

Broadkill River & St. Jones River Watershed Plans



Prepared by:



March 2009

Watershed Plan Components

Three Documents:

- Baseline Assessment
- Pollution Control Opportunities
- Watershed Implementation Plan

Baseline Assessment

Characterized the current and projected future Watershed through:

- Reviewing published studies and reports
- Conducting a field reconnaissance (volunteers)
- Generating and analyzing GIS databases (including a build out analysis – Community Viz)
- Completing a regulatory and program audit (CWP – Sussex, Milton, and Georgetown, Kent, Dover)

Legend

- Sub-watershed Boundary
- Water Features
- Rivers and Streams
- Major Roads

SOURCE: HILLSHADE OF
USGS/USGS CENTER
BARRE-EARTH DEM

DRAWN BY:
MPN

CHECKED BY:
JME

FILE:
3362WC_BROADKILL_Implementation_Fig4.mxd

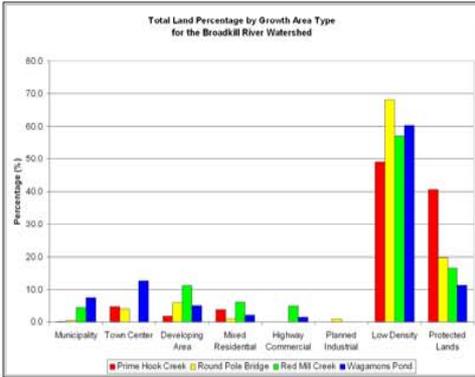
**BROADKILL RIVER WATERSHED
PROJECTED BUILD-OUT
SUSSEX COUNTY - DELAWARE**

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO:
3362 WC

SHEET:
FIGURE 4



BROADKILL RIVER WATERSHED BUILD-OUT STATISTICS

	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	28.2	0.0	0.0
Town Center	69.9	0.0	0.0
Developing Area	143.2	0.0	0.0
Mixed Residential	12.0	0.0	0.0
Highway Commercial	1.0	0.0	0.0
Planned Industrial	1.0	0.0	0.0
Low Density	248.8	10.0	10.0
Protected Lands	21.0	0.0	0.0
Total	585.1	10.0	10.0

	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	11.7	0.0	0.0
Town Center	78.0	0.0	0.0
Developing Area	11.0	0.0	0.0
Mixed Residential	11.0	0.0	0.0
Highway Commercial	1.0	0.0	0.0
Planned Industrial	1.0	0.0	0.0
Low Density	212.0	10.0	10.0
Protected Lands	11.0	0.0	0.0
Total	339.7	10.0	10.0

	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	1.0	0.0	0.0
Town Center	1.0	0.0	0.0
Developing Area	1.0	0.0	0.0
Mixed Residential	1.0	0.0	0.0
Highway Commercial	1.0	0.0	0.0
Planned Industrial	1.0	0.0	0.0
Low Density	1.0	0.0	0.0
Protected Lands	1.0	0.0	0.0
Total	7.0	0.0	0.0

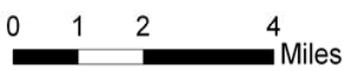
	Total Acres	Estimated Existing Impervious (Acres)	Projected Impervious (Acres)
Municipality	1.0	0.0	0.0
Town Center	1.0	0.0	0.0
Developing Area	1.0	0.0	0.0
Mixed Residential	1.0	0.0	0.0
Highway Commercial	1.0	0.0	0.0
Planned Industrial	1.0	0.0	0.0
Low Density	1.0	0.0	0.0
Protected Lands	1.0	0.0	0.0
Total	7.0	0.0	0.0

1 THIS MAP IS PART OF A REPORT TITLED "BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN" PREPARED BY DUFFIELD ASSOCIATES, INC. AND AS SUCH SHOULD ONLY BE VIEWED IN THE CONTEXT OF THAT REPORT.

2 THIS MAP WAS GENERATED BY DIGITALLY CONVERTING A FIGURE IN THE 2007 SUSSEX COUNTY COMPREHENSIVE PLAN TITLED "FUTURE LAND USE PLAN MAP". THE FIGURE CAN BE FOUND IN CHAPTER THREE OF THE PLAN ON PAGE 3-22 & ONLINE AT [HTTP://WWW.SUSSEXCOUNTYDE.GOV/COMPPLAN](http://www.sussexcountycde.gov/compplan)

3 PUBLIC AND MANAGED LAND AREAS TAKEN FROM MULTIPLE AVAILABLE PUBLIC DATA SETS OF VARIOUS DATES.

4 PROPOSED BUILD-OUT IS FOR PLANNING PURPOSES TO ASSIST IN IDENTIFYING POTENTIAL POLLUTION CONTROL AND/OR PRESERVATION OPPORTUNITIES.

