Sucker Brook

Stream Corridor and Watershed Survey

Bangor and Hampden, Maine

October 2014

Prepared by:

FB Environmental Associates
97A Exchange Street, Suite 305,
Portland, ME 04101
www.fbenvironmental.com

Prepared for:

City of Bangor
73 Harlow Street
Bangor, ME 04401
www.bangormaine.gov

Sucker Brook

Stream Corridor and Watershed Survey

Prepared by FB Environmental Associates
in cooperation with the City of Bangor, the Town of Hampden,
and the Maine Department of Environmental Protection

October 2014

Contact:
Wynne Guglielmo, Environmental Coordinator
City of Bangor ~ 73 Harlow Street
Bangor, Maine 04401
(207) 949-3819

Cover photos (clockwise from top left): Sucker Brook (Reach 1), Sucker Brook culverts with Greg Beane (Reach 4), Lotic Inc. staff at Sector 3, Sucker Brook (Reach 3). Source: City of Bangor

TABLE OF CONTENTS

FIGURES AND TABLES

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

Thank you to the following people and organizations for their assistance with completing the stream corridor and watershed surveys:

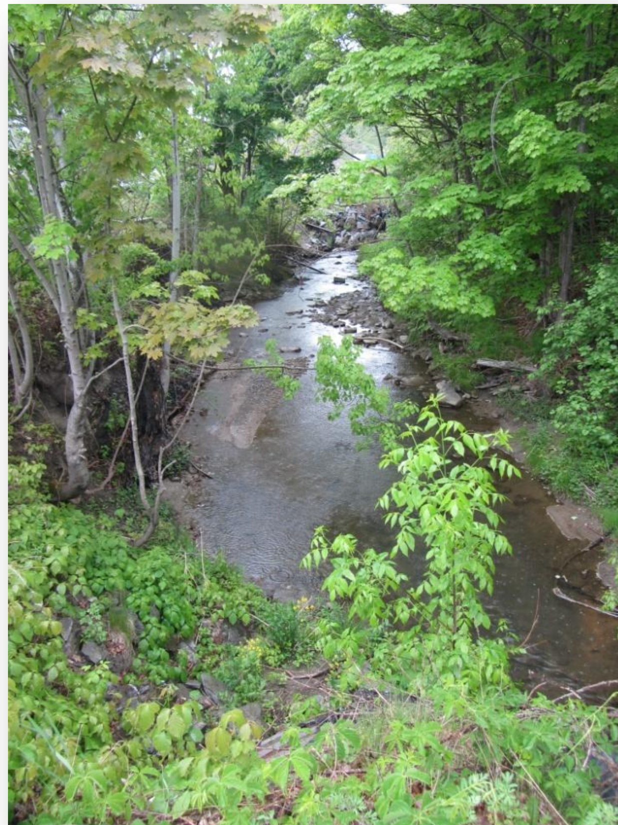
Stream Corridor Survey
Allen Rogers
Arthur Dijanic-Rogers
Corey Dill, Dexter High School Student
Elyse Dill, City of Bangor Intern EMCC
Greg Beane, Maine DEP
Wynne Guglielmo, City of Bangor

Watershed Survey
Angie Dijanic-Rogers, PhD
Elyse Dill, City of Bangor Intern EMCC
Greg Beane, Maine DEP
Jeff Dennis, Maine DEP
John Tipping, Lotic, Inc.
Laura Pasquine, City of Bangor Intern/ Civil Engineering Student, University of Maine
Wynne Guglielmo, City of Bangor

GIS/Mapping Support
Gretchen Heldmann, Town of Hampden
Peralie Burbank, City of Bangor
Sean Gambrel, City of Bangor

Technical Report Writing
Forrest Bell, FB Environmental
Jennifer Jespersen, FB Environmental
Sabrina Vivian, FBE Intern/University of Maine Student

Funding
Maine Department of Environmental Protection
City of Bangor, Maine
Town of Hampden, Maine



1. BACKGROUND

Sucker Brook is a small tributary to the Penobscot River, flowing from Bangor into Hampden, Maine. The brook begins near the southeastern end of the runway at Bangor International Airport, flows south through the exchanges of I-95, I-395, and US Rt. 2, and enters Hampden in a semi-forested area adjacent to industrial development off of Route 202 in Hampden. The brook continues under Route 202, passing through a mix of agricultural, residential, and commercial development before entering the Penobscot River at Hampden's waterfront marina and park area.

View of an undeveloped section of Sucker Brook near Route 202 in Hampden, Maine.

The Sucker Brook watershed covers approximately 2.76 mi^2 (1,766 acres). The brook itself is approximately 3 miles long; 2.5 of which are listed on the State of Maine's list of impaired waters based on benthic macroinvertabrate bioassessments and dissolved oxygen (Maine DEP, 2012a). In 2002, the Maine Department of Environmental Protection (Maine DEP) classified Sucker Brook as a Class B freshwater stream[1]. In 2010, the stream's water quality standard came into question when data collected downstream of Old County Road suggested that the dissolved oxygen and aquatic life use was not meeting the standard of a Class B stream (Maine DEP, 2010)

In 2012, Maine DEP published a ***Total Maximum Daily Load (TMDL)*** Assessment Summary which determined that the largest source of stream channel alteration and pollution to Sucker Brook is stormwater runoff from ***impervious cover (IC)*** within the watershed (Maine DEP, 2012b). The Sucker Brook watershed currently has an impervious cover of approximately 25%. The TMDL determined that in order for the brook to support Class B aquatic life use, the watershed requires the characteristics of a watershed with 8% impervious cover. An 8% impervious cover represents a 68% reduction in stormwater runoff volume and associated pollutants when compared to the load that is currently being delivered to the brook.

Total Maximum Daily Load (TMDL) *is the total amount of a pollutant that a water body can receive and still meet water quality standards.*

Impervious Cover (IC) *refers to surfaces that do not absorb rain and may direct large volumes of stormwater into the stream. These include roads, parking lots, rooftops, and driveways.*

[1] *Water quality in Sucker Brook must meet Class B standards as defined under Maine's Water Classification Program as designated by the Maine Legislature (Title 38 MRSA 464-468). The Maine Legislature also defined designated uses for all classified waters, which state that "Class B waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life."*

A combined stream corridor survey and watershed assessment for Sucker Brook will help to identify the many sources of pollutants in urban stormwater that is resulting in the water quality impairments (dissolved oxygen and aquatic life use). The survey was designed to identify and evaluate sources of soil erosion, habitat loss and unstable stream banks caused by excessive stormwater runoff. The surveys were conducted over the fall and summer of 2013, with follow-up work in the spring of 2014. This report presents the findings of both the stream corridor and watershed surveys.

2. SITE CONDITIONS

2.1 Topography

The elevation of Sucker Brook ranges from approximately 129 feet above sea level at the upper watershed near the Bangor International Airport, to approximately five feet above sea level at its confluence with the Penobscot River in Hampden. The stream is low gradient, with many areas of slow moving water. Steep banks are common among all of the reaches.

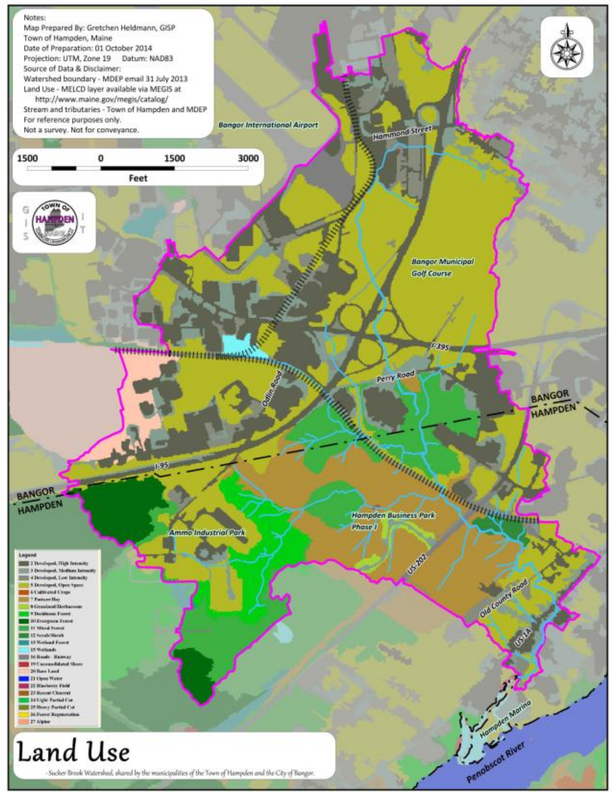


Figure 1. *Land uses in the Sucker Brook watershed. (Map 1, Appendix C)*

2.2 Land Use

Developed land makes up 69% of the total area of the Sucker Brook watershed. Developed open space makes up the largest area of the developed land (33%), followed by high intensity development (23%), medium intensity development (8%) and low intensity development (5%). Only 13% of the watershed is forested.

Several well-known landmarks in the watershed include the Bangor Municipal Golf Course in the northeast corner of the watershed, and Bangor International Airport in the northwest corner of the watershed. Large areas of industrial development make up the area between Odlin Road and I-95 in Bangor, along with Ammo Industrial Park and the Hampden Business Park, south of I-95 in Hampden. Residential development is largely restricted to the south-east corner of the watershed, south of Route 202, near the confluence of Sucker Brook and the Penobscot River in Hampden. Agricultural land is prominent in this area as well.

Example of a large area of impervious cover in the Sucker Brook watershed south of I-395.

2.3 Impervious Cover

Development within a watershed can greatly affect the water quality and health of a stream. Urbanized watersheds are usually less healthy than watersheds with a higher proportion of forestland and natural habitat. The urbanization of watersheds has a detrimental effect on watersheds largely due to the presence of impervious cover (roads, parking lots, driveways, rooftops, etc.), which prevents rainwater from being absorbed by the soil. As rainwater flows directly over the impervious areas, it picks up a wide range of pollutants such as nutrients, metals, hydrocarbons, bacteria and pathogens, fertilizers and pesticides, salt and sand, and trash and debris, and delivers it directly to the nearest waterbody- in this case, Sucker Brook.

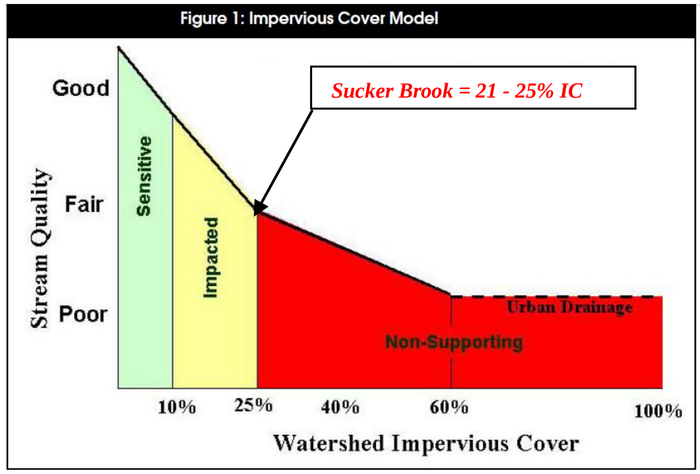


***Figure 2**. The Impervious Cover Model, showing the relationship between percent impervious cover and stream quality. (Source: CWP, 2003)*

There is a direct correlation between an increase in the percentage of impervious cover in a watershed and decreasing stream health (CWP, 2003). Studies of urban streams indicate that when impervious cover exceeds 10% of the watershed area, then streams begin to be affected by the development (Figure 2). A more recent study links high levels of impervious cover (>20%) to decreased summer base flow as a result of decreased groundwater recharge (Kauffman et al., 2008), which could have major implications on aquatic life in streams.

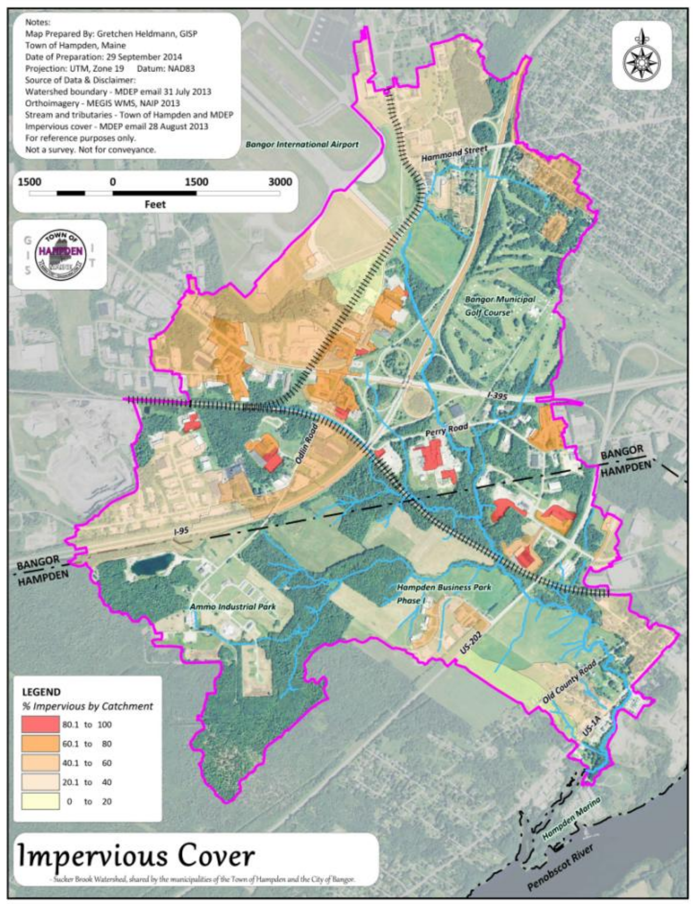


***Figure 3**. Impervious cover in the Sucker Brook watershed. (Map 2, Appendix B)*

The Sucker Brook watershed is considered highly impervious, with an impervious area of approximately 25-30%.[2] According to the Center for Watershed Protection Impervious Cover (IC) Model, at 25% streams move from "impacted", to non-attaining (or impaired). IC in the Sucker Brook Watershed is at the threshold between impacted and impaired. Under state and federal water quality regulations, Sucker Brook is

[2] The Maine DEP Impervious Cover TMDL calculated IC in the Sucker Brook watershed at 25%. In 2013, the Maine DEP conducted an assessment of IC in the watershed, and estimated IC at 22% (see Table 1).

required to meet Class B standards for aquatic life use. In order to meet that standard, the watershed should be retrofitted to reflect the characteristics of a watershed with 8% impervious cover - equivalent to a 68% reduction in stormwater runoff volume. This can be accomplished using a variety of Stormwater Best Management Practices such as stream buffers, rain gardens, bioretention devices, or pervious parking.

Maine DEP conducted a detailed analysis of IC in the watershed to determine the types and extent of IC in the watershed (Figure 3, Table 1). The analysis indicates that parking lots, roads and buildings make up 86% of the total IC in the watershed, and cover approximately 19% of the land area in the watershed. In general, the western portion of the watershed is of greatest concern due to the large areas of IC.

Table 1. *Sucker Brook Impervious Cover Analysis.*[3]

Sucker Brook Watershed Impervious Analysis (Acres)			
Type/Location	**Total Area (Acres)**	**Total IC (%)**	**% of Total Watershed**
Parking	162.8	42.3	9.3
Road	98.7	25.7	5.6
Building	67.6	17.6	3.9
Airport	25.7	6.7	1.5
Driveway	16.4	4.3	0.9
Sidewalk	7.3	1.9	0.4
Quarry Pit	5.9	1.5	0.3
Total Impervious	**384**	**100%**	**22%**

3. STREAM CORRIDOR SURVEY

The Level 1 stream corridor survey (SCS) was conducted in August 2013 to identify and assess elements of aquatic habitat within Sucker Brook. Survey methods were based on protocols developed by EPA’s Regional Office in Seattle, Washington, and modified by Maine Department of Inland Fish and Wildlife's (MDIFW) Fisheries Research Section (Bangor, Maine) and Maine DEP’s *Maine Stream Team Program*. The stream corridor survey consisted of documenting visual observation of stream habitat characteristics, wildlife present, and gross physical attributes of the stream. A simple in-stream macro-invertebrate evaluation was also performed.

The survey consists of two major parts: 1) A Rapid Habitat Assessment (RHA), and 2) a Rapid Geomorphic Assessment (RGA). The design of the stream corridor survey methods and analyses are biased towards small to medium-sized wadeable streams and rivers.

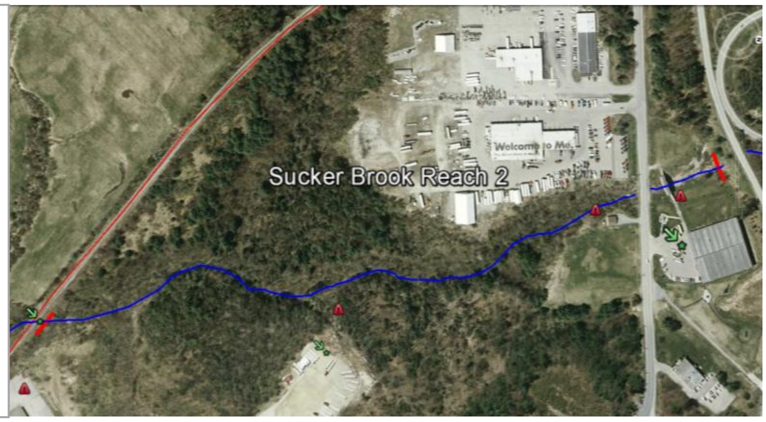
3.1 Rapid Habitat Assessment (RHA) Methods

Sucker Brook was divided into four stream reaches with a total of ten survey sites; four within Reach 1, three within Reach 2, two within Reach 3 and one within Reach 4 (next page).

