ±								

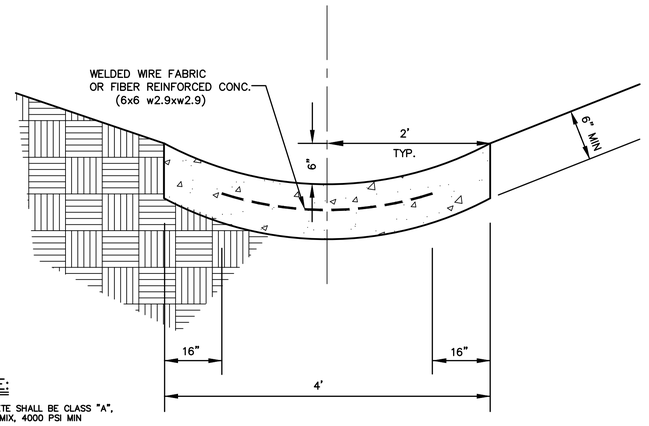
PRECAST CONCRETE END SECTION DETAIL

NO SCALE

DIMENSIONS OF CONCRETE END SECTIONS FOR ROUND PIPE

DIA.	WALL	G or T	WT. SEC.	A	B	C	D	E	DIA.+1	R_1	R_2	SKIRT
12"	2"	1 1/2"	530	4"	24"	48 7/8"	72 7/8"	24"	13"	10 1/16"	9"	3 1/2"
15"	2 1/4"	2"	740	6"	27"	46"	73"	30"	16"	12 1/2"	11"	3 1/2"
18"	2 1/2"	2 1/2"	990	9"	27"	46"	73"	36"	19"	15 1/2"	12"	4"
21"	2 3/4"	2 1/4"	1280	9"	35"	38"	73"	42"	22"	16 1/8"	13"	4"
24"	3"	2 1/2"	1520	9 1/2"	43 1/2"	30"	73 1/2"	48"	25"	16 11/16"	14"	4 1/2"
27"	3 1/4"	2 1/2"	1930	10 1/2"	48"	25 1/2"	73 1/2"	54"	28"	17 3/4"	14 1/2"	4 1/2"
30"	3 1/2"	3"	2190	12"	54"	19 3/4"	73 3/4"	60"	31"	18 5/16"	15"	5"
33"	3 3/4"	3 3/8"	3150	13 1/2"	58 1/2"	39 1/4"	97 3/4"	66"	34"	23 3/4"	17 1/2"	5 1/2"
36"	4"	3 1/2"	4100	15"	63"	34 3/4"	97 3/4"	72"	37"	24 1/16"	20"	5 1/2"
42"	4 1/2"	3 3/4"	5380	21"	63"	35"	98"	78"	43"	27 1/4"	22"	5 1/2"
48"	5"	4 1/4"	6550	24"	72"	26"	98"	84"	49"	28 1/8"	22"	5 3/4"
54"	5 1/2"	4 3/4"	8040	27"	65"	35"	100"	90"	55"	32 7/8"	24"	6 1/4"
60"	6"	5"	8750	30"	60"	39"	99"	96"	61"	36 3/4"	24"	6 3/4"
66"	6 1/2"	5 1/2"	10630	24"	78"	21"	99"	102"	67"	35 11/16"	24"	7 1/4"
72"	7"	6"	12520	34"	78"	21"	99"	108"	73"	38 5/8"	24"	7 3/4"
78"	7 1/2"	6 1/2"	14430	24"	78"	21"	99"	114"	79"	41 15/16"	24"	8 1/2"
84"	8"	7"	16350	24"	78"	21"	99"	120"	85"	44 13/16"	24"	9"

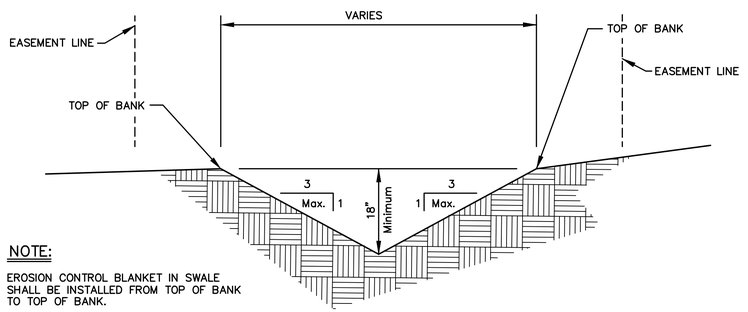
NOTE: MANUFACTURE OF END SECTION IS IN ACCORDANCE WITH APPLICABLE PORTIONS OF A.S.T.M. SPECIFICATION C76