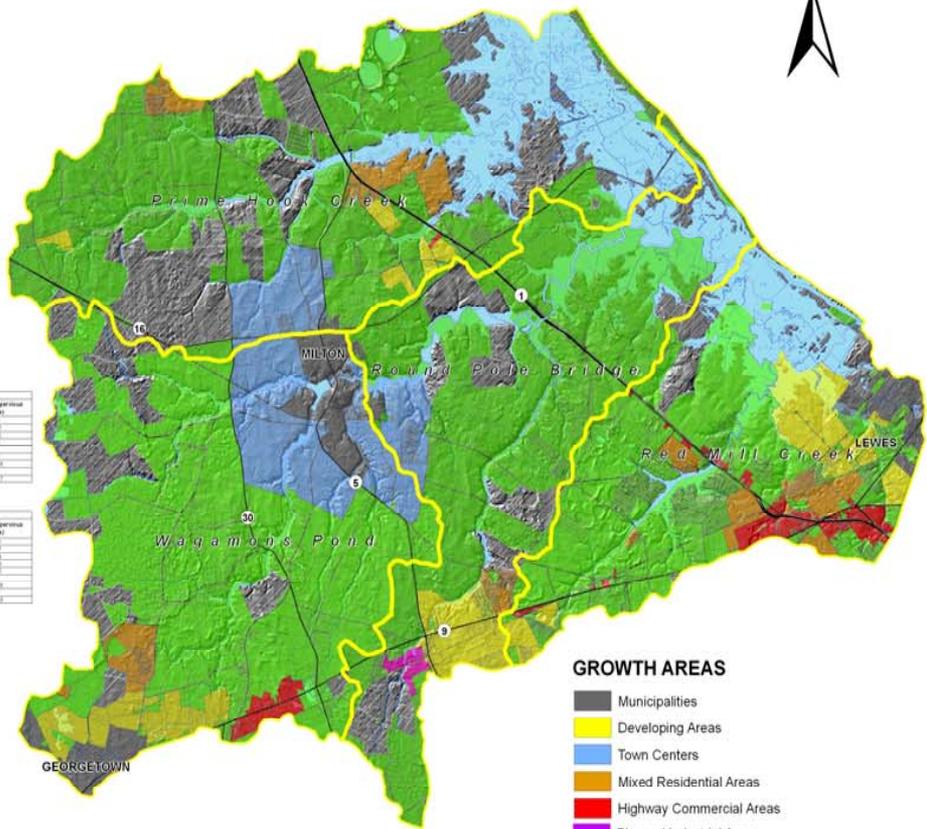


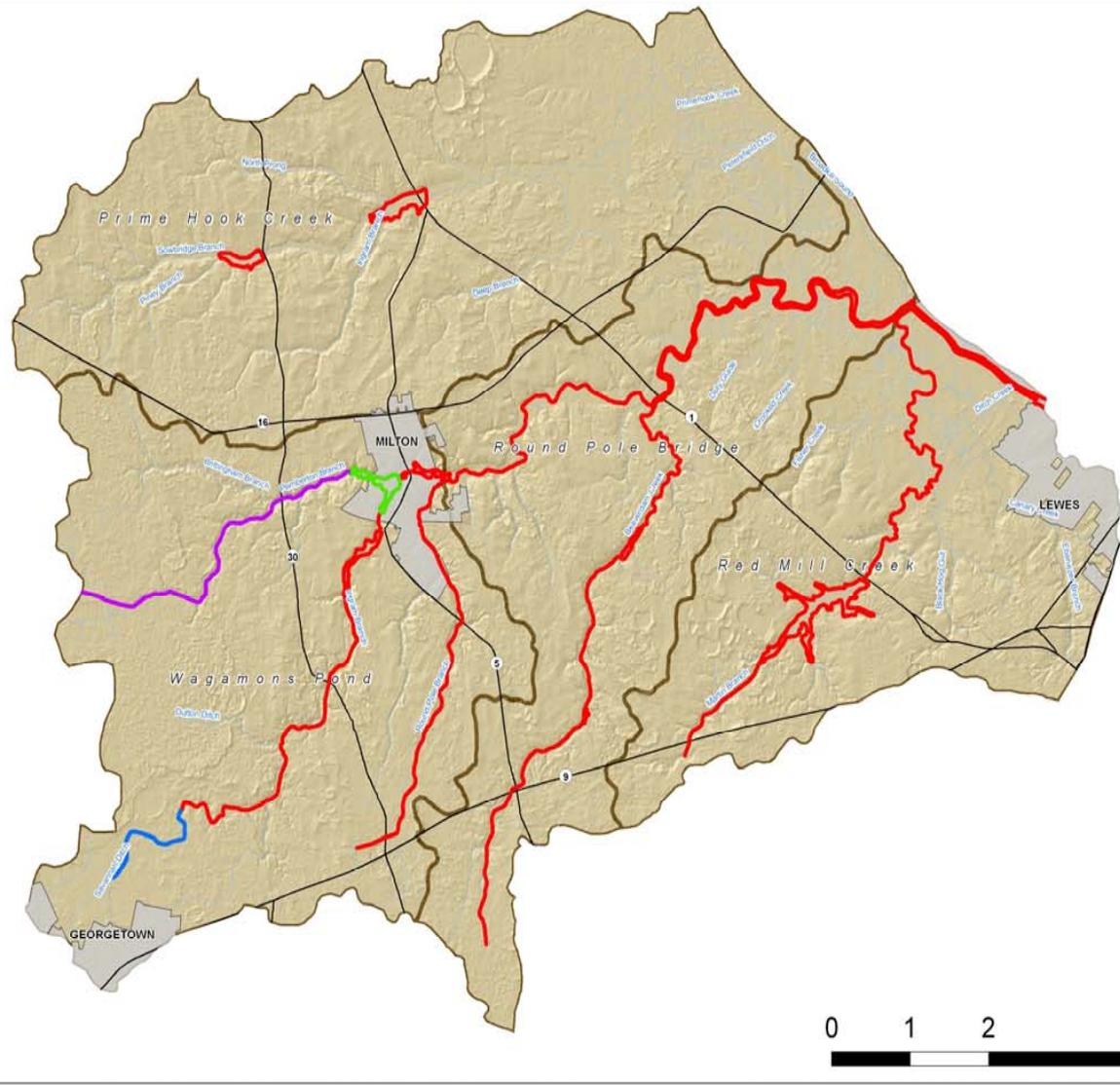
GROWTH AREAS

- Municipalities
- Developing Areas
- Town Centers
- Mixed Residential Areas
- Highway Commercial Areas
- Planned Industrial Areas

RURAL AREAS

- Low Density Areas
- Protected Areas
(All Federal lands, State Lands, agricultural easements, private conservancy lands, major wetlands and lands preserved by other conservation easements)





- Legend**
- Sub-watershed Boundary
 - Municipal Boundaries
- TMDL SEGMENTS**
- Dissolved Oxygen (DO)
 - Nutrients
 - Bacteria, DO, Nutrients
 - Bacteria, Nutrients
 - NON-TMDL STREAM SEGMENTS
 - Major Roads

SOURCE:
 HILLSLOPE OF USGS/SDGS 2-METER
 BASE EARTH DEM

DRAWN BY:
 MPN

CHECKED BY:
 JME

FILE:
 3362WC_Broadkill_Implementation_
 Fig5.mxd

**BROADKILL RIVER WATERSHED
 EPA 303(d) TMDL
 IMPAIRED STREAMS
 SUSSEX COUNTY- DELAWARE**

DATE:
 AUGUST 2008

SCALE:
 AS SHOWN

PROJECT NO:
 3362.WC

SHEET:
 FIGURE 5

1 THIS MAP IS PART OF A REPORT TITLED "BROADKILL RIVER WATERSHED IMPLEMENTATION PLAN," DATED NOVEMBER 2008, PREPARED BY DUFFIELD ASSOCIATES, INC. AND AS SUCH SHOULD ONLY BE VIEWED IN THE CONTEXT OF THAT REPORT.
 2 THIS FIGURE IS ADAPTED FROM SEGMENTS LISTED IN THE "BROADKILL RIVER WATERSHED PROPOSED TMDLS" DATED 2006.