[3] Maine DEP conducted an impervious cover analysis of the Sucker Brook watershed in 2013. The analysis included a breakdown of IC by cover type, and by subwatershed.

Reach 1: Reach 1 extends from the southern end of the runway at Bangor International Airport, through the I-95/I-395 interchange, and ends just past the culvert under the I-95N /I-395 exit ramp. This reach includes 6 culverts and a large area of impervious cover south of Odlin Rd. Reach 1 survey results were divided into four subreaches (1-1 through 1-4).

Reach 2: This reach extends from just below the I-95 exit ramp by the transportation museum, to the railway. It includes one road crossing and a large mixed forested floodplain. Reach 2 includes three subreaches (Reach 2-1 through 2-3).



Reach 3: The third reach extends from the rail line to the entrance to the Lane Construction yard. It includes four major road crossings and the Perry Farm, which did not allow access for this survey (right). Reach three includes two subreaches (Reach 3-1 and 3-2).

Reach 4: The last reach extends from the entrance of the Lane Construction yard to the culvert under the Marina Rd. While very short, this reach captures a great deal of stormwater runoff. Below the culvert Sucker Brook is tidally influenced.

The brook was apportioned among eight environmental professionals, technical staff, and several trained volunteers over the course of one day. The reaches were delineated based upon length, access, stream conditions, and number of personnel available. Reach 3 differs from the other reaches in that it has a much larger agricultural component than the other reaches. Unfortunately, the survey team did not have access to most of this reach. It is understood that there is a large pasture area with direct access to Sucker Brook, and there has historically been manure input along this reach.

3.2 Rapid Habitat Assessment (RHA) Results

Results of the RHA were tabulated and scored for comparison across stream reaches by site according to the Maine DEP scoring methodology (Varricchione, 2009, right), for each of the major stream characteristics.

Scoring System Used for Sucker Brook Stream Corridor Survey

1 *= problems not apparent/conditions appear to be in Very Good*

2 *= minor problem/conditions appear to generally be Good*

3 *= moderate problem/conditions appear to generally be Fair*

4 *= major problem/conditions appear to generally be Poor*

5 *= severe problem/conditions appear to generally be Very Poor*

Preliminary scores are presented as both tables (Appendix A) and maps (Appendix B, Map 3). All subreaches were scored individually, and then combined into a final reach score to represent each of the four major reaches. Scores are based upon best professional judgment after reviewing the available information such as field notes, photographs, and other observational data (including maps and aerial photographs).

3.2.1 Habitats

Typically, communities of coldwater fish (e.g., salmonids such as brook trout and Atlantic salmon) and other aquatic organisms (e.g., aquatic insects and other benthic (stream bottom) macroinvertebrates, which are food sources for fish) are more robust in streams and rivers having a diverse array of habitats – especially those containing riffles, with gravel and/or cobble substrates, and pools, formed by scouring action behind boulders and downed pieces of large wood (e.g., tree trunks, logs) or other stream processes (Allan and Castillo, 2007). These communities act as continuous monitors of environmental quality over time, because organisms that are more "sensitive" to pollution such as mayflies, caddisflies, dragonflies and stoneflies will be abundant in clean water with lots of dissolved oxygen; whereas, streams with low dissolved oxygen and lack of suitable habitat will have less of the sensitive organisms, and more of the "tolerant" organisms such as blackflies, midges, aquatic worms, and snails.

Example of different habitat types in Reach 3.

Examination of the in-stream characteristics of Sucker Brook indicates that the presence of habitat varies by stream reach. Reach 3 was found to have the most habitats present (pools, riffles, runs, cascades, and rapids), while Reach 1-1, a subreach of Sector 1, had the least (pools only). All other reaches (or subreaches as is the case for Reach 1 with four subreaches), had at least two or three habitats present. The most prevalent habitats include pools, riffles and runs. Average pool depth was between 1-2 ft. with the exception of reach subreach 1-3 and 3-2 with average pool depth greater than 2 ft. The most number of pools greater than 2 ft. were documented in Reach 3 (7 pools), and Reach 4 (12 pools). Deeper pools such as those documented in the lower reaches of Sucker Brook provide habitat for fish to spawn and rear their young. Reaches with low frequency of deep pools may be the result of aggradation (see RGA Results, Section 2.3).

3.2.2 Nature of Particles in Stream Bottom/Embeddedness

Stream Bottom (substrate) Material Size Classes:

Size Class	Millimeters	Inches	Approximate Relative Size
Bedrock	> 2048	> 80	Bigger than a car ; (a.k.a. ledge)
Boulder*	> 256	> 10.1	Bigger than a basketball
Cobble	64 – 256	2.5 - 10.1	Tennis ball to basketball
Gravel	2 – 64	0.08 – 2.5	Peppercorn to tennis ball
Sand	0.06 – 2.00	0.002 – 0.08	Salt to peppercorn
Silt	< 0.06	< 0.002	Finer than salt

* * Some scientists break out another group within the boulder category as "Rubble", which range from approximately from 10 to 20 inches in diameter (i.e., small boulders; larger than a basketball but smaller than a beach ball).

Of particular concern is the extent of embeddedness. Embeddedness refers to the extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish decreases. Embeddedness is a result of large-scale sediment movement and deposition. Rocks and snags provide fairly stable anchoring/attachment sites for macroinvertebrates, algae, and aquatic plants. When the spaces found between rocks and snags are not embedded, these types of substrates provide well-oxygenated spawning (egg-laying) sites for salmonids and excellent habitat for macroinvertebrates(food source for fish).

Half of the reaches were dominated by silt/clay/mud (1-1, 1-2, 2-3, 3-1, 3-2), three were comprised mainly of cobble (1-3, 1-4, 4). Rubble or boulders were present at reaches 1-3, 1-4, 3-1, and 4. Bedrock was not documented within any of the reaches.

Example of gravel and cobble substrate in Reach 4.

Overall, the extent of embeddedness through the stream varied from "not embedded" to "completely embedded". The most common extent was "mostly embedded" (75% of substrate embedded) (1-3, 1-4, 3-1, 3-2). Only reach 2-3 was determined to be "completely (100% embedded". This may be due in part to the steeply sloping banks (>30%) and undercut banks in this section which has resulted in a wide, shallow channel. Stream bottom conditions ranged from Good (Reach 4), to Poor (Subreaches 1-1, 1-2, 2-3, 3-1, 3-2). The remaining reaches scored Fair (Table A1, Appendix A).

3.2.3 Woody Debris

Large pieces of wood in streams and small rivers help form pools and provide cover (important habitat needs of salmonids; Flebbe and Dolloff, 1995), as well as trap leaves and twigs, which are an important food source for macroinvertebrates, which are a common food source for fish. Woody debris in Sucker Brook ranges from few to plentiful. The majority of the upper and lower reaches of the stream were found to have "few" coarse woody debris (Subreaches 1-1 through 1-3, Reach 3, and Reach 4), while the middle portion of the stream was characterized as having "many" or "plentiful" coarse woody debris (1-4, 2-2, 2-3).

In low-gradient sections of streams and small rivers dominated by fine sediment particles (e.g., sand, silt, or clay) on the stream bottom, large wood can be critical towards the maintenance of diverse communities, since it is essentially the only stable substrate available to aquatic organisms (Smock et al., 1989; Allan and Castillo, 2007).

Example of woody debris in Reach 2.

Some local scientists theorize that the amounts of large wood in rivers and streams in coastal (and perhaps other) regions of Maine may be significantly less than prior to European settlement of North America (Magilligan, et al., in press). (Scientists in other regions around the U. S. have proposed similar hypotheses for their own locales.) Recently, the Maine Forest Service developed standards for placing wood into streams to enhance cold water fisheries habitat (MDOC, 2012). Also, ongoing unpublished research conducted in streams in the White Mountain National Forest region of New Hampshire and Maine has suggested that additions of large wood to high gradient, rocky-bottomed streams in that area has a strong positive effect on brook trout and macroinvertebrate communities. The continued research of the potential benefits of large wood in streams and rivers is expected to have an increasing influence on restoration designs in Maine.

Iron rich brown/orange discharge at Reach 3.

3.2.4 Water Appearance/Odor

The water flowing in Sucker Brook is generally clear with no odor, with occasional algae on rocks in the stream, especially in Reach 1 and Reach 4. Exceptions include reaches in the middle of the stream, where water color was documented as light brown (3-1), dark brown (3-2), foamy (2-2, 3-1, 3-2), smelled of oil (2-2), or had a sheen (2-1, 3-1). Iron-rich water was documented at a few locations in Reach 2 and 3, which may be naturally occurring. Several sites of concern were documented in developed areas (commercial and agricultural) near the stream.

3.2.5 Streamside (Riparian) Vegetation and Water Temperature

Shading of stream waters is important to the health of coldwater fish species (e.g., brook trout and Atlantic salmon) and other aquatic organisms (e.g., aquatic insects and other macroinvertebrates) for a variety of reasons, including the fact that cold water has the ability to retain more dissolved oxygen and create less physiological stress on aquatic organisms (Allan and Castillo, 2007). A generally narrow stream like Sucker Brook has a better chance of having good canopy cover compared to a larger stream or river.

Three of the ten reaches/subreaches documented during the stream corridor survey have 100% shading (1-2, 2-2, 2-3), and five of the ten reaches sites have good riparian cover (75% cover) (1-1, 1-3, 3-1, 3-2, 4). Subreach 1-4 and 2-1 had the least amount of shading at 50%, and 0% respectively.

Example of good (top) and poor (bottom) riparian shading in Reach 2. Bottom photo is near the Cole Land Transportation Museum in Reach 2.

Since riparian cover is directly correlated with stream temperature, the better the shading, the cooler the water temperature and vice versa. Unfortunately, stream temperature was not recorded at any of the reach sites during the survey, so no correlations can be made.

Streamside (riparian) vegetation in Sucker Brook was scored using the Maine DEP scoring methodology (Varricchione, 2009). While riparian cover is one of the most important variables of stream health and habitat, it is not the only variable used to score the streamside vegetation. Other variables include: the extent of small and large woody debris, root wads, types of vegetation present, vegetative overhang, and adjacent land uses, among others. Results were tabulated for comparison purposes (Table A2, Appendix A). Scores for this category ranged from Good (1-2, 2-3) to Poor (1-1, 3-1), while the remainder of the reaches scored Fair.

3.2.6 Streambank and Channel Characteristics

Streambank and channel characteristics include bank shape (vertical or undercut, steeply sloping, gradual or no slope), channel shape, and the extent of artificial (human-made) bank modifications such as rip-rap or retaining walls. The nature of the soils and geology in the watershed, as well as within and adjacent to the stream, play a large role in the condition of the stream channel. For example, rocky streams lined with boulders and cobbles tend to be more stable than a stream comprised of sand, because sand is much lighter and can be picked up and moved easily downstream during high flow conditions.

Stream Width
Sucker Brook

Reach 1	3 ft. - 5 ft.
Reach 2	4 ft. - 9 ft.
Reach 3	4 ft. - 7 ft.
Reach 4	19 ft.

Overall, Sucker Brook is a narrow and relatively shallow stream (3 ft. - 9 ft.), with the exception of a few wide shallow reaches (2-2, 2-3, 3-1), and two narrow and deep reaches (Reach 3-2 and Reach 4). Reach 3 and Reach 4 contain the most number of pools greater than 2 ft. deep (7 pools and 12 pools, respectively). These pools are important because they provide potential habitat for fish.

A majority of the streambank contains vertical undercut banks, or is steeply sloping. With the exception of subreach 2-2, stream banks in all other reaches are either vertical/undercut, or steeply sloping (greater than 30% slope). Evidence of collapsed, eroded or undercut banks was present at a majority of the reaches. Reach 4 was documented as having severe collapsed banks.

Streambank and channel conditions ranged from Good (3-2) to Poor (4). A majority of the reaches ranked Fair (Table A1, Appendix A). Reach survey sites that ranked Poor mainly exhibited 75-100% bank modification and had few pools with no pools greater than two feet deep, with the exception of Reach 4-1.

Examples of artificial bank modification in Reach 3 (top), and Reach 4 (bottom).

Bank modifications were most often related to discharging pipes and culverts, and road crossings which cause erosion and sedimentation in the stream. Keeping riparian forests in good health and in a relatively undisturbed condition will be vital towards the long term protection of Sucker Brook.

3.2.7 Visual Biological Survey

As described in Section 3.2.1, benthic communities act as continuous monitors of environmental quality over time, beyond individual water quality sampling events. The Riparian Habitat Assessment (RHA) was used as a biological survey in this project. The RHA utilized simple visual observations including wildlife, fish, barriers to flow or fish passage, aquatic plants and algae, and presence and types of macroinvertebrates. Several methods were used to collect macroinvertebrates including rock-rubbing, stick-picking, and leaf-pack sorting.

Macroinvertebrates in Sucker Brook were present, but generally rare with the exception of one reach, in which no macroinvertebrates were found.

Evidence of mammals (deer, muskrat, gopher) were documented at fewer than half of the reach survey sites (1-1, 1-3, 1-4, 2-3). Fish were documented at six of the ten reach survey sites (1-1, 1-4, 2-1, 3-1, 3-2, 4), and amphibians were documented at four of the ten reaches (2-2, 2-3, 3-1, 4). Macroinvertebrates were present, but generally rare, at all of the sites with the exception of Reach 2-2 where none were found at all. Water striders, aquatic worms, blackflies, beetle larvae, and snails were the common insects identified. A caddisfly was documented in Reach 4. With the exception of the caddisfly, the other insects found in the stream are typically less sensitive to environmental pollution, and are often dominant in polluted urban streams.

Barriers to fish passage include natural features such as cascades (Reach 3) and culverts (all reaches except Reach 3). A formal fish and culvert survey should be considered in the future to document the valuable fish habitat and specific species and need for fish passage, culvert conditions, and the need for replacing or retrofitting existing culverts. Common problems with culverts include hanging culverts and long stretches of stream sections that have been culvertized; both factors are barriers to fish passage. The ultimate goal for improving culverts is to maintain or replicate natural stream channel or flow conditions, pass peak flows, improve habitat connectivity within Sucker Brook, and comply with state fish passage regulations.

3.2.8 Water Quality and Potential Pollution Sources and Problems

Water quality problems were common in all of the stream reaches in Sucker Brook, some causing more of an impact than others. The most apparent problems were related to the prevalence of stormwater runoff draining from large impervious areas such as roads, parking lots, and commercial and residential areas. Discharging pipes (including storm drain outfalls) and/or ditches that drain directly to the brook are present in all but one (2-3) of the ten surveyed reaches/subreaches. Runoff from stormwater outfalls and impervious areas reportedly has the greatest impact on water quality in Reach 1, while Reach 2, with a large forested buffer, may experience less severe effects from the runoff. Garbage and litter were most severe in and adjacent to the brook in Reaches 1 and 4.

Water quality and potential pollution sources were scored separately for each subreach (Table A3, Appendix A). Water quality ranged from Good (1-2, 1-2, 1-4, 2-1, 2-3) to Poor (1-1, 2-2, 4). The remainder of the reaches scored Fair. With the exception of Reach 2-3 (Very Good), survey results suggest there is a moderate to major problem when it comes to potential pollution sources in Sucker

Brook. However, none of the reaches ranked Severe/Very Poor for water quality and potential pollution sources.

Examples of discharging pipes or stormwater outfalls in Reaches 1, 3 and 4.

3.3 Rapid Geomorphic Assessment (RGA) Methods

The Rapid Geomorphic Assessment (RGA) was the second major component of the stream corridor survey for Sucker Brook. This type of survey is based on methods described in the Maine DEP Stream Survey Manual (Maine DEP, 2009). The RGA provides screening–level information about the fluvial geomorphological characteristics of the stream (shape and stability of the stream system), including the physical processes related to water and sediment transport through the stream system. There are four major geographic processes assessed through this type of survey: aggradation, degradation, widening, and planimetric form adjustment. These are discussed in more detail below. This type of survey is useful for identifying reaches receiving large volumes of stormwater which can cause channel instability, and identify reaches with signs of alteration from human activities. Stream reaches used for this survey were the same as described in 3.1 above. Information gathered from the RGA can be used to target specific stream reaches in Sucker Brook for further assessment and restoration planning.

3.4 Rapid Geomorphic Assessment (RGA) Results

The RGA survey documented four major geomorphic processes:

Soft unconsolidated sediment (causing silty brown color in water), and formation of mid-channel bars was evident in Reach 2.