NOTE:
CONCRETE SHALL BE CLASS "A", 6 BAG MIX, 4000 PSI MIN

CONCRETE PAVED SIDE DITCH CROSS SECTION DETAIL

NO SCALE



NOTE:
EROSION CONTROL BLANKET IN SWALE SHALL BE INSTALLED FROM TOP OF BANK TO TOP OF BANK.

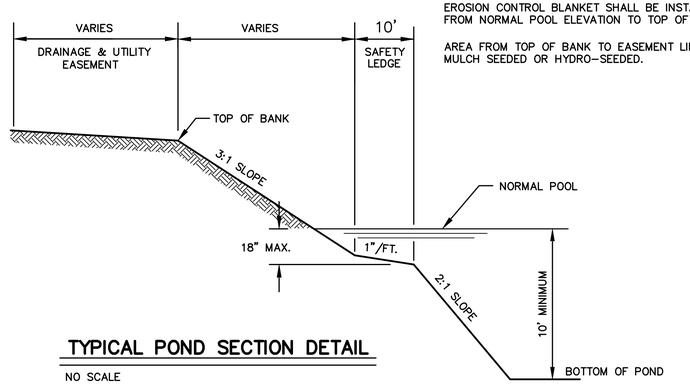
TYPICAL SWALE CROSS SECTION DETAIL

NO SCALE

NOTES:
NO SUBMERGED PIPES SHALL BE INSTALLED (ALLOWED) FOR EITHER INFLOWING (TO POND) OR OUTFLOWING (FROM POND)

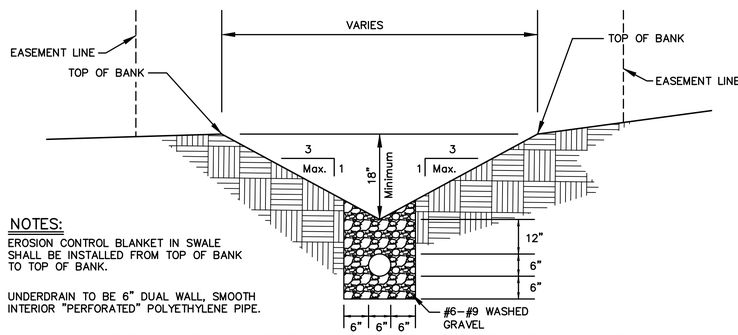
EROSION CONTROL BLANKET SHALL BE INSTALLED FROM NORMAL POOL ELEVATION TO TOP OF BANK.

AREA FROM TOP OF BANK TO EASEMENT LIMITS SHALL BE MULCH SEEDED OR HYDRO-SEEDED.



TYPICAL POND SECTION DETAIL

NO SCALE



NOTES:
EROSION CONTROL BLANKET IN SWALE SHALL BE INSTALLED FROM TOP OF BANK TO TOP OF BANK.

UNDERDRAIN TO BE 6" DUAL WALL, SMOOTH INTERIOR "PERFORATED" POLYETHYLENE PIPE.

TYPICAL SWALE WITH UNDERDRAIN CROSS SECTION DETAIL

NO SCALE

REVISION	DATE	BY
Per City Engineering Department	5/10/02	GLA
City Engineering Division	02/2013	pdp