- Legend**
- Sub-watershed Boundaries
 - Water Features
 - Rivers and Streams
 - Major Roads

SOURCE: HILLSHADE OF DOVER
 USGS/DGS 2-METER BARE-EARTH DEM

DRAWN BY:
 MPN

CHECKED BY:
 JME

FILE:
 3362.VC_STJONES_Implementation_Fig4.mxd

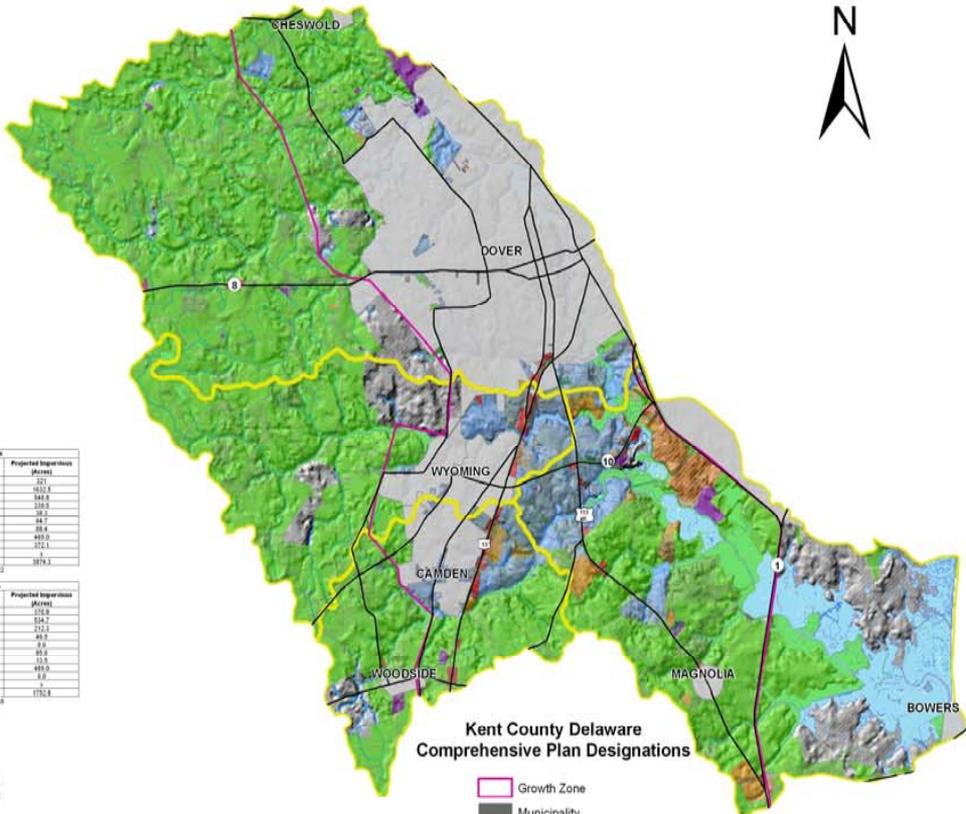
**ST. JONES RIVER WATERSHED
 PROJECTED BUILD-OUT
 KENT COUNTY - DELAWARE**

DATE:
 AUGUST 2008

SCALE:
 AS SHOWN

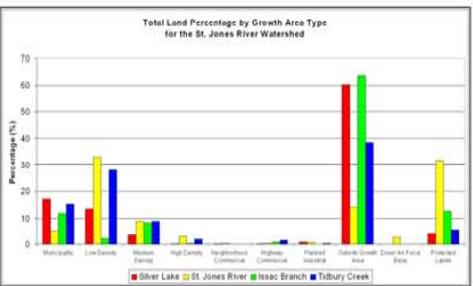
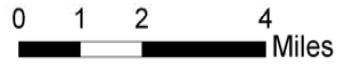
PROJECT NO:
 3362.VC

SHEET:
 FIGURE 4



**Kent County Delaware
 Comprehensive Plan Designations**

- Growth Zone
- Municipality
- Low Density
- Medium Density
- High Density
- Dover Air Force Base
- Neighborhood Commercial
- Highway Commercial
- Industrial
- Protected Areas
 (All Federal lands, State Lands, agricultural easements, private conservancy lands, major wetlands and lands preserved by other conservation easements)



ST. JONES RIVER WATERSHED BUILD-OUT STATISTICS

Silver Lake Sub-watershed Statistics		
Municipality	Total Acres	Estimated Existing Impervious (Acres)
Municipality	1058.8	297.7
Low Density	2193.6	196.1
Medium Density	708.0	38.4
High Density	29.7	3.8
Neighborhood Commercial	19.8	8.8
Highway Commercial	48.7	28.8
Planned Industrial	162.1	38.8
Outside Growth Area	12424.8	852.4
Dover Air Force Base	6.1	0.8
Protected Lands	378.7	118.8
Total Acres	20467.2	2068.8

Estimated Dwelling Units Calculated on the build-out scenario = 25,269

St. Jones River Sub-watershed Statistics		
Municipality	Total Acres	Estimated Existing Impervious (Acres)
Municipality	844.8	212.8
Low Density	2443.6	408.8
Medium Density	1448.2	228.8
High Density	102.0	127.8
Neighborhood Commercial	45.1	27.8
Highway Commercial	76.1	37.8
Planned Industrial	122.1	27.8
Outside Growth Area	2248.8	258.8
Dover Air Force Base	427.7	108.8
Protected Lands	328.2	38.8
Total Acres	10193.8	1399.8