AGGRADATION occurs when sediment loads accumulate in the stream. This happens when the sediment load increases (due to natural processes or human activities) and the stream lacks the capacity to transport it. Piles of sediment in a stream can re-direct flow against the banks, causing erosion (Maine DEP, 2009). Evidence of aggradation includes several features, including but not limited to: lateral bars, embeddedness, siltation in pools, a soft unconsolidated bed, and evidence of deposition around bank structures. Aggradation was recorded in Sucker Brook at all reaches, except Reach 4 and the lower portion of Reach 3 (3-2). The most common evidence of aggradation in these reaches is a result of substrate embeddedness, mid-channel bars, and siltation in pools.

Elevated tree roots and/or root fans, as seen above in Reach 4, are indicators of degradation.

DEGRADATION occurs when the stream cuts deeper into the land. One result of degradation is that bridge footings can be undermined and exposed. Degradation can sometimes be caused by straightening and shortening a channel, which increases the slope of the stream. The water flows faster down this steeper slope and has extra energy to move sediment, causing the stream channel to cut deeper or degrade. Other causes of degradation include increases in peak flows and frequency due to activities such as poorly planned urbanization, agriculture, and forest practices (Maine DEP, 2009), and an increase in the intensity and volume of rain events.

Evidence of degradation includes elevated tree roots, or root fans above the channel bed, bank height increases, and absence of depositional features such as bars. Degradation was most apparent at Reach 3-2 and Reach 4-1. All other reaches exhibited little to no evidence of degradation.

<u>WIDENING</u> occurs when banks collapse, and the stream becomes wider and shallower. A wider, shallower stream does not have the same capacity to transport sediment, so sediment can build up in the channel. Widening is a process that typically follows aggradation or degradation geomorphic phases. Widening occurs because the stream bottom materials eventually become more resistant to erosion (harder to move) by the flowing waters than the materials in the stream banks (Maine DEP, 2009).

Collapsed streambanks, and buildup of sediment in the stream channel has resulted in a wide, shallow stream in the upstream portion of Reach 3.

Evidence of widening includes fallen or leaning trees or fence posts, large organic debris, exposed tree roots, and steep bank angles throughout the reach, among others. Widening was most evident in Reaches 3-1 and 1-3. All other reaches exhibited some characteristics of widening. It is likely that increased delivery of stormwater has resulted in widening in these reaches.

Example of planimetric form adjustment in Reach 3 showing cut-off channels and mid-channel bars.

<u>PLANIMETRIC FORM ADJUSTMENT</u> is the change that can be seen from the air when looking down at a stream or river, showing that the stream's pattern has changed. This can happen because of human intervention (such as straightening the bends of the stream with heavy equipment). Planform changes also occur during floods. When there is no streambank vegetation with roots to hold soil in place, rivers cut new channels in the weak part of the bank during high water events. When not a result of direct human manipulation, planform adjustments typically are responses to aggradation, degradation, or widening geomorphic phases (Maine DEP, 2009).

Evidence of planimetric form adjustment includes formation of chutes, cut-off channels, and bar forms that are poorly formed, reworked or removed. Reaches 1-1 and 3-1 were the only ones that exhibited any evidence of planimetric form adjustment.

The RGA results were used to calculate the Stability Index and assign a geomorphic condition to each of the stream reaches (Varricchione, 2009). The Stability Index is calculated to assess reach stability (aggradation, degradation, widening, or planimetric form adjustment). Survey results are lumped into three major geomorphic conditions in order of condition from best (In Regime) to most affected (In Adjustment), where:

GEOMORPHIC CONDITION

In Regime= Where Stability Index is ≤ 0.20

In Transition or Stressed= Where Stability Index is between 0.21- 0.40

In Adjustment= Where Stability Index is ≥ 0.41

Results of the RGA survey indicate that Sucker Brook is currently in transition or stressed (Table 2; Table A4, Appendix A). Six of the ten subreaches met this condition, while one subreach (Reach 3-1) is in adjustment. Note however, that Reaches 1-1 and 1-2 were on the cusp of being "In regime". Reaches 1-3, 1-4 and 2-1 met the conditions for "In regime", indicating that these subreaches are more stable than the others.

Table 2. *Geomorphic Condition for subreaches of Sucker Brook.*

Reach ID	Stability Index	Geomorphic Position
1-1	0.22	In transition or stressed
1-2	0.21	In transition or stressed
1-3	0.14	In regime
1-4	0.16	In regime
2-1	0.15	In regime
2-2	0.26	In transition or stressed
2-3	0.27	In transition or stressed
3-1	0.43	In adjustment
3-2	0.35	In transition or stressed
4	0.35	In transition or stressed

3.5 Summary of Findings

Using the Maine DEP scoring criteria (Varrichione, 2009), a score was assigned to compare the overall condition of each subreach within the brook based on the combination of parameters described in sections 3.1 through 3.4, above. Generally, the overall stream condition represents an average of these conditions. Best professional judgment was used to assign the final score.

Upon review of the findings from this screening-level survey of representative reaches of Sucker Brook, this water resource appears to be in Fair condition (Table 3). An overall score was assigned to each of the full reaches (1, 2, 3, 4) by averaging the scores for all subreaches within a given reach (Figure 4).

Table 3. *Stream condition ranking for subreaches of Sucker Brook.*

Reach ID	Riparian Shading	Gen. Conditions	*Stream Bottom*	*Streambank / Channel*	*Water Quality*	*Potential Pollution Problem*	*RGA*	*Average Score*	*Overall Condition*
1-1	2	4	4	3	4	4	3	**3.4**	Fair
1-2	1	2	4	3	2	3	4	**2.7**	Good
1-3	2	3	3	3	2	4	3	**2.9**	Good
1-4	3	3	3	3	2	4	2	**2.9**	Fair
2-1	5	3	3	4	2	3	2	**3.1**	Fair
2-2	1	3	3	3	4	3	4	**3.0**	Fair
2-3	1	2	4	3	2	1	4	**2.4**	Good
3-1	2	4	4	3	3	4	5	**3.6**	Fair
3-2	2	3	4	2	3	4	5	**3.3**	Fair
4	2	3	2	4	4	4	4	**3.3**	Fair

***1** = Problems not apparent / conditions appear to be very good; **2** = Minor problem / conditions appear to generally be good; **3** = Moderate problem / conditions appear to generally be fair; **4** = Major problem / conditions appear to generally be poor; **5** = severe problem / conditions appear to generally be very poor.*

Given the high percentage of impervious cover in the watershed, and the numerous documented stormwater outfalls that deliver stormwater directly to the stream, it is clear that impervious cover (IC) and associated stormwater runoff is a major water quality issue in Sucker Brook. In addition, follow-up surveys are needed to assess the condition of tributaries that flow into Sucker Brook, and a follow-up survey is needed to assess the condition of the large stretch of Reach 3 that was not accessible during this survey due to active agricultural activities. This may require additional focused landowner outreach.

Watershed and stream restoration planning is needed immediately in order to improve conditions within the stream. Land use changes such as new development in previously undeveloped areas in the watershed should be designed appropriately to limit additional stormwater runoff. The City of Bangor and the Town of Hampden need to work actively with their development communities such as local business groups or municipal economic development committees, to encourage preservation of riparian areas and floodplains in order to maintain a healthy river system. Additionally, the City and Town should begin prioritizing implementation strategies such as voluntary best management practices or changes to their land use ordinances to include mandatory requirements, to prevent stormwater and associated pollutants (eroded soil, trash, winter sand, fertilizer and lawn care chemicals) from entering the stream. These suggested strategies will require a significant amount of public education and outreach, and stakeholder engagement. Reducing the effects of impervious cover, and redirecting or treating stormwater before it reaches the stream will help prevent severe shifts in the stream's geomorphology and improve in-stream habitat for aquatic life.

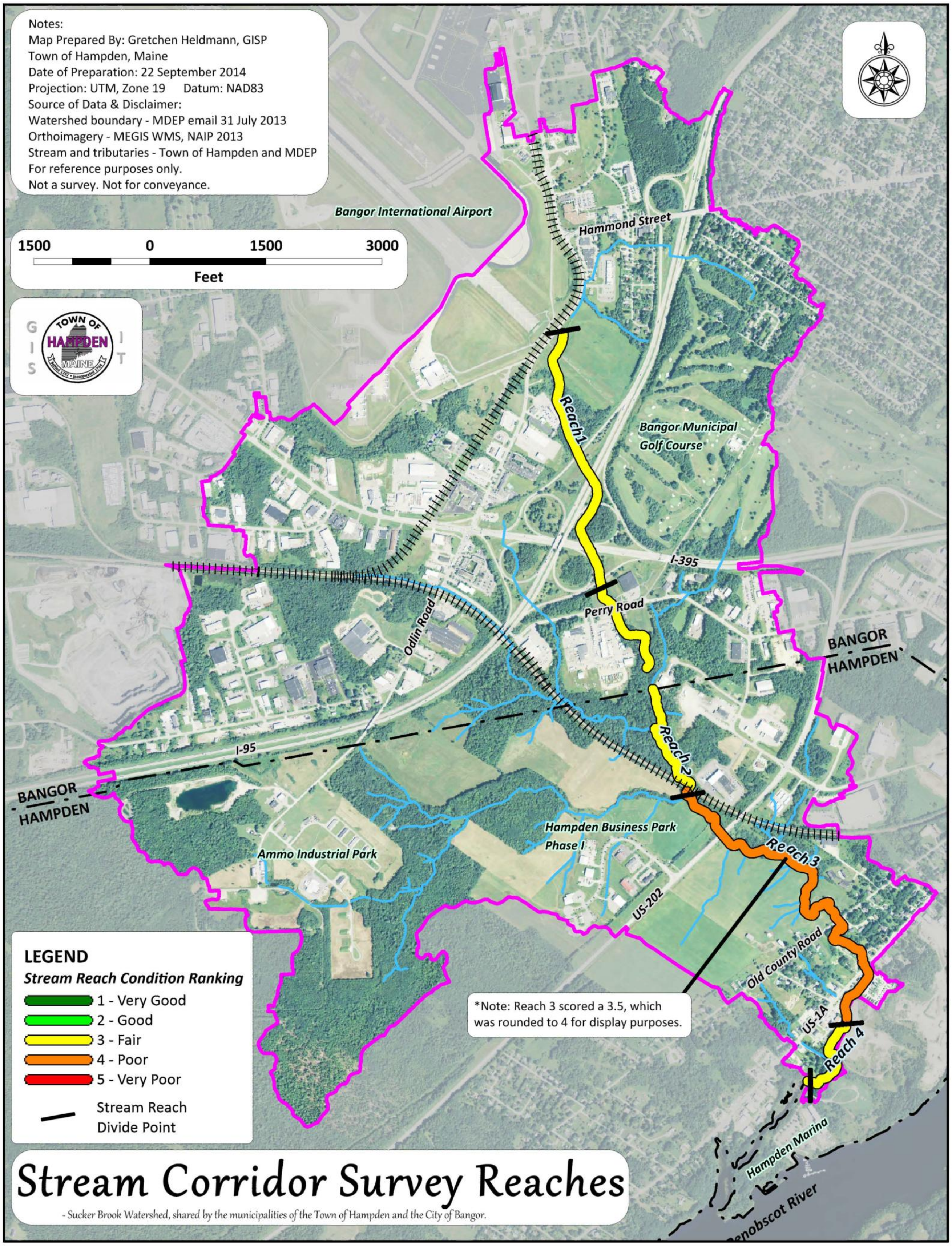


Figure 4. *Stream conditions map.*

4. WATERSHED SURVEY

The Sucker Brook watershed survey was based upon the method formalized by the Maine DEP *Stream Team Program* (Volume I): A Citizen's Guide to Basic Watershed, Habitat, and Geomorphology Surveys in Stream and River Watersheds (2009). The survey was designed specifically to identify sources of stormwater runoff and degradation to riparian areas in the Sucker Brook watershed.

The watershed survey was conducted in two phases; the first phase was completed in September 2013, and the second phase in June 2014. The purpose of the 2013 survey was to document land use types and nonpoint source pollution issues throughout the watershed. The purpose of the 2014 survey was to identify high priority "hot spots" that could be the target for future watershed implementation projects. For both surveys, the watershed was divided into six sectors (Figure 5).

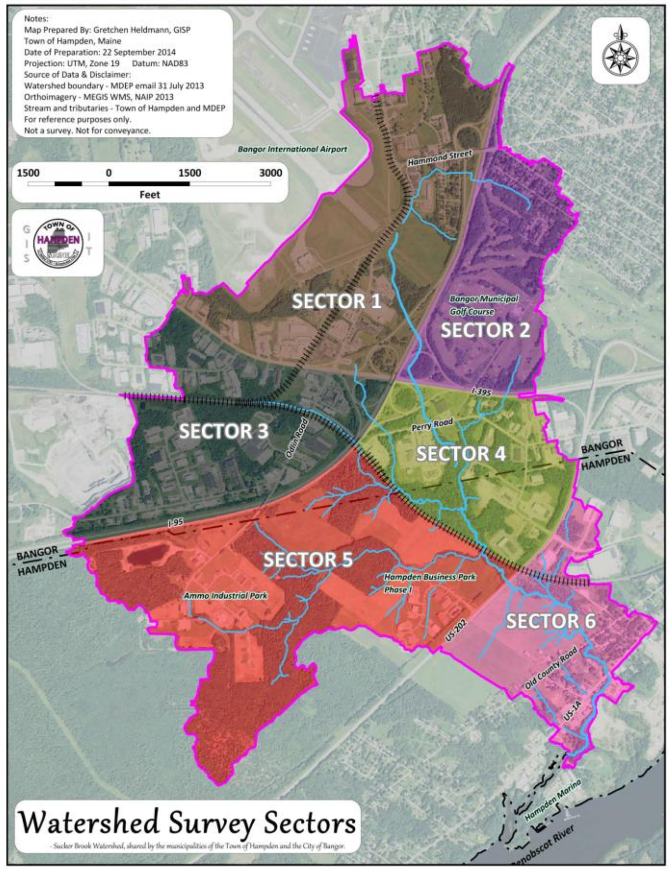


Figure 5. *Watershed survey sector map (Map 4, Appendix C).*

4.1 Sector Descriptions

The six watershed survey sectors include the land area from the Bangor International Airport at the north end (Sector 1), to just north of the Penobscot River in Hampden, Maine (Sector 6) at the southern end. The sectors vary in size, shape and land use type. Development intensity varies across sectors, but roads, forested areas, residential areas, agricultural lands and commercial/industrial development parks are all present within the watershed.

Example of a large area IC within a commercial development near VIP in Sector 1.

<u>Sector 1:</u> Sector 1 extends from the Bangor International Airport below Union Street on Route 15, south to the Interstate 395 and Interstate 95 interchange, and west to Ban air Road. This sector is heavily developed (commercial and industrial land uses). This sector has relatively large areas of impervious cover, with facilities and businesses such as Eastern Maine Medical Center

Family Medicine, Bangor Savings Bank and the Ramada Inn. Sector 1 is completely within the City of Bangor.

Sector 2: The boundaries of Sector 2 extend from the northern boundary of Sector 1 south to Hammond Street. This sector includes a portion of the residential area south of Hammond Street, to the Bangor Municipal Golf Course, reaching almost as far eastward as Webber Street. It cuts through approximately the middle of the golf course, south to Interstate 395, and includes all area west to the I-395/I-95 interchange. This sector is heavily residential and contains a lot of developed open space used for recreation including Fairmont Park and a large portion of the golf course. Sector 2 is located completely within the City of Bangor.

Example of a typical residential neighborhood off Hammond Street in Sector 2.

Sector 3: Sector 3 is located entirely within the City of Bangor, south of Sector 1, north of the Bangor/Hampden town line, and east of the Lane Quarry off Odlin Road. Like Sector 1, this sector is highly developed relative to the sectors to the south, and includes a long stretch of rail line, and the intersection of Odlin Road and Hammond Street (Rt. 2). Multiple catch basins and stormwater outfalls were documented in this sector. Some of the facilities and businesses within the sector include Gold's Gym, Evergreen Waste, Sergeant Corporation, United Rentals, and New England Salt Supply.

Numerous catch basins in Sector 3 collect road runoff and redirect stormwater directly to Sucker Brook.

Sector 4: Sector 4 is located east of Sector 3, and south of Sector 2. The northern portion of the sector is located in Bangor, while the southern portion is located in Hampden. This sector includes the area south and east of the I-395 and I-95 interchange. Specifically, this sector is bound by I-395 to the north, I- 95 to the west, and the railroad tracks to the south. Although not nearly as developed as Sectors 1 and 3, Sector 4 contains several locations with large amounts of impervious area, such as the Cole Museum, Freightliner, and N.S. Giles.

Runoff resulting from compacted grass and gravel in Sector 4.