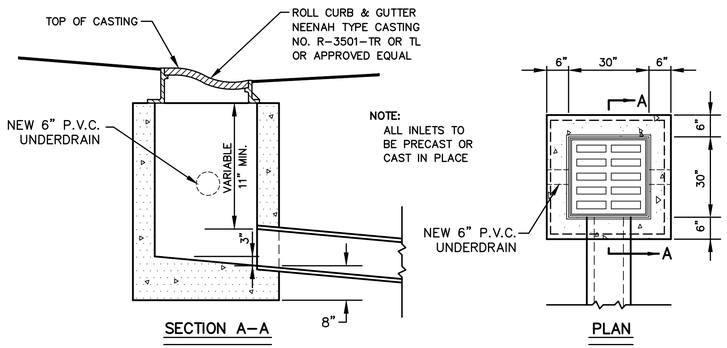
PROJECT

TITLE
STORM DETAILS- SHEET 1

CITY OF GREENWOOD, INDIANA
ENGINEERING DIVISION
225 South Emerson Avenue
Greenwood, Indiana 46143
Telephone: (317) 887-5230

Z:/ENGINEERING COMMON FILES/STANDARD DETAIL SHEETS/ROAD DETAILS SHEET1.DWG

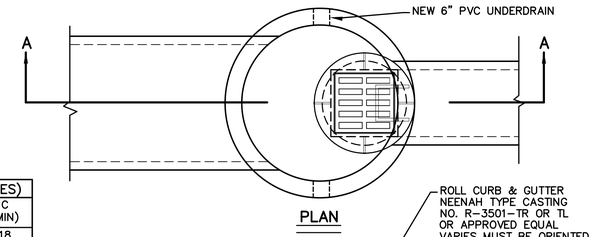
ALL STORM SEWER CASTINGS (OPEN LIDS AND SOLID LIDS) SHALL HAVE AN ENVIRONMENTAL LOGO SUCH AS "DUMP NO WASTE, DRAINS TO WATERWAYS" EMBOSSED (STAMPED) INTO CASTING. NO "ADD-ON" PLATES OR STICKERS (DECALS) WILL BE PERMITTED.



TYPE "C" INLET DETAIL

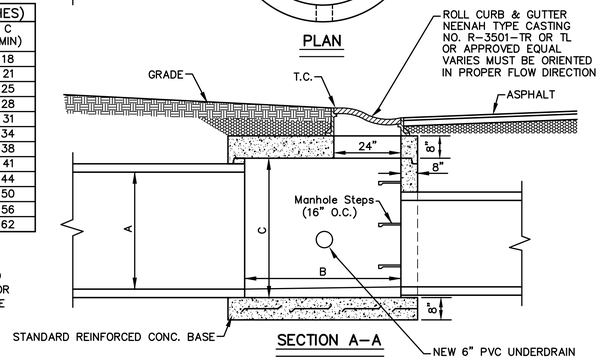
NO SCALE

ALL STORM SEWER CASTINGS (OPEN LIDS AND SOLID LIDS) SHALL HAVE AN ENVIRONMENTAL LOGO SUCH AS "DUMP NO WASTE, DRAINS TO WATERWAYS" EMBOSSED (STAMPED) INTO CASTING. NO "ADD-ON" PLATES OR STICKERS (DECALS) WILL BE PERMITTED.



DIMENSIONS (INCHES)		
A (MAX)	B (I.D.)	C (MIN)
12	36	18
15	36	21
18	48	25
21	48	28
24	48	31
27	60	34
30	60	38
33	60	41
36	60	44
42	60	50
48	66	56
54	72	62

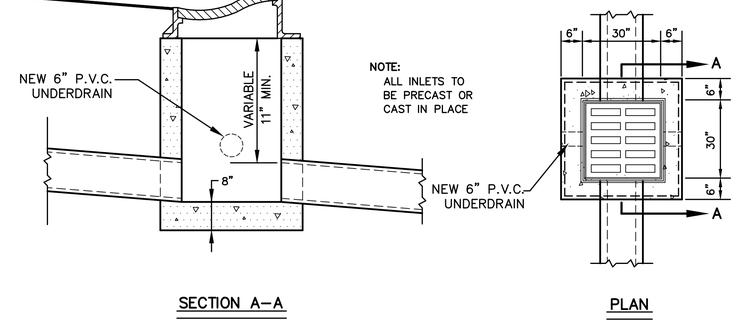
NOTE:
ALL INLETS TO
BE PRECAST OR
CAST IN PLACE