Estimated Dwelling Units Calculated on the build-out scenario = 27,322

Issac Branch Sub-watershed Statistics		
Municipality	Total Acres	Estimated Existing Impervious (Acres)
Municipality	1044.8	228.8
Low Density	208.8	38.8
Medium Density	148.8	118.8
High Density	29.8	3.8
Neighborhood Commercial	2.8	1.8
Highway Commercial	74.8	32.8
Planned Industrial	1.8	1.8
Outside Growth Area	1718.8	448.8
Dover Air Force Base	2.8	3.8
Protected Lands	1144.8	29.8
Total Acres	7054.8	1224.8

Estimated Dwelling Units Calculated on the build-out scenario = 12,227

Tibbury Creek Sub-watershed Statistics		
Municipality	Total Acres	Estimated Existing Impervious (Acres)
Municipality	815.8	228.8
Low Density	1782.2	108.8
Medium Density	308.2	27.8
High Density	123.8	11.8
Neighborhood Commercial	8.8	2.8
Highway Commercial	39.8	34.8
Planned Industrial	18.8	6.8
Outside Growth Area	2448.8	104.8
Dover Air Force Base	6.8	2.8
Protected Lands	343.8	4.8
Total Acres	6325.2	668.8

Estimated Dwelling Units Calculated on the build-out scenario = 13,348

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2. THIS MAP WAS GENERATED BY DIGITALLY CONVERTING A FIGURE IN THE 2007 KENT COUNTY COMPREHENSIVE PLAN TITLED "FUTURE LAND USE MAP". THE FIGURE CAN BE FOUND IN CHAPTER TWO MAP 2-2 & ONLINE AT <http://www.co.kent.de.us/Departments/Planning/Zoning/compplanupdate.htm>

2. PUBLIC AND MANAGED LAND AREAS TAKEN FROM MULTIPLE AVAILABLE PUBLIC DATA SETS OF VARIOUS DATES.

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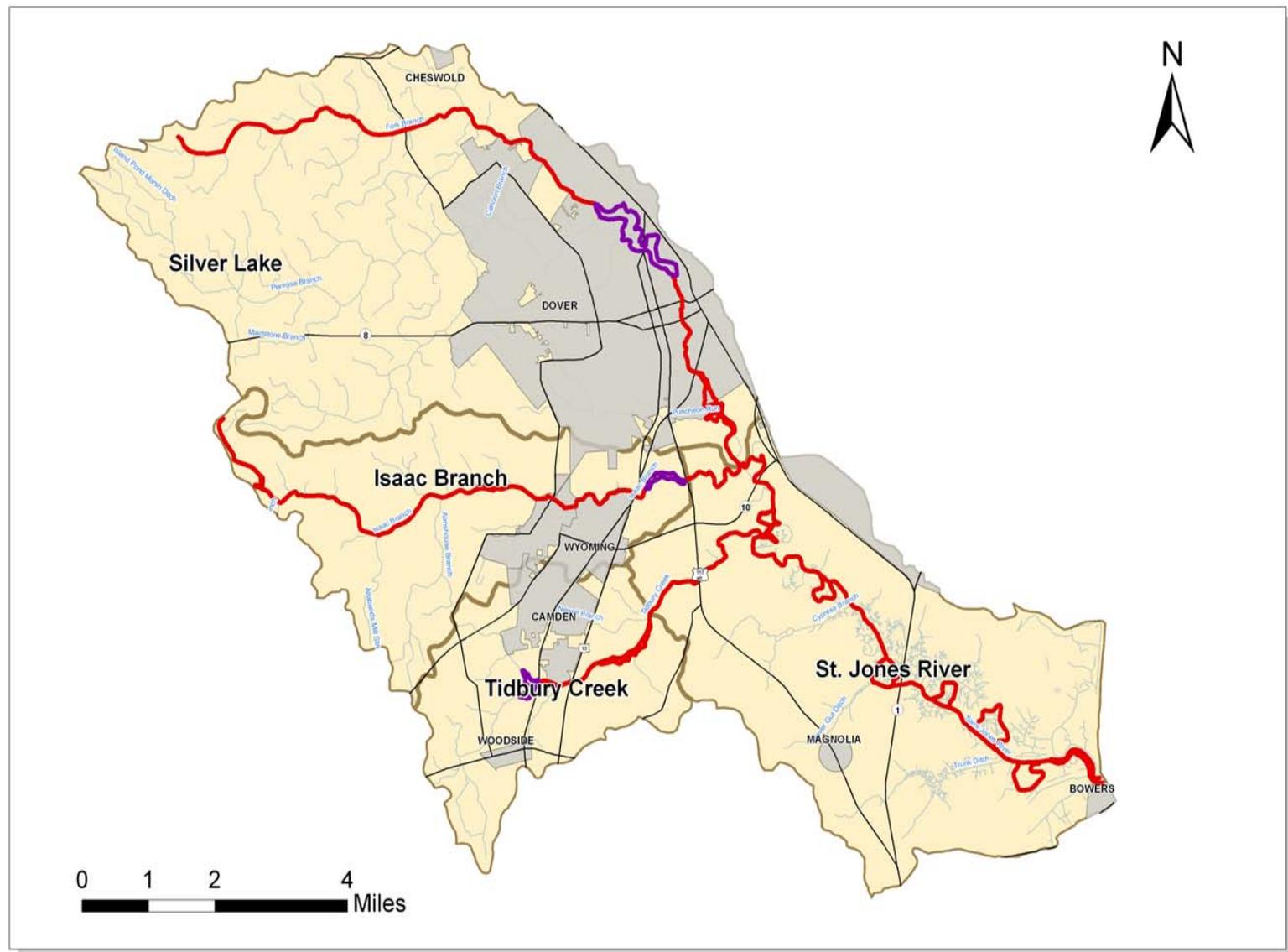