Sector 5: Sector 5 is located almost entirely within the Town of Hampden, with the exception of a small portion of land adjacent to a tributary that flows to Sucker Brook in the northeast corner of the sector. This sector extends southeast and southwest from the intersection of the train tracks near Perry Road and I-95. It includes Ammo Industrial Park, the Hampden Business Park, a portion of Route 202, and large tracts of agricultural land. Route 202 and the train tracks serve as the southeast and northeast boundaries of this sector, respectively. The prominent commercial and industrial developments include Ammo Industrial Park and the Hampden Business Park, which includes businesses such as Clean Harbors, Hampden Veterinary Clinic, Wight's Sporting Goods, and Central Maine Diesel.

Example of a business park in Sector 5 in Hampden.

Sector 6: Sector 6 is located entirely within the Town of Hampden, and is southeast of Sectors 4 and 5 including the last section of Sucker Brook before it flows into the Penobscot River. This sector includes a mix of residential and commercial buildings, the intersection of Route 202 and the railroad to the north, and a portion of Route 1A. Some of the notable locations in this sector include the Hampden Trailer Park, a storage unit facility, and the Perry Farm.

View of the agricultural land adjacent to Sucker Brook in Sector 6.

4.2 Methodology

In September 2013, environmental professionals paired off to survey each of the six watershed survey sectors. Field teams surveyed multiple sites within each of the six sectors using official field forms and/or field notes. More than 100 nonpoint source pollution (NPS) sites were documented across the six sectors. GPS cameras were used to document the location of each NPS site. Only 38 of the NPS sites were documented using approved field forms. The other 60+ sites were documented as field notes without field forms. Sector 3 had the most number of documented NPS sites.

Field forms and field notes were sorted and entered into a common spreadsheet for analysis. For purposes of consistency and accuracy in reporting, only the 38 NPS sites documented in 2013 with field forms were used in the analysis for this report. Following data entry, each of the 38 sites were assigned a unique Site ID corresponding to the six sectors. While field teams documented NPS problems at each observed site, recommendations were not always included. However, some of these sites were revisited by staff from the City of Bangor and the Town of Hampden during a "hot spots" survey in June 2014 using the knowledge gained about the watershed from the 2013 survey. The survey targeted high priority locations within each of the six sectors. This included locations believed to be most damaging to the water quality in Sucker Brook.

No official field forms were used to document the 2014 hot spots, but field notes included information on hot spot site location, identified problems, and recommendations. This information was entered into an Excel spreadsheet for analysis, and maps were created to show the location of these sites (Appendix B, Maps 5 - 11).

4.3 2013 Watershed Survey Results

Thirty-eight sites were formally surveyed during the 2013 watershed survey. These sites were located throughout the six sectors with the majority being in Sectors 1 and 3. This is not surprising given the large area and high intensity of developed land within these sectors compared with the other sectors. Documented NPS sites were located in close proximity to commercial and industrial facilities, roads, and residential buildings.

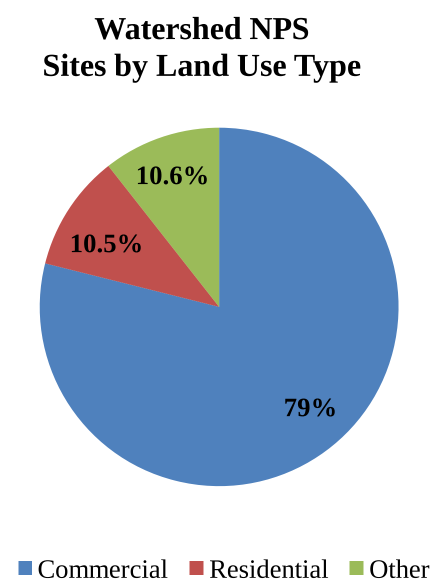


Figure 6. *NPS sites by land use type.*

Additional hand-written field notes for 60 other NPS problems sites were documented with the name of the business. These sites are not addressed in this report simply because they are additional field notes and not formally reported on the official field data sheets. For this reason, there are no formally documented sites in Sector 5, and only one in Sector 4, though field notes indicate at least 37 other locations that may be contributing to poor water quality in Sucker Brook in these two sectors. This reduction in survey size should be noted for future watershed work, as many of these sites may need attention. Furthermore, a large area of agricultural land adjacent to the stream in Sector 3 was inaccessible to survey teams, and should be considered in future watershed planning activities.

Close to 80% of the documented NPS sites from the 2013 survey are located on commercial lands, and approximately 10% on residential lands (Figure 6). Combined, other land uses, such as public parks, or other municipal land (e.g. golf course) comprise the remaining 10% of documented NPS sites.

Several areas were identified as having the potential, due to high traffic or site activities, to be hot spots for discharging pollutants to Sucker Brook. Activities conducive to pollutant dispersal (vehicle idling, wash areas, storage, etc.), were observed during the watershed survey. Sectors 1, 3 and 4 have a heavier industrial component than the other sectors; they also have a much heavier traffic component, and many intersections in these sectors lead to long vehicle idle times. Many of these intersections (such as the Odlin Rd./Rt. 202 intersection) contain numerous catch basins that direct runoff from the intersection into the stream, making these sectors more likely to have moderate to severe petroleum inputs.

A common factor across all six survey sectors was the management of stormwater runoff from roofs and impervious surfaces. A considerable number of residential homes (> 60%) had roof gutters and downspouts that were directed onto impervious surfaces (driveways, walkways, etc) rather than being infiltrated into the ground via lawn area, rain gardens, infiltration trenches or drywells. Runoff discharging from roof downspouts has the force to sweep over driveways and walkways and collect any oil, pet wastes, grass clippings, leaves, excess fertilizer and herbicides, or other potential pollutants, and dump them into the municipal storm drain system, which discharges into Sucker Brook with little to no treatment.

The largest proportion of residential NPS sites are located in Sectors 2 and 4. In addition to pollution from residential development, a major consideration in Sector 2 is the municipal golf course, which without proper management has the potential to contribute excess pesticides and fertilizers directly into Sucker Brook. Fortunately, the golf course is managed by the City of Bangor, and is an Audubon-certified course, meaning the use of pesticides, herbicides, and fertilizers is carefully controlled both in terms of storage and application. Pesticides, herbicides and fertilizers are located in a locked building and the City employs agronomists to care for the fairways and greens.

Agricultural land uses in Sector 6 are a concern, as a large cattle farm (known as the Perry Farm) is located within this sector. Historically, animals have had access to the brook. Without proper management of farm animals, Sucker Brook is more at risk to soil erosion as a result of cattle in and adjacent to the stream, and addition of bacteria and nutrients from animal waste. Proper fencing along the brook, targeted bridge placement for cattle crossing, and nutrient management should be considered within this portion of the watershed.

4.4 2014 Hot Spot Survey

In June 2014, a hot spot survey was conducted throughout the six watershed survey sectors visited in 2013. A total of 39 sites were documented as hotspots; eleven of which overlapped with formally documented NPS sites from the 2013 survey (Figure 7). The number of hot spots within each sector ranges from two (Sector 2) to eleven (Sector 3). Sectors 1 and 3 have the greatest number of documented hot spots. This is not surprising based on the extent of impervious cover (IC) in these sectors, and the high number of NPS sites documented in these sectors during the 2013 survey.

Problems that were identified at these hot spots include idling, hydrocarbons, sediment and erosion issues, chemical and metal exposure and the presence of nutrients. Recommendations to remediate these issues include installing rain gardens and/or biofilters, increasing vegetation, installing water diversions, swale or drainage work, and bank stabilization.

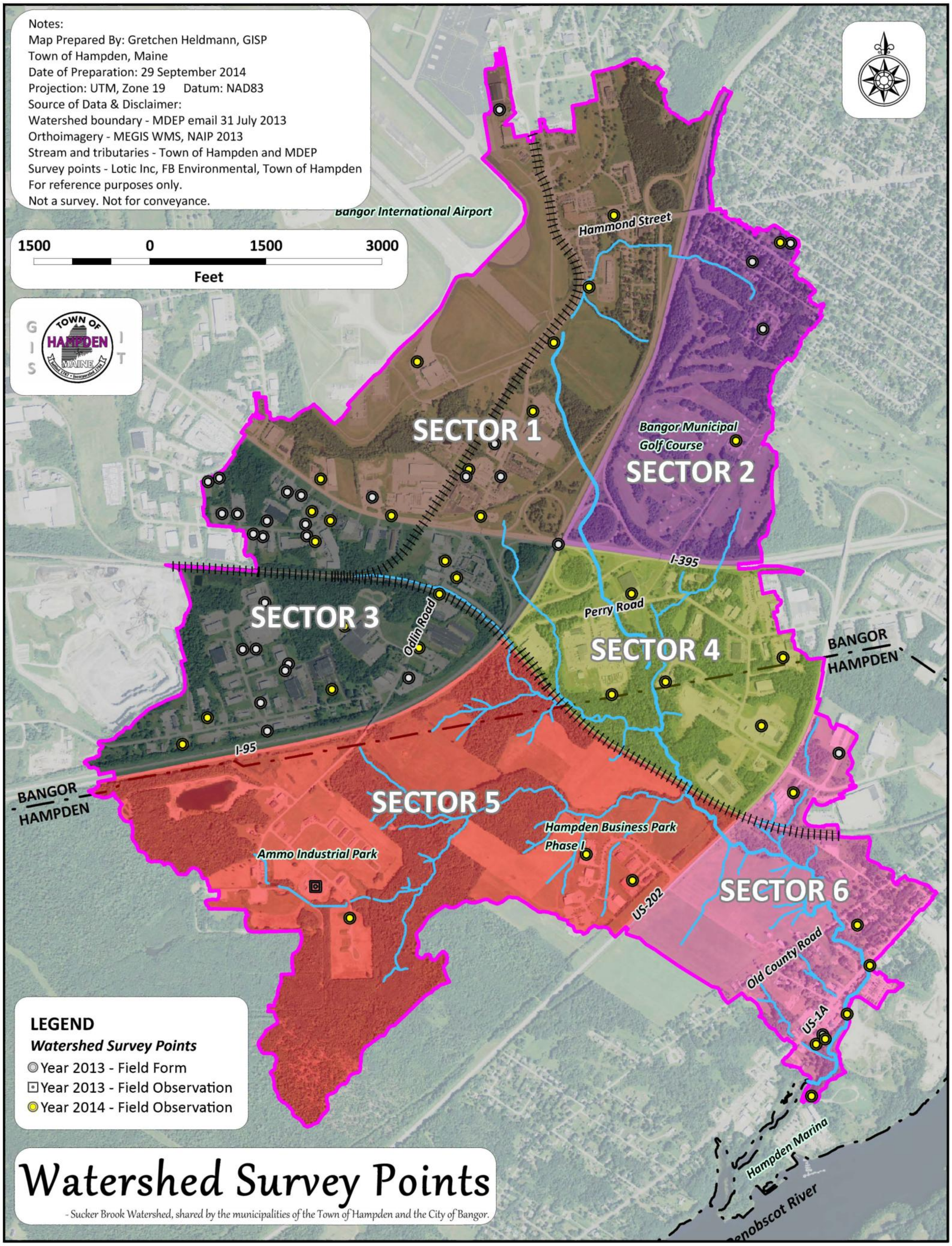


Figure 7. *2013 Watershed Survey and 2014 Hot Spot Survey results map. (Map 5, Appendix B)*

Documented NPS sites from the 2013 watershed survey and the 2014 hot spots survey were combined to eliminate duplicate sites, for a total of 67 sites (Figure 7 and Table C1, Appendix C). Sector specific maps are presented in Appendix B (Maps 6 - 11).

4.5 Next Steps

The 2013 watershed survey and 2014 hot spot survey served as a preliminary investigation for documenting sources of NPS pollution in the Sucker Brook watershed. Additional investigation is needed to prioritize and develop detailed designs for the high-priority NPS sites. The City of Bangor and Town of Hampden should work cooperatively to develop a watershed plan that includes the following recommendations:

From Stream Corridor Survey

Actions are needed to improve the physical, chemical, and biological conditions in Sucker Brook so that it meets the State Class B water quality criteria for aquatic life.

1. Develop a list and cost estimate of habitat and riparian restoration options (watershed plan);
2. Sample water quality at select stormwater outfalls;
3. Conduct a culvert survey – upgraded for stability, fish passage, and geomorphic conditions;
4. Fish survey – identify and document the state of the existing fish population and make recommendations for habitat enhancement projects.

From Watershed Survey

Actions are needed to reduce the effects that impervious cover and stormwater are having on Sucker Brook. This includes increased flow, delivery of pollutants, thermal pollution, and changes in habitat and stream morphology.

1. Reduce flow to stream/disconnect impervious cover;
2. Develop a prioritization methodology for highest impact sites;
3. Develop a pollutant load and flow reduction estimate for sites (watershed plan);
4. Engage stakeholders (watershed plan);
5. Set milestones for restoring water quality;
6. Identify demonstration sites (IC reduction or Low Impact Development strategies).

REFERENCES

Allan and Castillo (2007). Allan, J. D. and M. M. Castillo. *Stream ecology: structure and function of running waters*. 2nd ed., Springer, Dordrecht, Netherlands. 436 pp.

CWP (2003). Center for Watershed Protection. *Impacts of Impervious Cover on Aquatic Systems.* Watershed Protection Research Monograph No. 1. Center for Watershed Protection. Elliot City, MD. 142 pp.

Flebbe, P. A. and C. A. Dolloff (1995). *Trout use of woody debris and habitat in Appalachian wilderness streams of North Carolina.* North American Journal of Fisheries Management 15: 579-590.

Kauffman, Gerald, J., Andrew C. Belden, Kevin J. Vonck, and Andrew R. Homsey (2009). *Link between Impervious Cover and Base Flow in the White Clay Creek Wild and Scenic Watershed in Delaware*. J HYDROL ENG 01/2009; 14(4). DOI 10.1061/(ASCE)1084-0699(2009) 14:4(324.

Maine DEP (2009). *Stream Survey Manual, A Citizen's Guide to Basic Watershed, Habitat, and Geomorphic Surveys in Stream and River Watersheds. Vol. 1.* Maine Stream Team Program, Maine Department of Environmental Protection. Online: https://maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/stream-survey-manual/index.html

Maine DEP (2010). *2010 Integrated Water Quality Monitoring and Assessment Report.* Report # DEPLW-1187. Online: http://www.maine.gov/dep/water/monitoring/305b/2010/report.pdf

Maine DEP (2012a). *2012 Integrated Water Quality Monitoring and Assessment Report.* Report # DEPLW-1246. Online: http://www.maine.gov/dep/water/monitoring/305b/2012/report-final.pdf

Maine DEP (2012b). *Maine Impervious Cover Total Maximum Daily Load Assessment (TMDL) for Impaired Streams.* Report # DEPLW-1239. Online: http://www.maine.gov/dep/water/monitoring/tmdl/2012/IC%20TMDL_Sept_2012.pdf

MDOC (2012). *Standards for Placing Wood Into Stream Channels to Enhance Cold Water Fisheries Habitat, Maine Forest Service (MFS) Rule, Chapter 24.* Adopted Rule 2012-350. Maine Department of Conservation, Maine Forest Service, December 25, 2012. Online: http://www.maine.gov/dacf/mfs/publications/rules_and_regs/chap_25_rules.pdf

Smock, L. A.; Metzler G. M.; Gladden, J. E. (1989). *Role of organic debris jams in the structure and functioning of low-gradient headwater streams.* Ecology 70: 764-775.

Varricchione, Jeff (2009). *Recommended Steps for Scoring and Writing Stream Corridor Survey Reports (DRAFT).* Maine Stream Team Program, Maine Department of Environmental Protection, Augusta, Maine. Last Modified: December 10, 2009.

