Pearce Brook Watershed Based Plan

Prepared by
Southern Aroostook Soil and Water Conservation District
Funded by the Environmental Protection Agency October,
September 2012

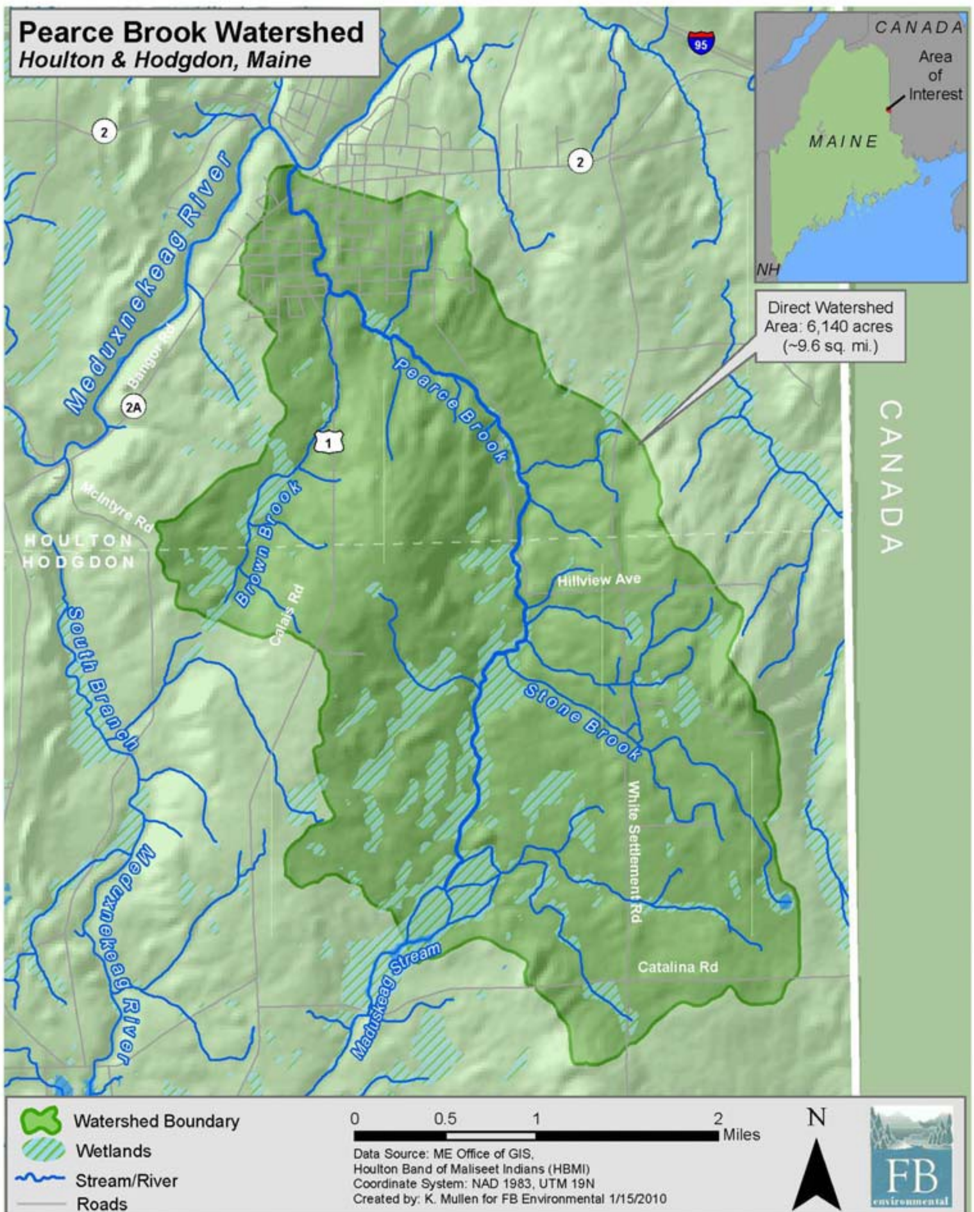

Figure 1 – Pearce Brook Watershed Boundary

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1. Introduction

1.1 Document Purpose

The purpose of the Watershed Based Plan, herein referred to as the "plan", is to lay out a strategic plan of actions needed to achieve load reductions for restoration of the Pearce (pronounced *purse*) Brook Watershed, tributary to the Meduxnekeag River. The Environmental Protection Agency (EPA) requires the completion of a Watershed-Based Plan before obtaining §319 funds to implement Best Management Practices (BMPs) in an impaired watershed. A Watershed-Based Plan must be written to achieve pollutant load reductions as indicated in a TMDL and address EPA's 9 mandatory elements for watershed planning.

1.2 Scope of Plan

The plan is an outline of actions expected to be implemented over the course of a ten-year period (thru 2020) in the Pearce Brook watershed in the towns of Houlton and Hodgdon. Agriculture and forest land make up the majority of the watershed (93%) with the remainder located in the urbanized area of Houlton. While many of the sites in the majority will focus on protection measures rather than restoration, the urban area needs restorative actions. The urban part of the watershed has historically been used intensively for a variety of land uses including mills, industry, transportation and retail – all having a major impact on Pearce Brook.

1.3 How the Plan was Developed

The Plan was developed by gathering public input, implementing a nonpoint source watershed survey/assessment, assembling existing information from watershed stakeholders and analyzing and summarizing this information in a draft report available for public review.