- Legend**
- Sub-watershed Boundaries
 - Municipal Boundaries
 - TMDL Segments**
 - Bacteria, Nutrients
 - Bacteria, DO, Nutrients
 - Non TMDL Stream Segments
 - Major Roads

SOURCE:
 Publicly available spatial datasets, clipped
 by Duffield Associates, Inc.
 DRAWN BY:
 MPN
 CHECKED BY:
 JME
 FILE:
 3302WC_StJones_Implementation_
 Fig5.mxd

ST. JONES RIVER WATERSHED
EPA 303(d) TMDL
IMPAIRED STREAMS
KENT COUNTY - DELAWARE

DATE:
 AUGUST 2008
 SCALE:
 AS SHOWN
 PROJECT NO:
 3362.WC
 SHEET:
 FIGURE 5



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 2. THIS FIGURE IS ADAPTED FROM SEGMENTS LISTED IN THE "ST. JONES RIVER WATERSHED PROPOSED TMDL" DATED AUGUST 2008.

Baseline Assessment

Broadkill

- Forest/Agriculture to Residential (97-07)
- Bacteria/DO/Nutrients
- Projected Increase in Impervious (all sub-watersheds)

St Jones

- Agriculture to Residential (97-07)
- Bacteria/DO/Nutrients
- Projected Increase in Impervious (all sub-watersheds)

Pollution Control Opportunities

The identification of potential pollution control opportunities within the Watershed using the recommended types of approaches identified in the Baseline Assessment for the documented impairments:

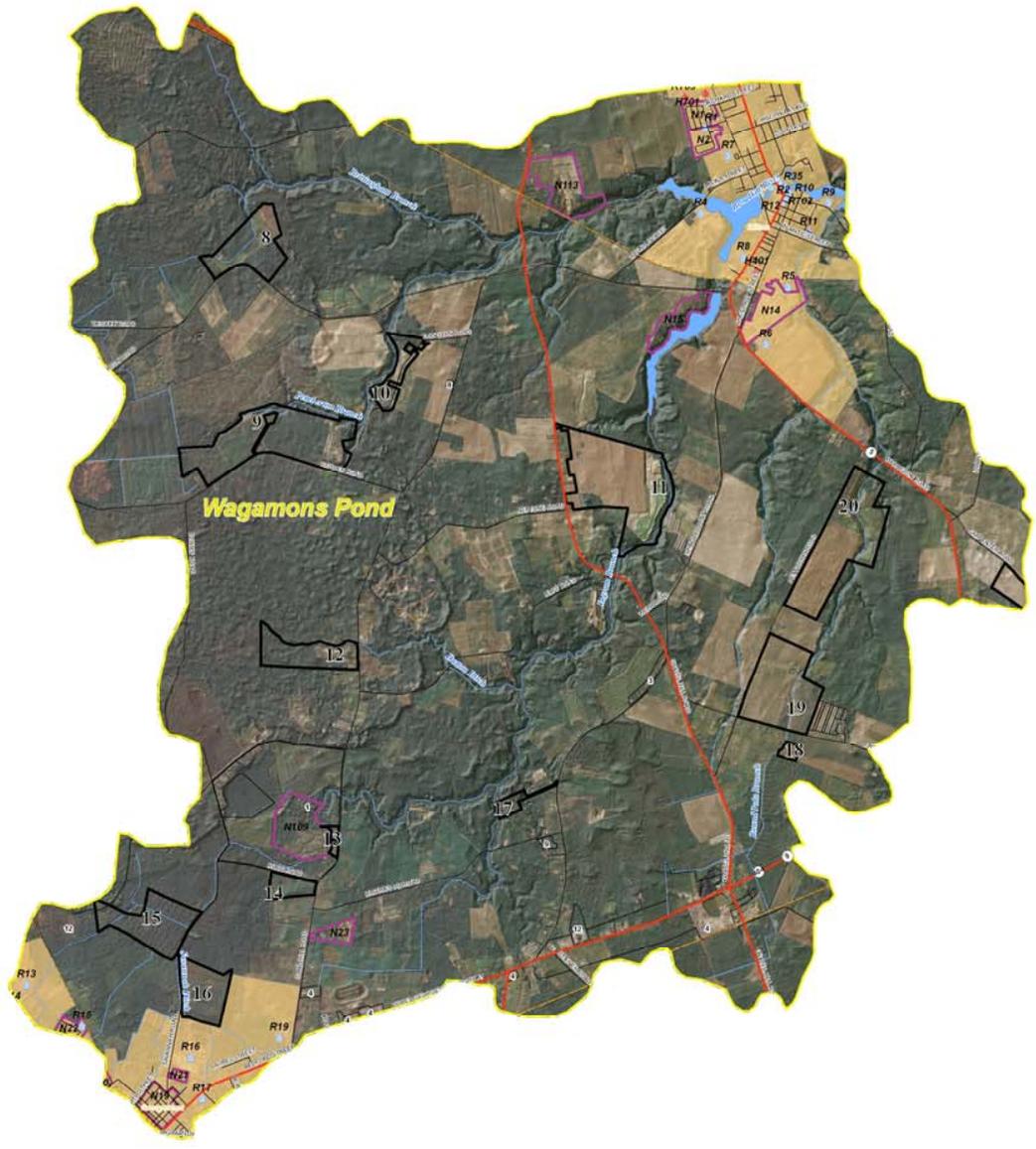
- Review of published studies
- Stakeholder input
- Generating and analyzing GIS databases
- Field reconnaissance by technical professionals

PCO – Broadkill River

- 109 Upland sites reviewed:
 - Retrofits in urban areas
(bioswales, rain gardens, tree planting)
 - Neighborhoods
(better open space management, retrofits)
 - Hotspots
(gas stations, hardware store better site management of materials)

PCO – Broadkill River

- Thirty (30) Watershed Management Water Quality (WMWQ) sites reviewed:
 - Aquatic Buffers
 - Wetland/floodplain creation or restoration
 - Stormwater infiltration
 - Stream channel improvements
 - Land preservation
 - Flood control



NOTES

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2. RESTORATION/RETROFIT SITES IDENTIFIED BASED ON DESKTOP REVIEW AND FIELD RECONNAISSANCE (TECHNICAL MERIT). NOT ALL SITES COORDINATED WITH OWNERS TO DATE.