TYPE "C2" INLET DETAIL

NO SCALE

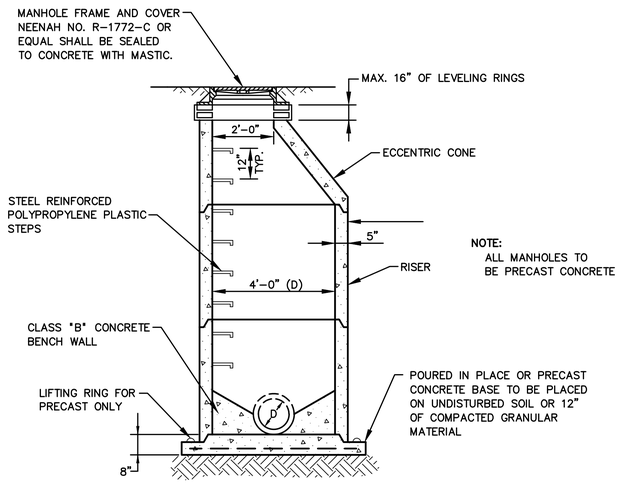
ALL STORM SEWER CASTINGS (OPEN LIDS AND SOLID LIDS) SHALL HAVE AN ENVIRONMENTAL LOGO SUCH AS "DUMP NO WASTE, DRAINS TO WATERWAYS" EMBOSSED (STAMPED) INTO CASTING. NO "ADD-ON" PLATES OR STICKERS (DECALS) WILL BE PERMITTED.



TYPE "C1" INLET DETAIL

NO SCALE

ALL STORM SEWER CASTINGS (OPEN LIDS AND SOLID LIDS) SHALL HAVE AN ENVIRONMENTAL LOGO SUCH AS "DUMP NO WASTE, DRAINS TO WATERWAYS" EMBOSSED (STAMPED) INTO CASTING. NO "ADD-ON" PLATES OR STICKERS (DECALS) WILL BE PERMITTED.



STORM MANHOLE DETAIL

NO SCALE

ALL STORM SEWER CASTINGS (OPEN LIDS AND SOLID LIDS) SHALL HAVE AN ENVIRONMENTAL LOGO SUCH AS "DUMP NO WASTE, DRAINS TO WATERWAYS" EMBOSSED (STAMPED) INTO CASTING. NO "ADD-ON" PLATES OR STICKERS (DECALS) WILL BE PERMITTED.

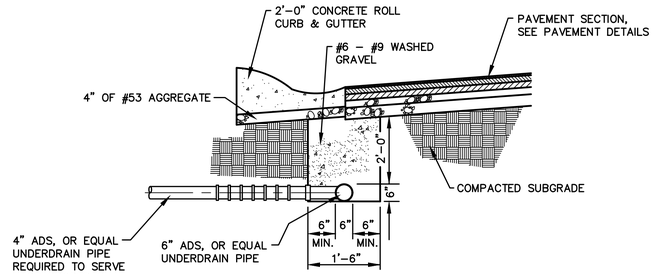
REVISION	DATE	BY
Per City Engineeing Department	5/10/02	GLA
City Engineering Division	02/2013	pdp

PROJECT

TITLE
STORM DETAILS- SHEET 2

CITY OF GREENWOOD, INDIANA
ENGINEERING DIVISION
225 South Emerson Avenue
Greenwood, Indiana 46143
Telephone: (317) 887-5230

Z:/ENGINEERING COMMON FILES/STANDARD DETAIL SHEETS/STORM DETAILS SHEET 2.DWG



SEE TYPICAL SUMP PUMP LATERAL DETAIL 2 & 3 THIS SHEET

NOTES:

ALL PLASTIC ADS, OR EQUAL, UNDERDRAIN PIPE SHALL RUN LONGITUDINALLY ALONG BOTH SIDES OF THE PAVEMENT FOR THE ENTIRE LENGTH OF THE PAVEMENT.