APPENDICES

APPENDIX A

RHA Summary Tables

Table A1. *Stream Bottom, Sreambank and Channel Conditions for Sucker Brook.*

Reach ID	Substrate & Stream Bank Conditions			
	Stream Bottom Conditions	**Score**	**Stream Bank/Channel Conditions**	**Score**
1-1	Dominant Substrate: Silt/clay/mud Embeddedness: Somewhat (5-25%) Large Wood Presence: Few Presence of Organic Matter: Plentiful	4	0-25% bank modification; no pools >2ft deep; shallow pools 1-2ft deep; avg distance b/t pool 12.5ft	3
1-2	Dominant Substrate: Silt/clay/mud Embeddedness: Somewhat (5-25%) Large Wood Presence: Few Presence of Organic Matter: Occasional	4	0-25% bank modification; no pools >2ft deep; shallow pools 1-2ft deep; avg distance b/t pool 3ft; runs present	3
1-3	Dominant Substrate: Cobble Embeddedness: Mostly (75%) Large Wood Presence: Few Presence of Organic Matter: Plentiful	3	0-25% bank modification; 1 pool >2ft deep; avg. distance b/t pools 5ft; riffles present.	3
1-4	Dominant Substrate: Cobble Embeddedness: Mostly (75%) Large Wood Presence: Many Presence of Organic Matter: Plentiful	3	0-25% bank modification; no pools >2ft deep; shallow pools 1-2ft deep; avg distance b/t pool 3ft; riffles and runs present	3
2-1	Dominant Substrate: Gravel Embeddedness: Somewhat (5-25%) Large Wood Presence: Few Presence of Organic Matter: Occasional	3	25-50% bank modification; no pools >2ft deep; shallow pools <1ft deep; avg distance b/t pool 10ft; riffles present	4
2-2	Dominant Substrate: Sand Embeddedness: Halfway (50%) Large Wood Presence: Plentiful Presence of Organic Matter: Occasional	3	0-25% bank modification; no pools >2ft deep; shallow pools 1-2ft deep; avg distance b/t pool 15ft; riffles present	3
2-3	Dominant Substrate: Silt/clay/mud Embeddedness: Completely (100%) Large Wood Presence: Plentiful Presence of Organic Matter: Plentiful	4	0-25% bank modification; no pools >2ft deep; shallow pools 1-2ft deep; avg distance b/t pool 25ft; runs present	3
3-1	Dominant Substrate: Silt/clay/mud, gravel, cobble, rubble, boulder Embeddedness: Mostly (75%) Large Wood Presence: Few Presence of Organic Matter: Occasional	4	0-25% bank modification; 4 pools >2ft deep; avg distance b/t pool 90ft; riffles, runs, cascades and rapids present	3
3-2	Dominant Substrate: Silt/clay/mud, sand Embeddedness: Mostly (75%) Large Wood Presence: Few Presence of Organic Matter: Plentiful	4	0-25% bank modification; 3 pools >2ft deep; avg distance b/t pool <50ft; runs and cascades present.	2
4	Dominant Substrate: Cobble Embeddedness: Not embedded Large Wood Presence: Few Presence of Organic Matter: None	2	25-50% bank modification; 12 pools >2ft deep; avg. distance b/t pools 20ft; riffles and runs present.	4

***Table A2**. Riparian Vegetation Conditions for Sucker Brook.*

Reach ID	Streamside (Riparian) Vegetation & In-Stream Temperature Conditions			
	Shading of Stream by Vegetation	Score	General Conditions	Score
1-1	75%	2	Small woody debris and vegetative overhang common; undercut banks present; manmade structures and lawns common; evidence of collapsed/eroded banks; garbage/litter adjacent to stream common and present in stream; mud, silt or sand in or entering the stream present, actively discharging pipes and other pipes or ditches entering stream common.	4
1-2	100%	1	Large woody debris present and small woody debris and vegetative overhang common; trees, bushes, and shrubs common; tall grasses and ferns present; actively discharging pipes and other pipes or ditches entering stream common.	2
1-3	75%	2	Large woody debris present and small woody debris and vegetative overhang common; undercut banks present; manmade structures present and lawns common; evidence of collapsed/eroded banks; bare soil present; other pipes discharging into stream present and ditches entering the stream common.	3
1-4	50%	3	Woody debris and vegetative overhang present, undercut banks, manmade structures and lawns common; evidence of collapsed/eroded banks; other pipes or ditches entering stream common.	3
2-1	0%	5	Root wads present and overhanging vegetation common; undercut banks common, manmade structures present and lawns common; bare soil present; evidence of collapsed/eroded banks; ditches entering the stream present.	3
2-2	100%	1	Woody debris and overhanging vegetation present; garbage/litter adjacent to and in the stream present; foam or sheen on bank present; actively discharging pipes present.	3
2-3	100%	1	Overhanging vegetation present; evidence of collapsed/eroded banks.	2
3-1	75%	2	Large woody debris and overhanging vegetation common; small woody debris present, undercut banks present; manmade structures common; evidence of collapsed/eroded banks; garbage/litter adjacent to and in stream present; foam or sheen on bank present; mud, silt or sand in or entering the stream present; actively discharging pipes and other pipes entering the stream present.	4
3-2	75%	2	Large woody debris and overhanging vegetation common; small woody debris present, undercut banks common; deepwater, turbulence or foam common; bare soil present; evidence of collapsed/eroded banks; mud/silt or sand in or entering the stream common.	3
4	75%	2	Woody debris and vegetative overhang present; undercut banks common; evidence of natural streamside plant cover degraded; banks collapsed/eroded common; garbage/litter adjacent to or in stream common; other pipes or ditches entering the stream present.	3

Table A3. *Water Quality Issues and Potential Pollution Source Conditions for Sucker Brook.*

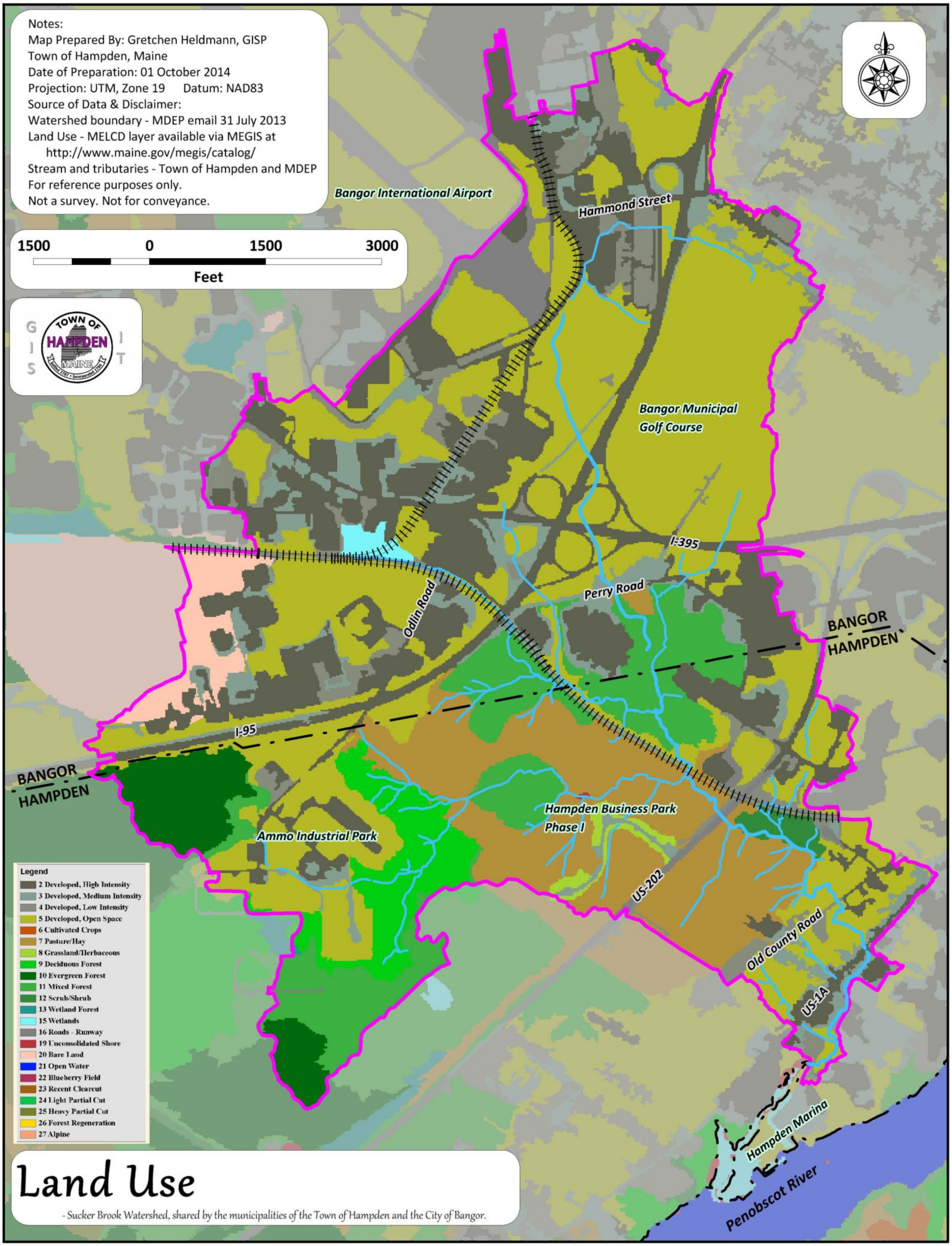
Reach ID	Water Quality Issues & Potential Pollution Sources			
	Water Quality Issues	Score	Potentially Significant Sources of Pollution	Score
1-1	Water clear; no odor; abundance of organic matter; garbage/litter adjacent to and in stream; mud, silt or sand in or entering stream; actively discharging pipes and other pipes or ditches entering the stream; abundance - occasional algae; erosion	4	Manmade structures; commercial residences; laws; pipes, ditches and culverts; discharge from this portion of Odlin Rd and other stormwater conveyances; drainage from BIA landing approach; lawn waste or runoff; road and roof runoff; trash dump; industrial areas; erosion; stormwater outfalls and outfalls draining large impervious areas	4
1-2	Water clear; no odor; actively discharging pipes and other pipes or ditches entering the stream; occasional algae	2	Pipes, ditches and culverts; road runoff; area behind Ground Round	3
1-3	Water clear; no odor; abundance of organic matter present; pipes or ditches entering the stream, erosion, occasional algae	2	Manmade structures; commercial residences; lawns; pipes and ditches; bare soil; road and roof runoff; stormwater outfalls and outfalls draining large impervious areas	4
1-4	Water clear; no odor; pipes or ditches entering the stream; occasional algae; iron bacteria; abundance of organic matter	2	Manmade structures; commercial residences; lawns; pipes and ditches; bare soil (drainage from I-95 & I-395); road and roof runoff; commercial and road construction; roof and road runoff; culvert from 95 and drainage from I-95 & I-395; stormwater outfalls and outfalls draining large impervious areas; industrial areas	4
2-1	Water clear; no odor; small area of sheen on water; ditch under bridge entering stream; occasional algae	2	Manmade structures; lawns; road runoff; bare soil; ditch under bridge; drain pipe from freightliner dealer	3
2-2	Water clear; some oily odor further upstream; brownish orange foam; garbage/litter adjacent to and in stream; foam on bank; actively discharging pipes; occasional algae	4	Drainage pipe from Freightliner dealer	3
2-3	Water clear; no odor; occasional algae; erosion; abundance of organic matter	2	Erosion (bank)	1
3-1	Water clear - light brown; foam and oily sheen on water but rare; garbage/litter adjacent to and in stream; mud, silt or sand in or entering stream; actively discharging or other pipes entering stream; occasional algae	3	Manmade structures; erosion; pipes; residential areas; road and lawn runoff; housing and commercial development; agricultural lands located out of site area; stormwater outfalls and outfalls draining large impervious areas	4
3-2	Water dark brown; no odor; abundance of organic matter; deep water, turbulence or foam; mud, silt or sand in or entering the stream	3	Bare soil; commercial residences; erosion; road runoff; agricultural lands, commercial development; industrial areas; stormwater outfalls and outfalls draining large impervious areas	4
4	Water clear; no odor; garbage/litter adjacent to and in stream; pipes and ditches entering the stream	4	Erosion (banks); commercial residences; road runoff; mining or gravel pits; stormwater outfalls and outfalls draining large impervious areas	4

Table A4. *Geomorphic Position of Sucker Brook.*

Reach ID	Major Geomorphic Process	Notes	Stability Index	Geomorphic Position	Preliminary Score
1-1	Aggradation	Coarse materials in riffles embedded; siltation in pools; poor lateral sorting of bed materials	0.22	In transition or stressed	3
1-2	Aggradation	Coarse materials in riffles embedded; siltation in pools; poor lateral sorting of bed materials; soft, unconsolidated bed	0.21	In transition or stressed	4
1-3	Aggradation	Lateral bars; siltation in pools; poor lateral sorting in beds; soft, unconsolidated bed	0.14	In regime	3
1-4	Aggradation	Lateral bars; coarse materials in riffles embedded	0.16	In regime	2
2-1	Aggradation	Coarse materials in riffle embedded; siltation in pools	0.15	In regime	2
2-2	Aggradation	Lateral bars; coarse material in riffle embedded; siltation in pools; mid-channel bars; soft, unconsolidated bed; deposition in the overbank zone	0.26	In transition or stressed	4
2-3	Aggradation	Coarse materials in riffle embedded; siltation in pools; soft, unconsolidated bed; evidence of deposition in/around bank structures; deposition in the overbank zone	0.27	In transition or stressed	4
3-1	Aggradation	Lateral bars; coarse materials in riffles embedded; siltation in pools; mid-channel bars; deposition on point bars; evidence of deposition in/around bank structures; deposition in the overbank zone	0.43	In adjustment	5
3-2	Widening	Fallen/leaning trees/fence posts/etc.; exposed tree roots; basal scour on inside meander bends; steep bank angles through most of subject reach; length of bank scour >50% through subject reach	0.35	In transition or stressed	5
4	Degradation	Channel incision into undisturbed overburden/bedrock; elevated tree roots/root fan above channel bed; bank height increases; suspended armor layer visible in bank	0.35	In transition or stressed	4