0 0.5 1 1.5 2 Miles

DUFFIELD ASSOCIATES
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OFFICES IN DELAWARE, MARYLAND, PENNSYLVANIA, AND NEW JERSEY

Legend

- Municipal Boundary
- Broadkill Watershed Boundary
- Broadkill Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad
- Retrofit Site
- Hotspot
- Neighborhood Site
- Potential Restoration Parcel

SOURCE:
2006 USDA NAIP AERIAL DRAPED OVER
USGS 30M 3-DEGREE BARE EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME

FILE:
3362WC_Broadkill_Implementation_
Fig 13.mxd

WAGAMONS POND SUBWATERSHED

POLLUTION CONTROL OPPORTUNITIES

SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

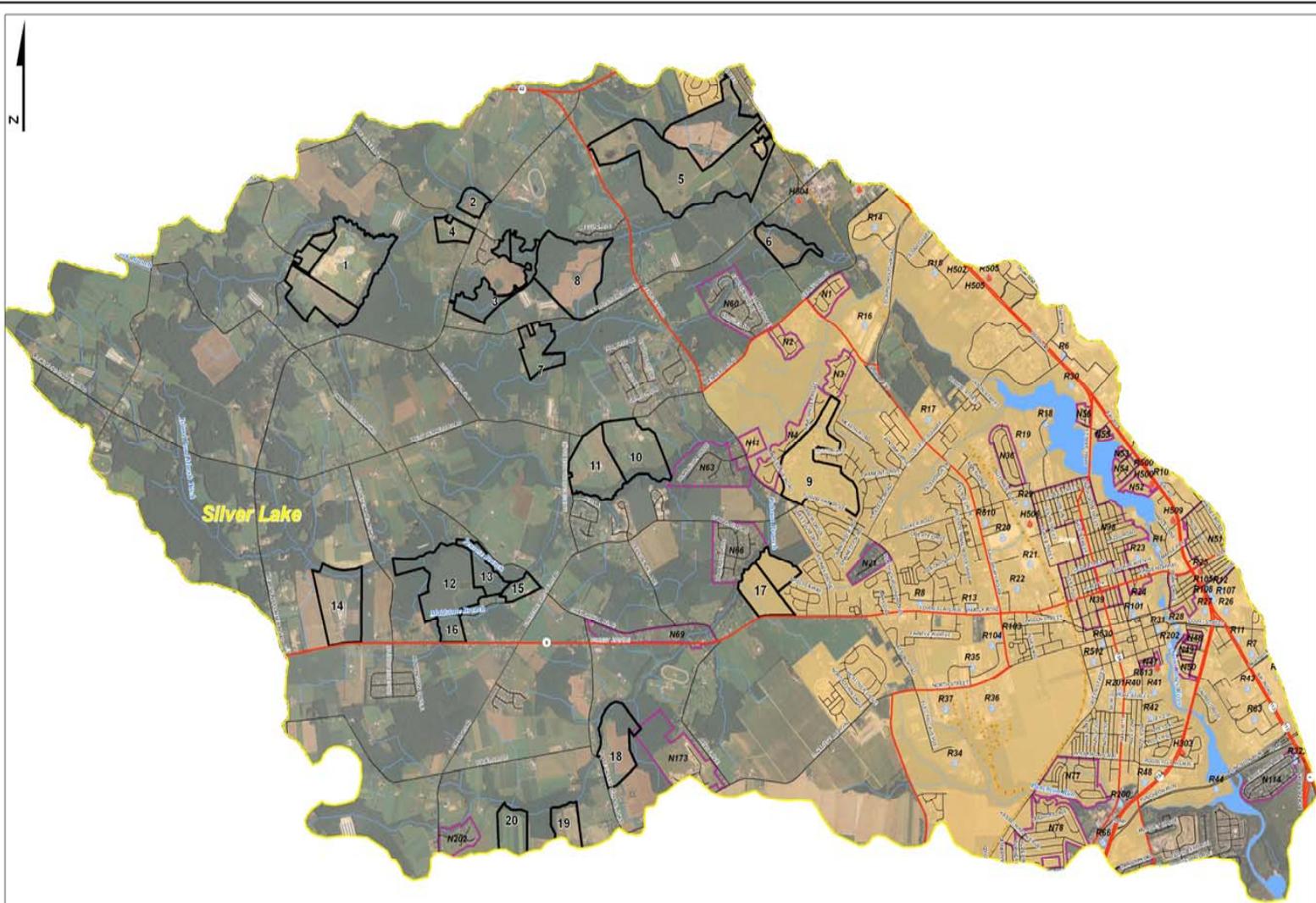
SHEET:
FIGURE 13

PCO – St. Jones River

- 132 Upland sites reviewed:
 - Retrofits in urban areas
(bioswales, rain gardens, tree planting)
 - Neighborhoods
(better open space management, retrofits)
 - Hotspots
(gas stations, hardware store better site management of materials)

PCO – St. Jones River

- Twenty Six (26) Watershed Management Water Quality (WMWQ) sites reviewed:
 - Aquatic Buffers
 - Wetland/floodplain creation or restoration
 - Stormwater infiltration
 - Stream channel improvements
 - Land preservation
 - Flood control



Legend

- Municipal Boundary
- St. Jones Watershed Boundary
- St. Jones Subwatershed Boundary
- Water Body
- Stream or River
- Road
- Road
- Railroad
- Retrofit Site
- Hotspot
- Neighborhood Site
- Potential Restoration Parcel

BASEMAP:
2006 USDA NAIP AERIAL

DRAWN BY:
ADK

CHECKED BY:
JME/DJ

FILE:
302514C_StJones_Implementation_Fig13.mxd

SILVER LAKE SUBWATERSHED
POLLUTION CONTROL OPPORTUNITIES
 KENT COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE:
AS SHOWN

PROJECT NO.
3362.WC

SHEET:
FIGURE 13

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0 0.25 0.5 1 1.5 2 Miles

Pollution Control Opportunities

- Opportunity Reporting
 - Watershed-wide
 - Sub-watershed
 - Technology
 - Jurisdiction
- Preservation Corridors
 - identified within each sub-watershed.