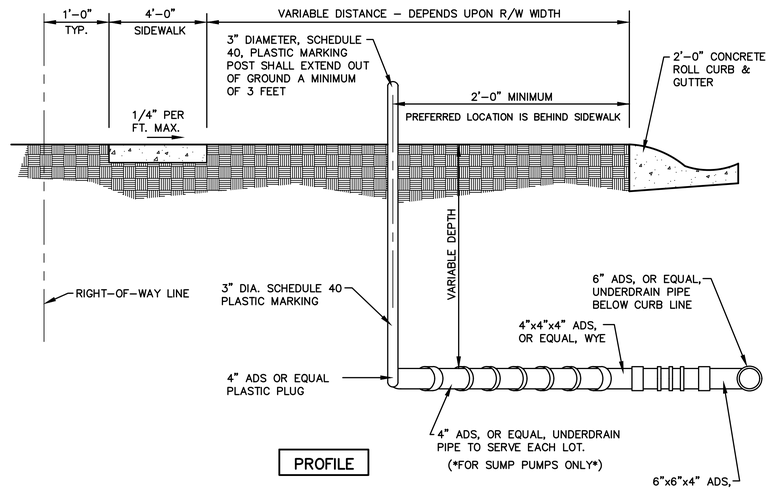
ALL PLASTIC ADS, OR EQUAL, UNDERDRAIN PIPE GRADE SHALL MATCH PAVEMENT GRADE.

ALL PLASTIC ADS, OR EQUAL, UNDERDRAIN SHALL CONNECT TO THE STORM WATER SEWER SYSTEM.

UNDERDRAIN DETAIL

NO SCALE

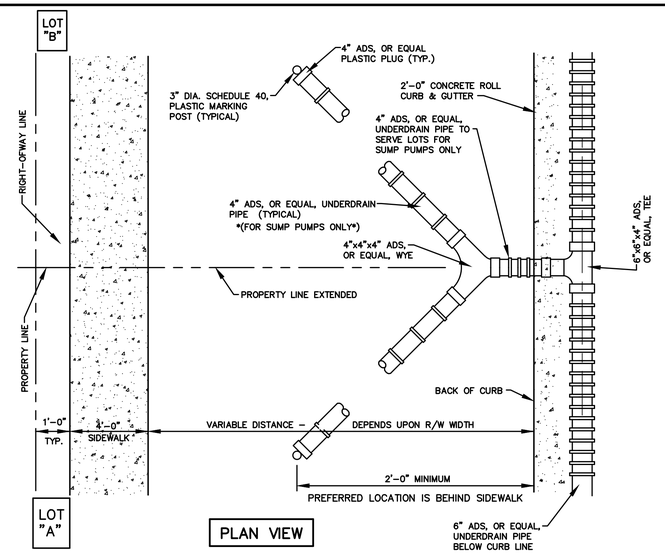
1



TYPICAL SUMP PUMP LATERAL DETAIL AT EACH LOT LINE

NO SCALE

2



TYPICAL SUMP PUMP LATERAL DETAIL AT EACH LOT LINE

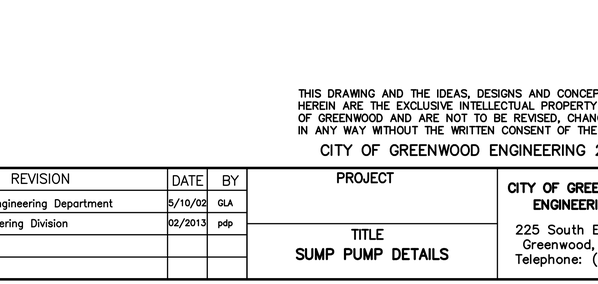
NO SCALE

3

TYPICAL SUMP PUMP LATERAL DETAIL THRU FOUNDATION WALL

NO SCALE

4



SUMP PUMP LATERAL DETAIL FROM UNDERDRAIN TO PROPOSED RESIDENCE

NO SCALE

5

REVISION	DATE	BY
Per City Engineering Department	5/10/02	GLA
City Engineering Division	02/2013	pdp

PROJECT

TITLE
SUMP PUMP DETAILS

CITY OF GREENWOOD, INDIANA
ENGINEERING DIVISION
225 South Emerson Avenue
Greenwood, Indiana 46143
Telephone: (317) 887-5230

Z:/ENGINEERING COMMON FILES/STANDARD DETAIL SHEETS/SUMP PUMP DETAILS SHEET 1.DWG