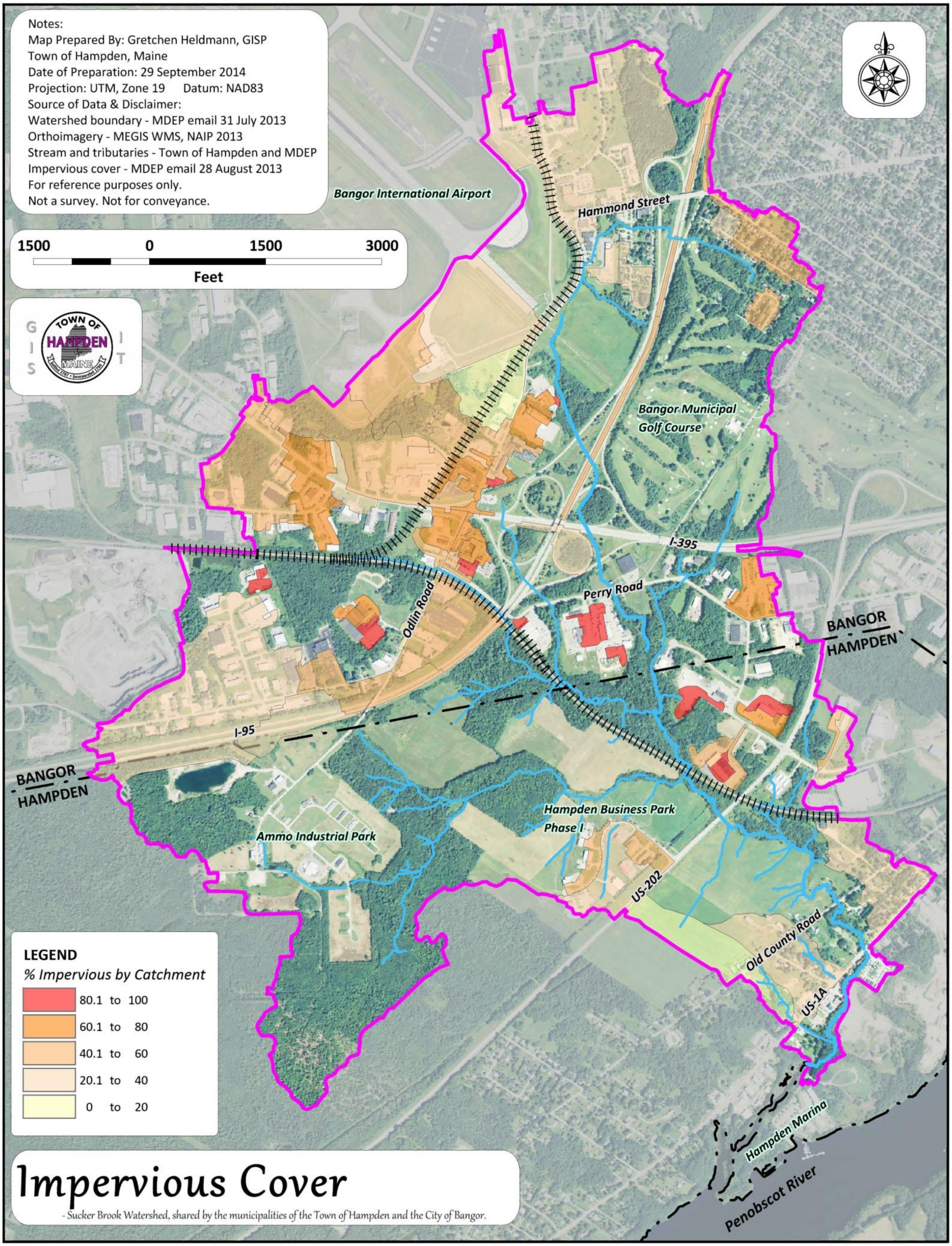
APPENDIX B

Stream & Watershed Maps

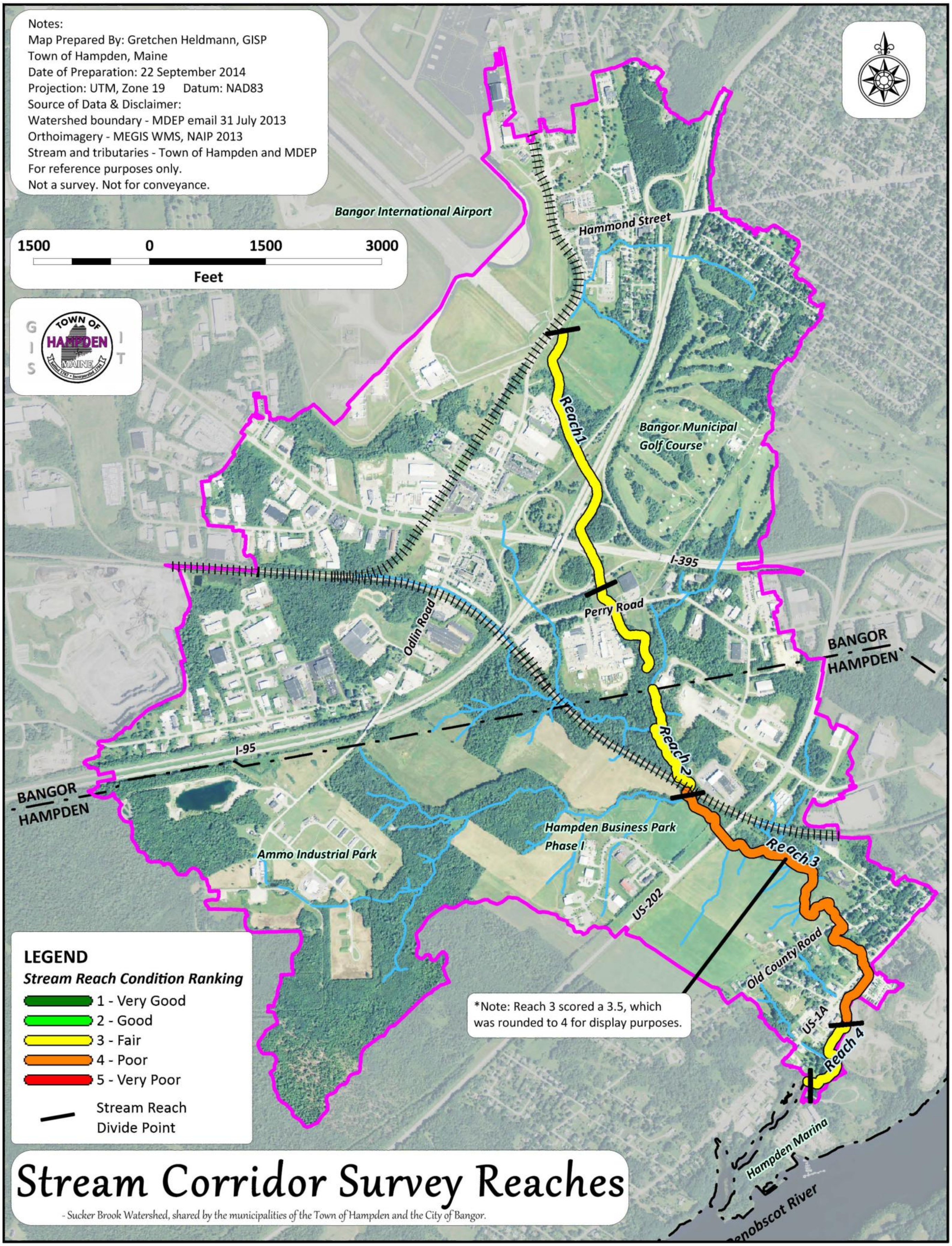


Notes:
Map Prepared By: Gretchen Heldmann, GISP
Town of Hampden, Maine
Date of Preparation: 01 October 2014
Projection: UTM, Zone 19 Datum: NAD83
Source of Data & Disclaimer:
Watershed boundary - MDEP email 31 July 2013
Land Use - MELCD layer available via MEGIS at
http://www.maine.gov/megis/catalog/
Stream and tributaries - Town of Hampden and MDEP
For reference purposes only.
Not a survey. Not for conveyance.
1500 0 1500 3000
Feet
GIS
IT
TOWN OF HAMPDEN MAINE
Bangor International Airport
Hammond Street
Bangor Municipal Golf Course
I-395
Perry Road
Odlin Road
BANGOR
HAMPDEN
I-95
BANGOR
HAMPDEN
Hampden Business Park Phase I
Ammo Industrial Park
US-202
Old County Road
US-1A
Hampden Marina
Penobscot River
Legend
2 Developed, High Intensity
3 Developed, Medium Intensity
4 Developed, Low Intensity
5 Developed, Open Space
6 Cultivated Crops
7 Pasture/Hay
8 Grassland/Herbaceous
9 Deciduous Forest
10 Evergreen Forest
11 Mixed Forest
12 Scrub/Shrub
13 Wetland Forest
15 Wetlands
16 Roads - Runway
19 Unconsolidated Shore
20 Bare Land
21 Open Water
22 Blueberry Field
23 Recent Clearcut
24 Light Partial Cut
25 Heavy Partial Cut
26 Forest Regeneration
27 Alpine
Land Use
- Sucker Brook Watershed, shared by the municipalities of the Town of Hampden and the City of Bangor.

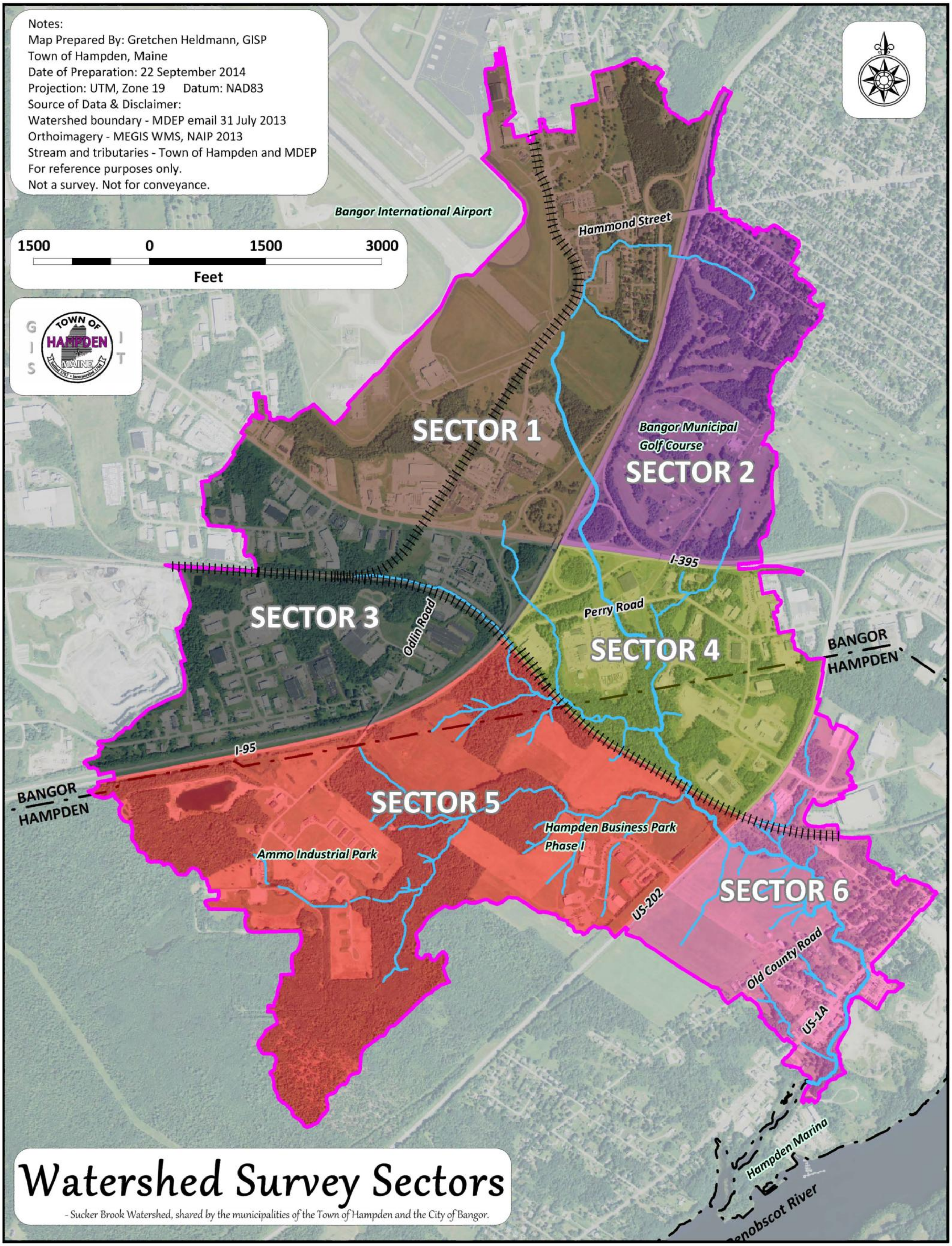
Map 1


Notes:
Map Prepared By: Gretchen Heldmann, GISP
Town of Hampden, Maine
Date of Preparation: 29 September 2014
Projection: UTM, Zone 19 Datum: NAD83
Source of Data & Disclaimer:
Watershed boundary - MDEP email 31 July 2013
Orthoimagery - MEGIS WMS, NAIP 2013
Stream and tributaries - Town of Hampden and MDEP
Impervious cover - MDEP email 28 August 2013
For reference purposes only.
Not a survey. Not for conveyance.
1500 0 1500 3000
Feet
Bangor International Airport
Hammond Street
Bangor Municipal Golf Course
I-395
Perry Road
Odlin Road
BANGOR
HAMPDEN
I-95
BANGOR
HAMPDEN
Hampden Business Park Phase I
Ammo Industrial Park
US-202
Old County Road
US-1A
Hampden Marina
Penobscot River
LEGEND
% Impervious by Catchment
80.1 to 100
60.1 to 80
40.1 to 60
20.1 to 40
0 to 20
Impervious Cover
- Sucker Brook Watershed, shared by the municipalities of the Town of Hampden and the City of Bangor.

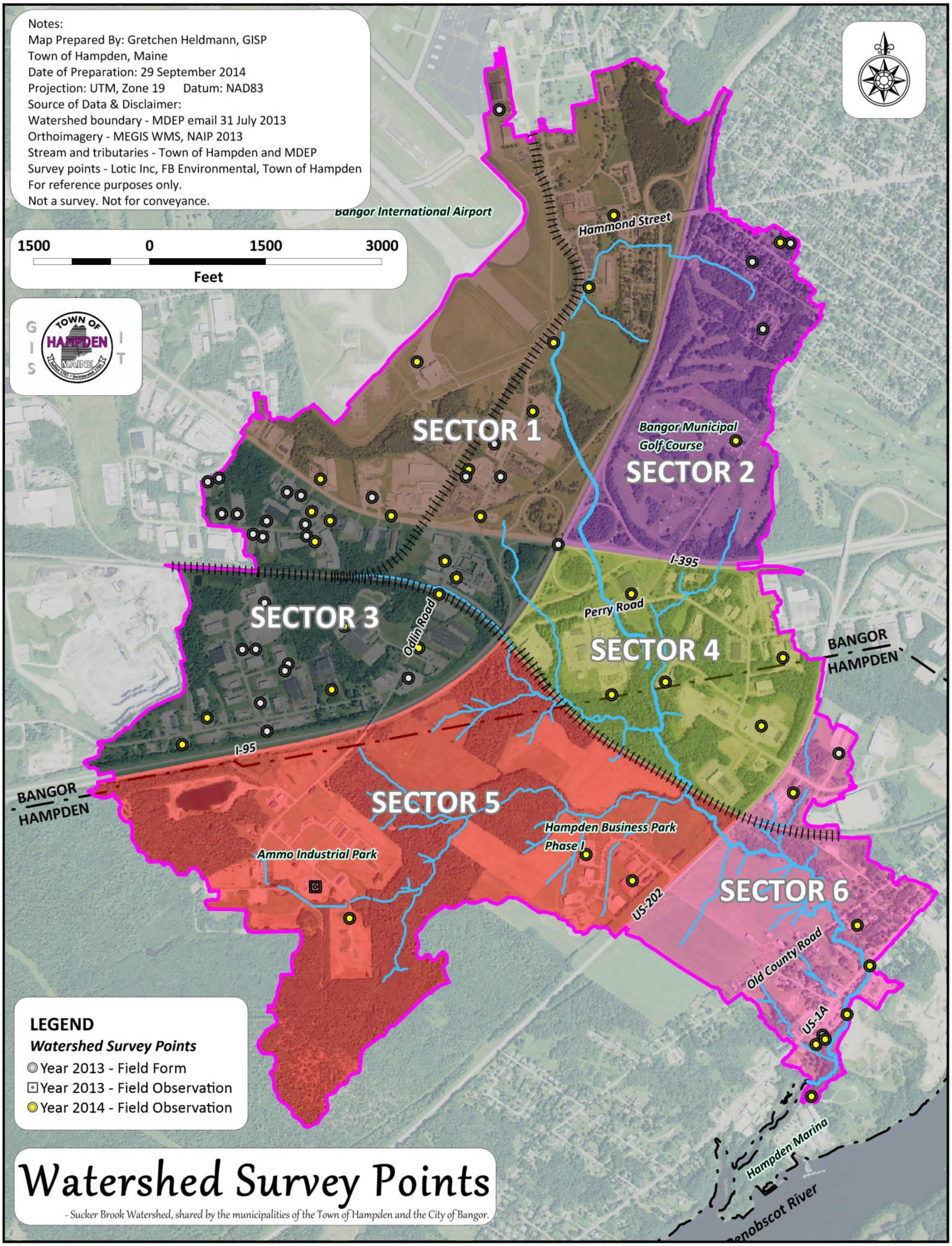
Map 2


Notes:
Map Prepared By: Gretchen Heldmann, GISP
Town of Hampden, Maine
Date of Preparation: 22 September 2014
Projection: UTM, Zone 19 Datum: NAD83
Source of Data & Disclaimer:
Watershed boundary - MDEP email 31 July 2013
Orthoimagery - MEGIS WMS, NAIP 2013
Stream and tributaries - Town of Hampden and MDEP
For reference purposes only.
Not a survey. Not for conveyance.
1500 0 1500 3000
Feet
GIS IT
TOWN OF HAMPDEN MAINE
Bangor International Airport
Hammond Street
Reach 1
Bangor Municipal Golf Course
I-395
Perry Road
Odlin Road
BANGOR
HAMPDEN
Reach 2
I-95
BANGOR
HAMPDEN
Hampden Business Park Phase I
Reach 3
Ammo Industrial Park
US-202
Old County Road
*Note: Reach 3 scored a 3.5, which was rounded to 4 for display purposes.
US-1A
Reach 4
Hampden Marina
Penobscot River
LEGEND
Stream Reach Condition Ranking
1 - Very Good
2 - Good
3 - Fair
4 - Poor
5 - Very Poor
Stream Reach Divide Point
Stream Corridor Survey Reaches
- Sucker Brook Watershed, shared by the municipalities of the Town of Hampden and the City of Bangor.

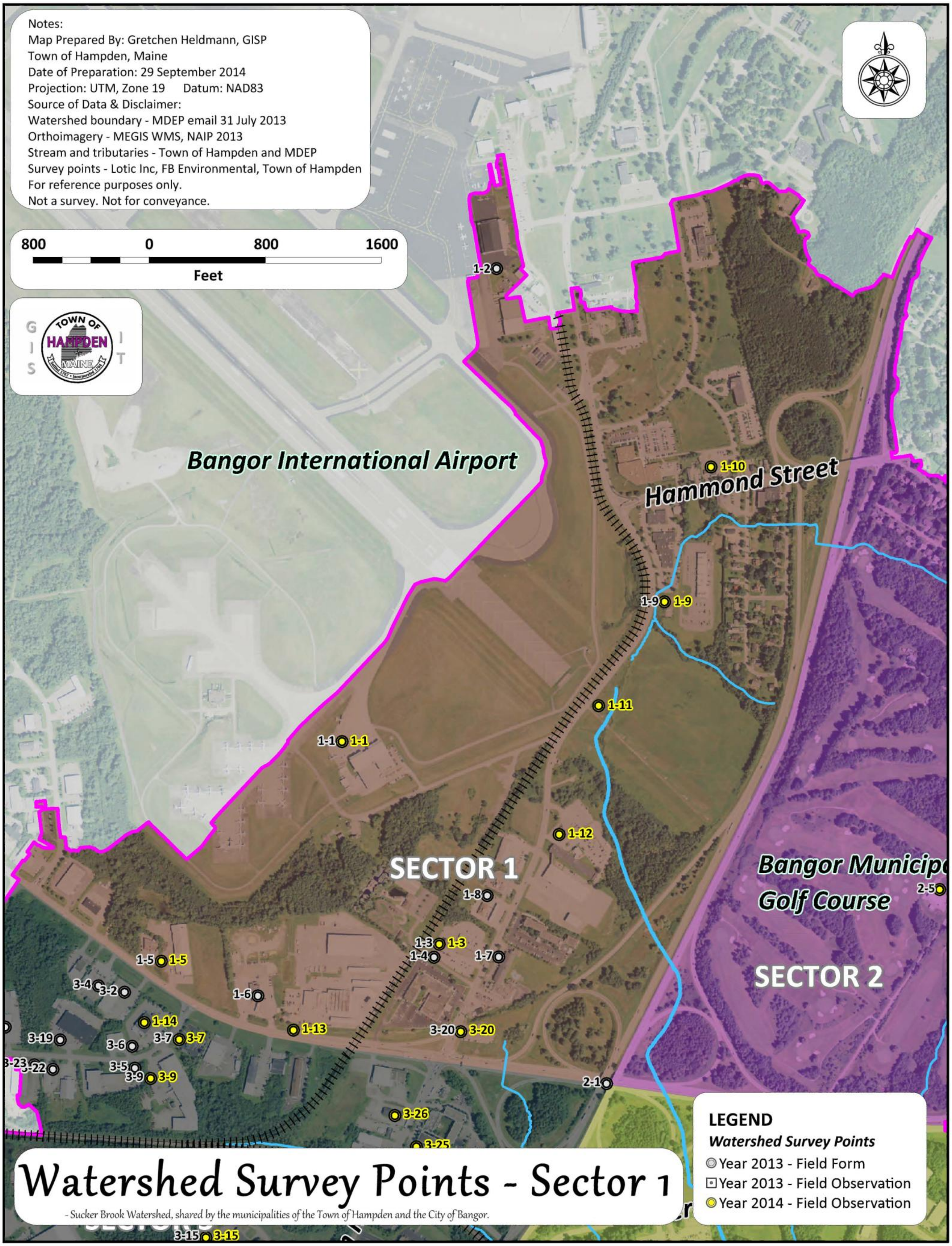
Map 3


Notes:
Map Prepared By: Gretchen Heldmann, GISP
Town of Hampden, Maine
Date of Preparation: 22 September 2014
Projection: UTM, Zone 19 Datum: NAD83
Source of Data & Disclaimer:
Watershed boundary - MDEP email 31 July 2013
Orthoimagery - MEGIS WMS, NAIP 2013
Stream and tributaries - Town of Hampden and MDEP
For reference purposes only.
Not a survey. Not for conveyance.
1500 0 1500 3000
Feet
Bangor International Airport
Hammond Street
SECTOR 1
Bangor Municipal Golf Course
SECTOR 2
I-395
SECTOR 3
Odlin Road
Perry Road
SECTOR 4
BANGOR
HAMPDEN
I-95
BANGOR
HAMPDEN
SECTOR 5
Hampden Business Park Phase I
Ammo Industrial Park
US-202
SECTOR 6
Old County Road
US-1A
Hampden Marina
Penobscot River
Watershed Survey Sectors
- Sucker Brook Watershed, shared by the municipalities of the Town of Hampden and the City of Bangor.