Legend

- Protected Lands**
- Federal
 - Municipal
 - Private Conservation
 - State Park (SP)
 - State Forest
 - State Forest (SFA)
 - Fish and Wildlife Area
 - Timber Conservation Easement
 - Agricultural Preservation
 - Municipal Boundary
 - Broadkill Watershed Boundary
 - Broadkill Subwatershed Boundary
 - Water Body
 - Stream or River
 - Road
 - Railroad
 - Potential Corridors for Preservation Opportunities

BASEMAP:
2006 USDA NIP AERIAL DRAPED OVER
USGS 30x30 2-METER BARE-EARTH DEM

DRAWN BY:
ADK

CHECKED BY:
JME/DJ

FILE:
3362WC_Broadkill_Implementation_
Fig2.mxd

BROADKILL RIVER WATERSHED
Potential Corridors For Preservation Opportunities
(shown with Existing Holdings)
SUSSEX COUNTY-DELAWARE

DATE:
AUGUST 2008

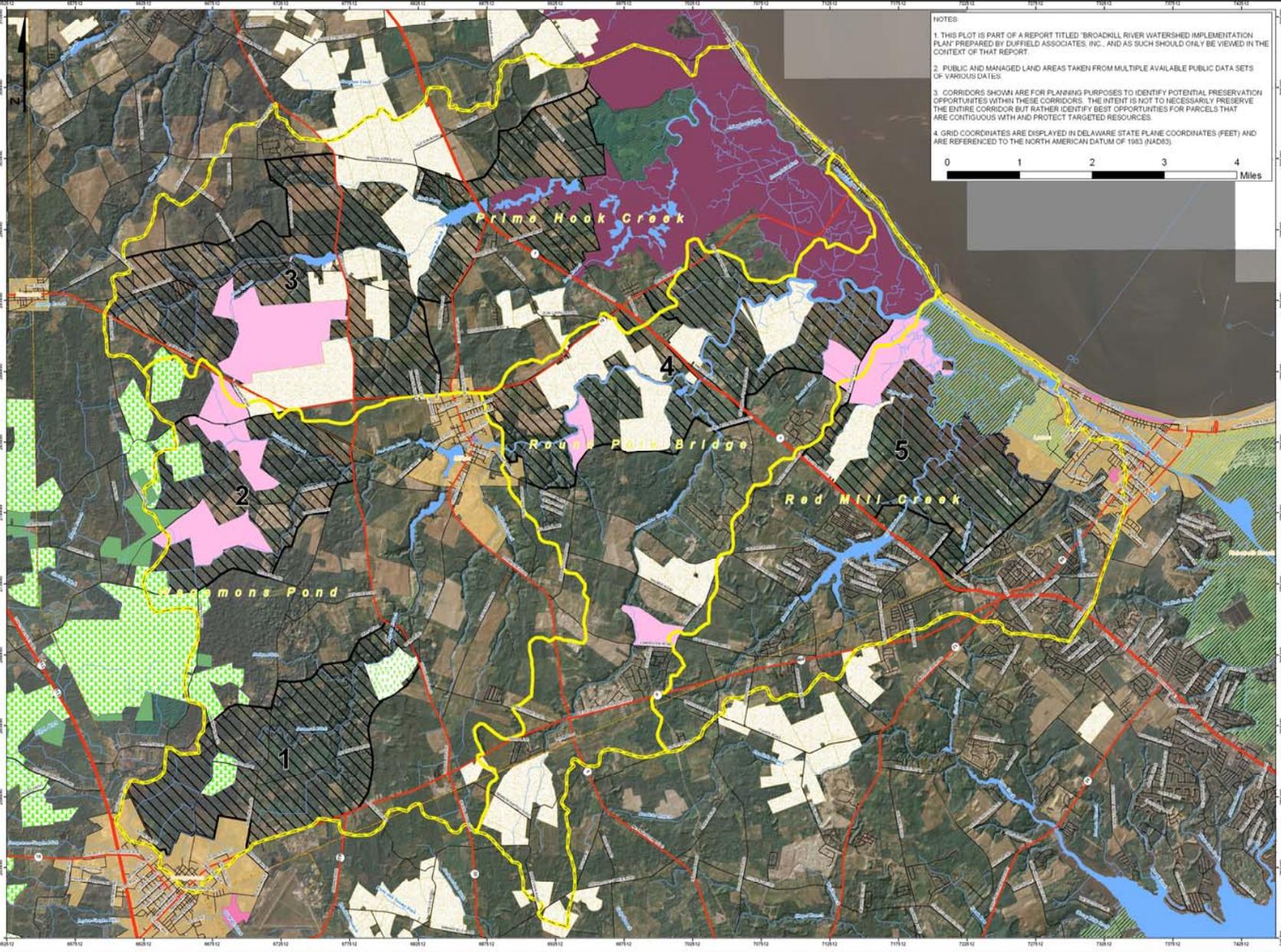
SCALE: 1:36,000
1 inch equals 3,000 feet