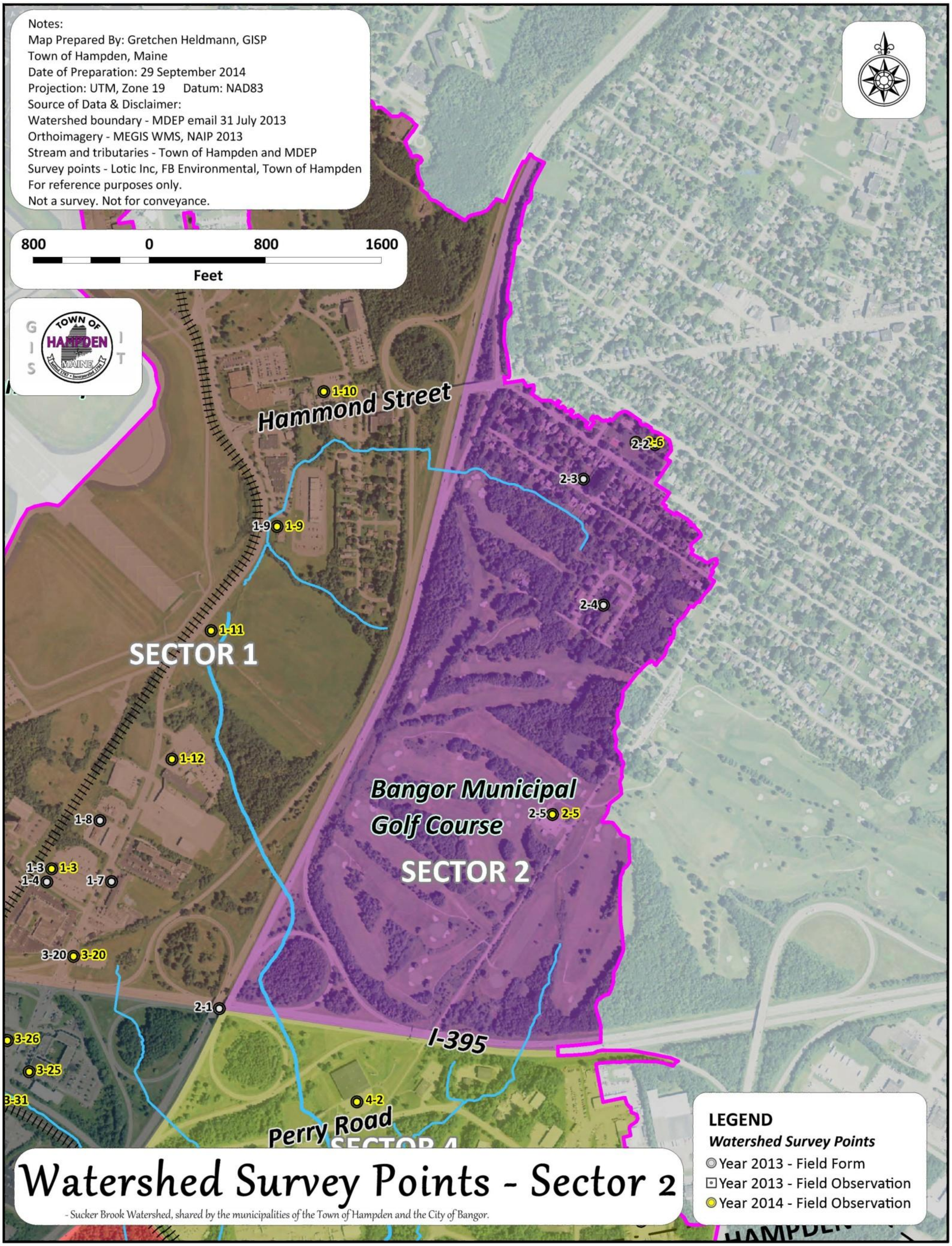
Map 4



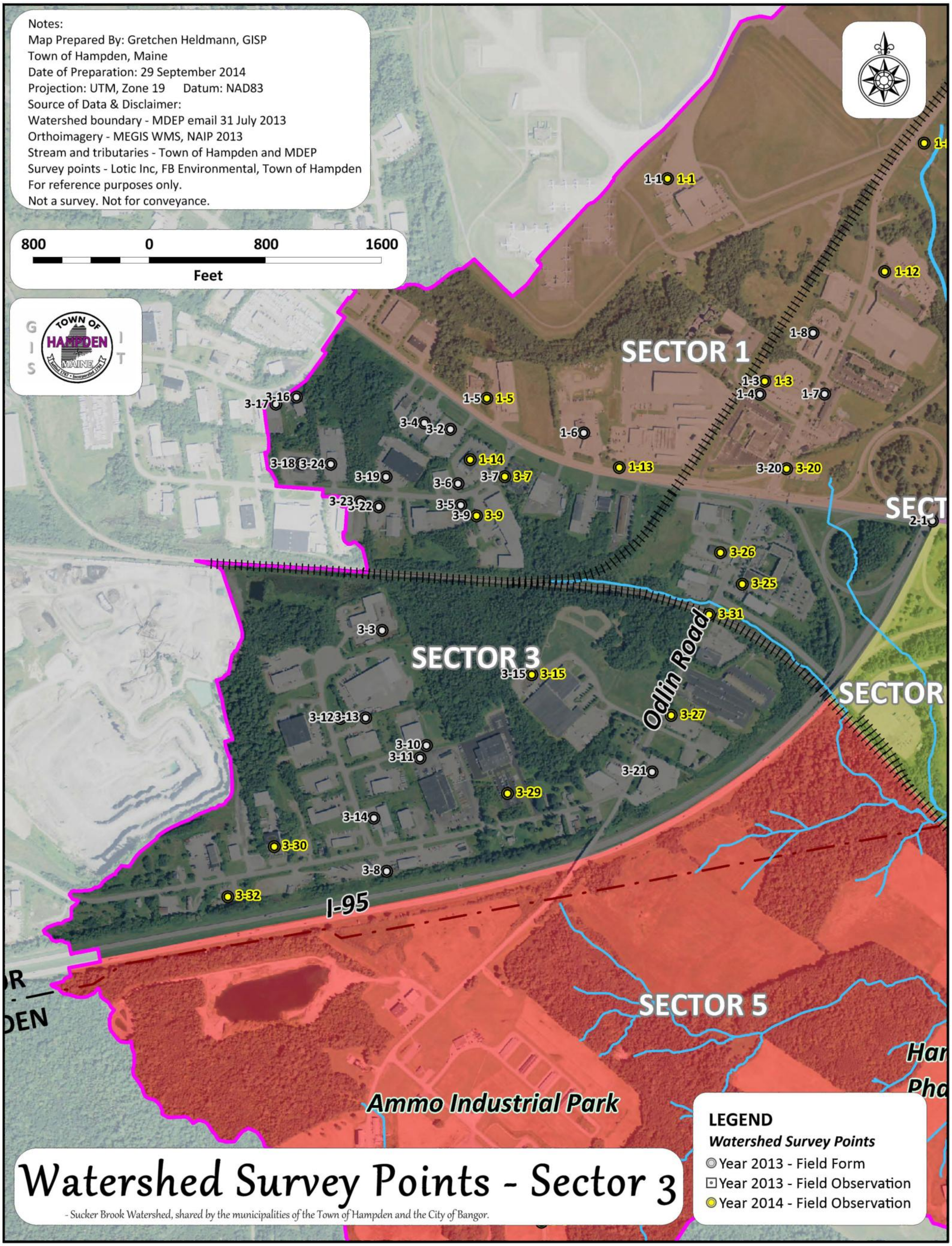
Map 5 (Overview)



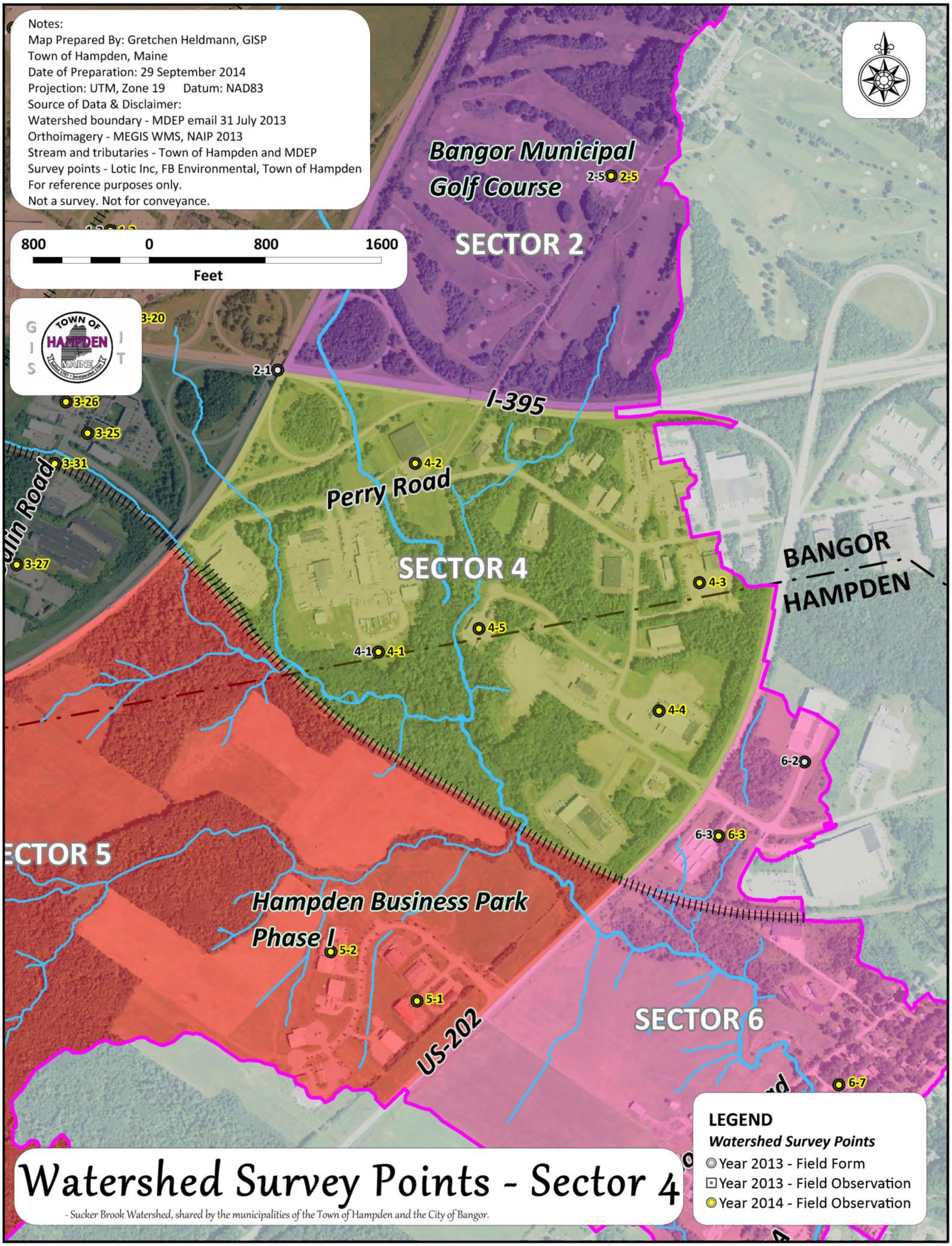
Map 6 (Sector 1)



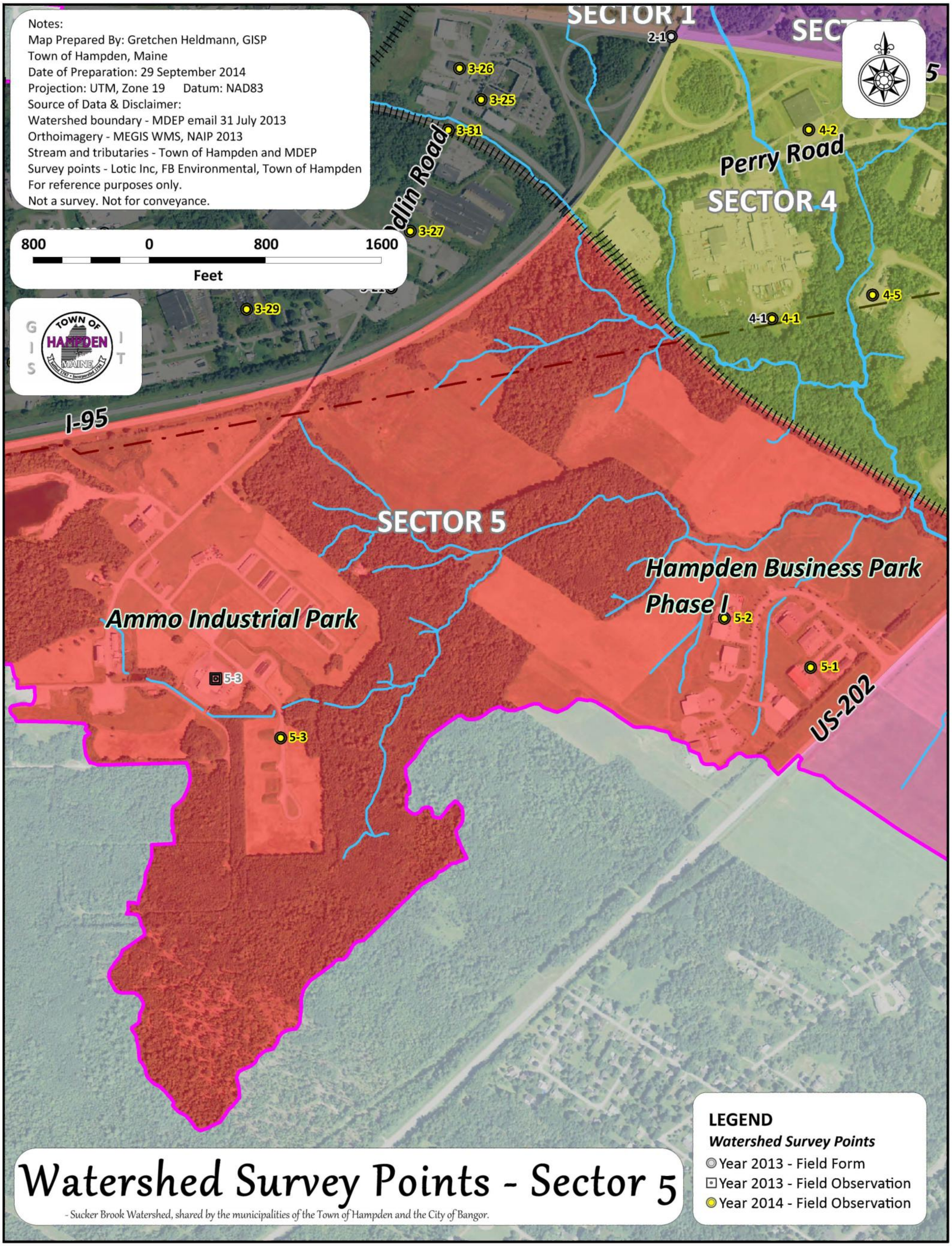
Map 7 (Sector 2)



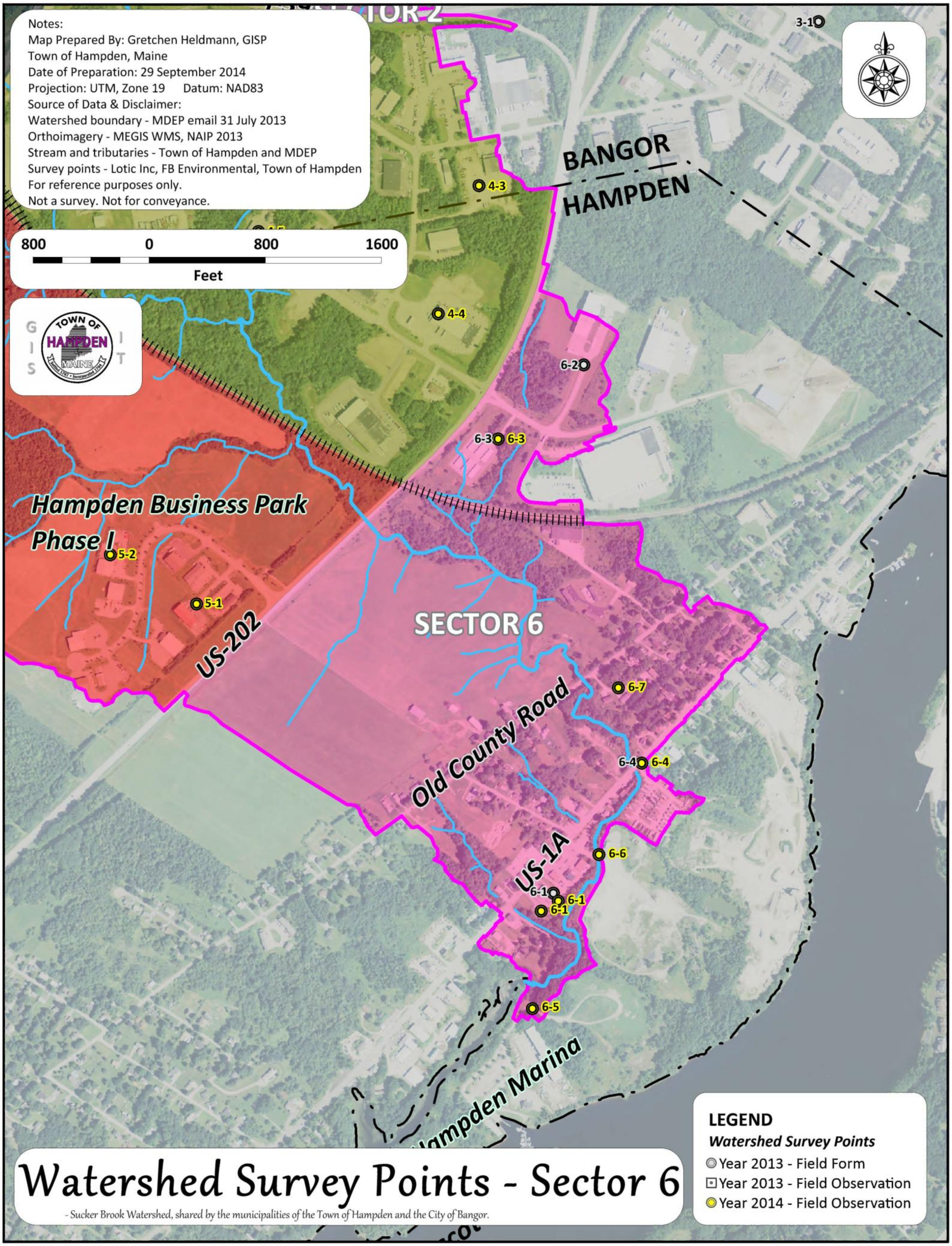
Map 8 (Sector 3)



Map 9 (Sector 4)



Map 10 (Sector 5)



Map 11 (Sector 6)

APPENDIX C

2013 & 2014 Pollutant Sources & Recommendations

Table C.1. 2013 & 2014 Pollutant Sources & Recommendations

Site ID	Year Surveyed	Location	Identified Problems	Recommendations
1-1	2013, 2014	C&L Aviation; C& L Aerospace	Unknown	Rain gardens in existing swale, grade and install turnout at employee parking
1-2	2013	Maine Aero	Direct flow to stream, blacktop erodes into basin, catch basin behind storage, large areas of IC	TBD
1-3	2013, 2014	Rear of Hammond Lumber & Black Beards & EconoLodge & Ramada Inn	High use lots, dog walking	Catch basin insert in front of egress at Ramada Inn
1-4	2013	Roads/Parking near the Ramada Inn	Pet waste, drainage from high-use parking lot, dumpster runoff/"juice"	Improve storm water controls, stencil storm drain, insert hydro carbon filter
1-5	2013, 2014	Magazines Inc. - outer Hammond St.	Direct flow to stream, algal growth in standing water, erosion, disturbed soil near wetland	Stabilize and vegetated eroded areas; dust collector on roof; catch basin inserts placed down gradient
1-6	2013	Mobil Leadbetter	Hot spot, in and out constant traffic, quick turn around, oil greases, metals	Install hydrocarbon filters at filling stations-diesel & gasoline filling stations/islands
1-7	2013	Irving & Hojo's (Odlin Rd & Rt 100/R Cloverleaf)	Hydrocarbons & metals from traffic/interchange, high salt use	Irving - filter; Hojo's sediment filter
1-8	2013	Irving, Subway, Tim Horton's, VIP	Hydrocarbons & metals from heavy vehicle traffic, high salt use; uncovered dumpster, potholes	Hydrocarbon filter
1-9	2013, 2014	Maine Enterprise Business Park (including Northeast cardiology, Sunbury, Hope House, Elks, Red Cross, Maine Savings Bank and residential properties; EMMC Family Medicine, Spekhardt Dental	High potential for chlorides, hydrocarbons from idling; fertilizer/pesticide use	Rain gardens, biofilters, winter barley to absorb chlorides; repair culvert at Elks, filter sediment, nutrients, hydrocarbons & metals in catch basins
1-10	2014	Bangor Savings Bank	Hydrocarbons, 3 catch basins located in parking lot	More vegetation to control runoff, more islands, potential focal point in parking area

Site ID	Year Surveyed	Location	Identified Problems	Recommendations
1-11	2014	Bangor International Airport approach area	no data	Focal point with no vegetation, biofilters on either side
1-12	2014	Days Inn + Ground Round	Hydrocarbons, idling, buses/trucks parked	Rain garden, open up curbing to create diversion, detention pond
1-13	2014	Triangular grass area in front of Hammond Lumber	no data	Diversion on grass triangle at merge from Odlin to outer Hammond
1-14	2014	Stratham Tire	Container of de-icers (magnesium chloride), lots of staining on lot	Rain garden
2-1	2013	I95 Corridor & I95/I395 Intersection	Oil, greases, lubricants, brine/salt, sand, hydrocarbons, trash	TBD
2-2	2013	Residential & Fairmont Park	Moderate use of salt, nutrients, sediment, pesticides, herbicides	TBD
2-3	2013	Residential Area (Silver and Graham Area - residential area south of Hammond St)	High salt use, nutrients, sediment, pesticides, herbicides, direct flow to stream	TBD
2-4	2013	Residential (Fairway Road and New York St Area, nestled between Webster in the east and I95 to the west)	Moderate use of salt, nutrients, sediment, pesticides, herbicides, perforated manholes present; direct flow to stream	TBD
2-5	2013, 2014	Bangor Municipal Golf Course	Nutrients, chlorides, sediments, potential toxics from pesticides + herbicides	Cover sand piles
2-6	2014	Fairmount Park	no data	Potential for rain gardens
3-1	2013	Ditch	ponding of water on impervious area; slight odor	TBD
3-2	2013	Sebco	Large impervious parking area, loading docks	TBD

Site ID	Year Surveyed	Location	Identified Problems	Recommendations
3-3	2013	DOWD Industrial	Potential lubricants and dust from steel area, potential for metal runoff; drains to catch basin	Close dumpsters
3-4	2013	Freihofer's	Impervious and gravel, some erosion, storage, some puddling in graveled area	TBD
3-5	2013	Building #40	Nutrients from lawn, sheet flow to ditch	TBD
3-6	2013	Car service station and store	Stains, leaks/spills in driveway/parking, erosion at culvert	TBD
3-7	2013, 2014	Machias Savings Bank	High use parking and traffic area, high turnover area, coal tar; Hot spot	Lots of vegetation, everything is contained
3-8	2013	JD Raymond	Oils, greases, lubricants, lots of foamy water out of building, open containers; clogged culvert	Add gravel/resurface entire area by I95, good housekeeping and BMPs needed
3-9	2013, 2014	Evergreen Waste	Potential nutrient issues, commercial parking lot, dumpsters	Focal point; detention pond or bioretention cell to deal with huge volume coming off parking lot to outfall, swale, storage cell
3-10	2013	Webber Manufacturing	Construction/bare soil- site is at least 300+ x 400+ ft., silt	TBD
3-11	2013	Fairpoint	90% impervious, moderate use parking- runoff flows to ditch which flows to stream	Treat runoff in swale between Fairpoint and Weber; close dumpsters
3-12	2013	Coca Cola (distribution center)	Loading dock is potential hot spot	Reduce runoff by diverting roof gutters into swale, stop mowing perimeter
3-27	2014	New England Salt Supply	Lots of sediment/salt, uncovered piles, 3 sided storage bins	Sediment piles need covering

Site ID	Year Surveyed	Location	Identified Problems	Recommendations
3-28	2014	615 Odlin Road	Hot spot	Enhance swale with biofilter
3-29	2014	PCHC (Odlin Road)	Hot spot	Erosion from winter plowing damage
3-30	2014	739 Odlin Road	Plugged culvert	Clean out culvert
3-31	2014	Intersection of Odlin + Railroad	Hydrocarbons, creosote, sediment, waxes, metals	Biofilter
3-32	2014	Harvey Paving + Seal Coating	Major off site tracking, erosion, uncovered sediment piles	Biofilter
4-1	2013, 2014	Freightliner	Hydrocarbons from parking lot	Fabco hydrocarbon filter, stabilize vegetation
4-2	2014	Cole Museum	Test BMPs	winter barley, shade trees along both sides of brook
4-3	2014	CB (Chadwick-BaRoss)	Sediments issues/tracking/erosion	Recommend rock/gravel yard
4-4	2014	R.H. Foster, Foster's Mobil and Service	Hydrocarbons. Detention pond issue?	Hydrocarbon filter
4-5	2014	N.S. Giles	pH, hydrocarbons, TSS, sediments, collapsing stream bank	NPRA issue- biofilter
5-1	2014	Hampden Business and Commerce Park (Hampden Vet Clinic, Wight's Sporting Goods, U.S. Blades, Haverlock Estey & Curran CPAs, Central Maine Diesel, Homans Associates, John W. Kennedy Company, Penske)	Frequent deliveries to Wight's, low traffic businesses; idling, oils & metals	Already existing vegetation, rain gardens, possible biofilters
5-2	2014	Clean Harbors	Sediment issues, erosion, potential oils and metals	Biofilters, plunge pool, fix collapsed culvert, berm perimeter of storage area, possible rain gardens, develop snow plow BMP and boundary
5-3	2013, 2014	Ammo Park (Alternative Auto body, BSP, Universal Detailing, other unnamed small businesses)	Sediment issues, potential oils and metals from auto body shop; grass in swale at BSP chlorotic	Existing naturally low land drainage areas, lots of existing vegetation. Lots sold are going to be designed to treat on site. When site is developed institute SW controls and treatment at that time; treatment for nutrients/metals in swale at BSP

Site ID	Year Surveyed	Location	Identified Problems	Recommendations
6-1	2013, 2014	Rawcliffe Carwash & Bosch Auto Service, Rawcliffe's Garage & Hampden Auto Center	Sediment issues in back, old cars lodged in banks and stream at car wash; oil, greases, lubricants, salt, surfactants and waxes, hydrocarbons and metals at garage, unlabeled drums	Gabion baskets, silt filter, grease catch
6-2	2013	Bangor Daily News	Salt use and nutrients, outfall present	TBD
6-3	2013	A*1 Safe Storage	Catch basin with asphalt, silt fence falling, sedimentation issues, salt use	Upper level pond needs cleaning and conduct a BMP inspection on lower pond, silt fence needs to be removed, repair rills on upper area and reseed and stabilize, catch basin needs cleaning
6-4	2013, 2014	Hampden Trailer Park	Severe erosion and sediment issues, open dumpster (leachate), above ground heating oil tanks, trash, animal waste	Stabilize banks, education & outreach on closing dumpster lids and remove unused above ground heating oil tanks
6-5	2014	City of Bangor snow dump entrance	Sediment and mud tracking	Add 100 ft rock apron to egress
6-6	2014	Lane Construction	Erosion problems along banks, failing culvert/fish passage improbable	Stabilize banks, remove culvert and provide an open channel for fish passage
6-7	2014	Residential Areas off Old County Rd.	Nutrient runoff, residential area is steep/topographically higher	Catch basin inserts along Main St.

APPENDIX D

Stream Corridor Survey Photos

Reach 1

Slow moving portion of Sucker Brook in Reach 1.

Reach 2

Section of Sucker Brook flowing through a wooded area in Reach 2.

Reach 3

Example of a pool documented in Sucker Brook in Reach 3.

Reach 4

Steep, eroding banks within Reach 4 resulting in a fallen tree.

APPENDIX E

Stream Watershed Survey Photos

Sector 1

A portion of Sucker Brook flowing near the Red Cross.

Sector 2

Ponded area near the brook at the Bangor Municipal Golf Course.

Sector 3

Eroding ditch along Odlin Road in Sector 3.

Sector 4

Slow moving area and overgrown well in Sector 4.

Sector 5

An agricultural access road crosses Sucker Brook in Sector 5.

Sector 6

Steep bank above Sucker Brook in Sector 6.

APPENDIX F

2014 Watershed Survey Hot Spot Photos

Sector 1

Site 1-9. Northeast Cardiology is one of several businesses at the Maine Enterprise Business Park. <u>Potential pollutants</u>: Chlorides, hydrocarbons, fertilizer and pesticides. <u>Recommendations</u>: Rain gardens, biofilters, catch basin inserts.

Site 1-12. Days Inn and Ground Round. <u>Potential Pollutants:</u> Hydrocarbons from idling vehicles and parked cars and trucks. <u>Recommendations:</u> Rain garden, detention pond.

Sector 2

Site 2-5. Bangor Municipal Golf Course. <u>Potential Pollutants:</u> Nutrients, chlorides, sediments, pesticides and herbicides. <u>Recommendations:</u> Continue implementing management plan; cover sand piles.

Site 2-2. Fairmont Park & Residential Areas. <u>Potential Pollutants</u>: Salt use, nutrients, pesticides, herbicides, direct flow to stream. <u>Recommendations:</u> TBD

Sector 3

Site 3-15. Sargent Corporation. Potential Pollutants: Bare soil, erosion, petroleum in parking lot. Recommendations: Resurface mud parking lot with course gravel, 100-ft rock apron on egress.

Site 3-26. Jimar Construction. Recommendations: Add swale or drainage ditch in front, install bioretention/focal point.

Sector 4

Site 4-1. Freightliner. Potential Pollutants: Hydrocarbons from parking lot. Recommendations: Hydrocarbon filter, stabilize vegetation.

Site 4-2. Section of Sucker Brook in Reach 2, Sector 4 near the Cole Land Transportation Museum. Potential Pollutants: Possible failing BMPs- needs testing. Recommendations: Winter barley, shade trees along both side of brook.

Sector 5

Site 5-2. Clean Harbors. Potential Pollutants: Sediments, oils and metals. Recommendations: Biofilter, plunge pool, rain garden, fix collapsed culvert, install berm around perimeter, snowplow BMPs.

Site 5-3. Ammo Park and Associated Businesses. Potential Pollutants: Sediments, oils and metals from auto body shop, grass swale at BSP chlorotic. Recommendations: Stormwater controls when sites are developed.

Sector 6

Site 6-1. Rawcliffe's Car wash, Bosch Auto Service and Hampden Auto Center. Potential Pollutants: Sediments, old cars in bank and in stream, hydrocarbons, metals, unlabeled drums, etc. Recommendations: stream banks need stabilization and vehicles removed from stream banks; hydrocarbon filter for each catch basin at Garage & Auto Center

Site 6-5. City of Bangor Snow Dump Entrance. Potential Pollutants: Sediment and mud tracking. Recommendations: Change location or add 100ft rock apron to egress.