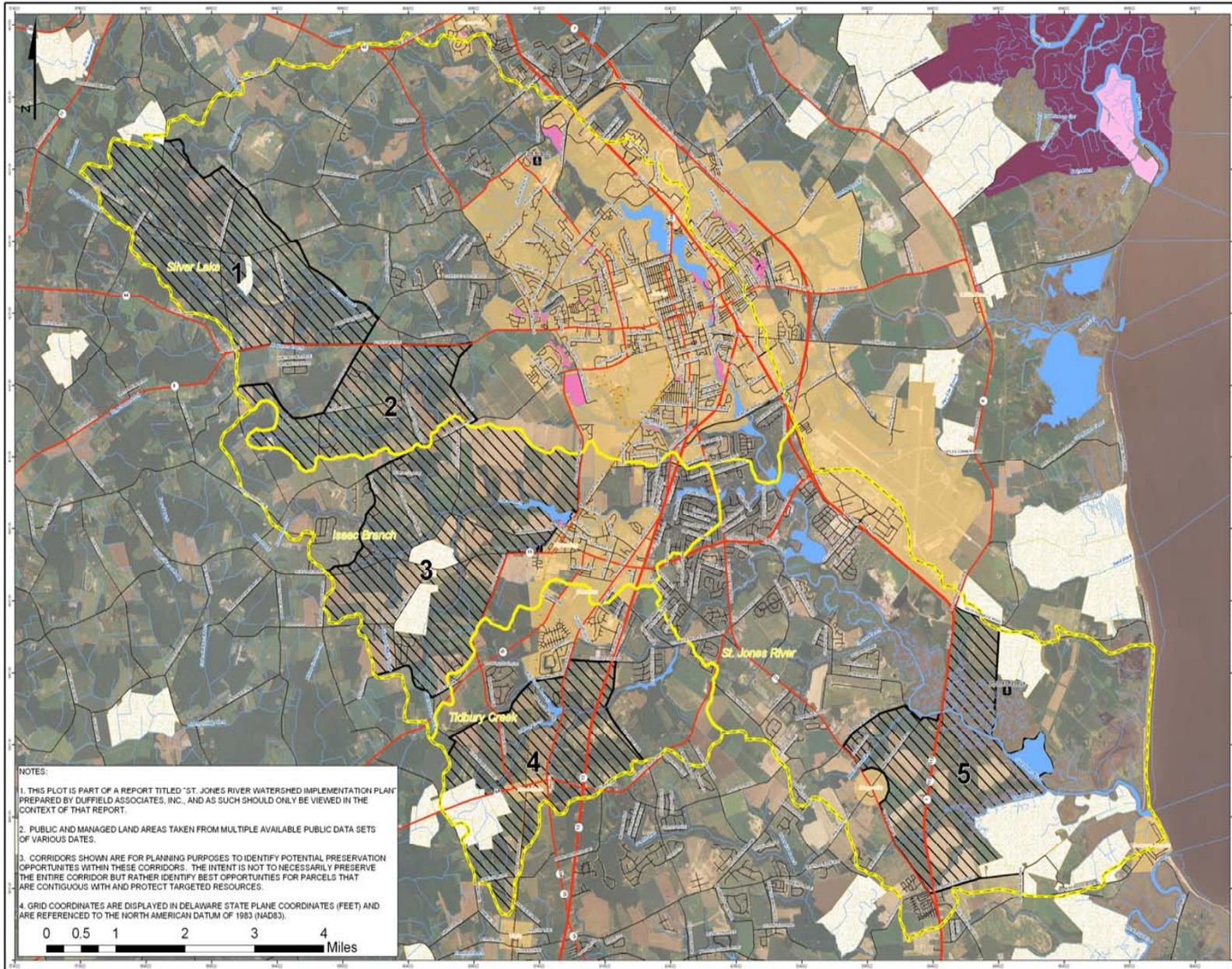
PROJECT NO.
3362 WC

SHEET:
FIGURE 6

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3. CORRIDORS SHOWN ARE FOR PLANNING PURPOSES TO IDENTIFY POTENTIAL PRESERVATION OPPORTUNITIES WITHIN THESE CORRIDORS. THE INTENT IS NOT TO NECESSARILY PRESERVE THE ENTIRE CORRIDOR BUT RATHER IDENTIFY BEST OPPORTUNITIES FOR PARCELS THAT ARE CONTIGUOUS WITH AND PROTECT TARGETED RESOURCES.
4. GRID COORDINATES ARE DISPLAYED IN DELAWARE STATE PLANE COORDINATES (FEET) AND ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD83).





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0 0.5 1 2 3 4 Miles



DUFFIELD ASSOCIATES
Consultants in the Geosciences

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MILLSBORO, DELAWARE
FAC. DESIGNATION

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E-MAIL: DUFFIELD@DUFFIELD.COM

Legend

Protected Lands

- Federal
- Municipal
- Private Conservation
- Nature Preserve
- Agricultural Preservation
- Municipal Boundary
- St. Jones Watershed Boundary
- St. Jones Subwatershed Boundary
- Water Body
- Stream or River
- Route
- Road
- Railroad

Potential Corridors for Preservation Opportunities

BASEMAP:
2006 USDA NAIP AERIAL

DRAWN BY:
ADK

CHECKED BY:
JME/DJ

FILE:
3362WC_StJones_implementation_Fig.mxd

ST. JONES RIVER WATERSHED

Potential Corridors For Preservation Opportunities
(Shown with Existing Holdings)

KENT COUNTY-DELAWARE

DATE:
AUGUST 2008

SCALE: 1:36,000
1 inch equals 3,000 feet

PROJECT NO.
3362.WC

SHEET:
FIGURE 6

Implementation Plan

Strategy/Plan Goals

- EPA Criteria a through i

Sub-watershed Strategies

Jurisdiction Strategies

Implementation Strategies/Recommendations

- Ranking basis (high to low)
- Technology
- Sub-Watershed focus

DNREC Project Goals

EPA Criteria A Through I: Section 319 Funding

- a) Causes and Sources of Degradation
- b) Estimate of Load Reductions – by Subcategory
- c) Description of NPS Management Measures
- d) Estimate of Technical/Financial Assistance
- e) Information/Education
- f) Schedule for Implementation
- g) Description of Interim/Measurable Milestones
- h) Criteria Demonstrating Substantial Progress
- i) Monitoring

Monitoring

Monitoring Plan Elements

- a) Project (Performance Monitoring)
- b) Sentinel Stations
- c) Illicit Discharge Monitoring
- d) Project Tracking
- e) Reassessment of Watershed Status

Implementation Plan

QUESTIONS AND DISCUSSION

Implementation Plan

- Any sites that should be included?
- Any thoughts on the various implementation approaches?
- How quickly can we get comments back?
- Who wants to review any of the documents in detail?