Three public meetings were held in the Towns of Houlton and Hodgdon in October of 2008. This presented a good opportunity to not only educate the public as to what a Watershed-Based Plan is but to gather local concerns, issues and values of Pearce Brook. Previous to the public meetings, articles on the Pearce Brook Watershed ran for two consecutive weeks in the Houlton Pioneer Times.

In the spring of 2009, volunteers gleaned from these public meetings gathered for watershed survey training with Kathy Hoppe from the Maine Department of Environmental Protection (MDEP). Volunteers then worked in teams to survey the Pearce Brook Watershed.

Information was gathered from many different sources including the Houlton Band of Maliseet Indians (HBMI), MDEP, the USDA's Natural Resources Conservation Service (NRCS), Houlton Water Company, the Towns of Houlton and Hodgdon and local agricultural producers. Historical records and data submitted in partnership with the above provided valuable information in determining and documenting EPA's 9 mandatory elements for watershed planning.

2. Watershed Description

2.1 Location

As indicated on the map in Figure 1 on the title page of the plan, the Pearce Brook Watershed is located in the southeast portion of Aroostook County, approximately 8 miles from the Canadian border. Originating in the Town of Hodgdon, Pearce flows in a northerly direction before joining the Meduxnekeag River in Houlton. There are several small tributaries of Pearce including the better known Stone and Brown Brooks. Brown Brook meets Pearce in the residential portion of Houlton and contributes to water levels in the stretch of the brook traveling through Houlton's urbanized portion.

2.2 Population & Demographics

Houlton, incorporated in 1831, is the county seat for Aroostook County, lending it the nickname of "Shiretown". At the time of the 2000 census, there were 6,476 residents in Houlton. The median income for a household in the town was $26,212, and the median income for a family was $34,812. The per capita income for the town was $14,007. 17.7% of the population and 13.5% of families live below the poverty line. Out of the total people living in poverty, 21.0% are under the age of 18 and 15.8% are 65 or older.

Hodgdon had 1,240 residents at the time of the 2000 census. Median household income in the town was $30,188, and the median income for a family was $36,607. The per capita income for the town was $14,573. About 17.4% of the population and 15.6% of families were below the poverty line, including 20.2% of those under age 18 and 26.9% of those 65 years or over.

2.3 Climate

Pearce Brook Watershed is located in an area of the northeast of seasonal temperature extremes. Average snowfall amounts are between 90 – 100 inches annually. Annual precipitation is 38.63 inches. The warmest month of the year is July with an average maximum temperature of 78.40 degrees Fahrenheit, while the coldest month of the year is January with an average minimum temperature of 0.20 degrees Fahrenheit. Average frost free period is about 120 days.

2.4 Landuse

Pearce Brook Watershed contains just over 6,100 acres of farm and forestland with a small, concentrated urban area above the confluence with the Meduxnekeag River in Houlton. It lies within the larger 328,827 acre Meduxnekeag Watershed, a Maine Priority Watershed as designated by MDEP. A map of the watershed is shown in Figure 1.

Land use in the upper Pearce Brook watershed is primarily agriculture (39%) that includes pastures for livestock, cropped land for potatoes and grain rotations and fields that are mowed annually but have been taken out of production. The watershed also has abundant wetland features and good forest coverage (54%) and shade providing cool fish habitat. Forest cover includes approximately 9% wetlands and 45% mixed forest. The lower portion of the watershed (7%) is composed of residential, light industrial and retail.

Present day businesses include hardware and lumber stores, auto repair garages, gas stations including the bulk fueling station, and professional offices, among others. The result is a concentrated urban landscape which features mostly impervious land areas, lack of riparian buffers, and manipulated stream channel morphology near the confluence with the Meduxnekeag River.

2.5 Historic Landuse

Pearce historically housed several mills. The spring 1895 edition of the *Aroostook Pioneer* notes that a steam planing mill, woolen mill, and grist mills were located either on Pearce or nearby tributaries. A cheese factory was also located on Pearce Brook serving nearby dairy farms. In the fall of that year, a tannery was built on Pearce for the tanning of moccasins specifically for lumberman's use. These mills contributed to the remains of demolition debris still visible along parts of the stream bank.

According to Houlton historian Catherine Bell, the area around Pearce Brook was farmland until the early 1900's. It was then that conversion from farms to residential homes began. Many of these early residences near Pearce Brook remain today and retain the architectural details from that time period.

2.6 Recreational Use

The surrounding watershed community has placed a high value on Pearce Brook for many years. According to biologist Dave Basley of the Maine Department of Inland Fisheries and Wildlife, as early as the late '50s or early '60s, Pearce Brook was designated as "fishing restricted to persons 16 years of age and younger" to provide recreational opportunity to school children living in the area. In 1996, the Meduxnekeag Watershed Coalition (MWC) chose to undertake a nonpoint source (NPS) assessment of Pearce Brook citing this fact and their concern for the health of the brook and neighborhood kids fishing in and playing in and around Pearce Brook. Water quality monitoring by HBMI indicates a lower level of water quality than most other tributaries in the Meduxnekeag Watershed. Based on comments from the fall, 2008 public meetings, the brook continues its tradition of being used for youth fishing.

2.7 Soils, Geology and Topography

General surface topography in the watershed is gently to moderately sloping to Pearce Brook with some steep banks, primarily in the urban area of Houlton. The 1985 Maine Geological Survey Department of Conservation Surficial Geologic Map of Maine show the primary geologic unit on the property as till, a heterogeneous mixture of sand, silt, clay, and stones. Soil surveys from the United States Department of Agriculture (USDA) show the primary soil classification throughout the watershed as Mapleton shaly silt loam (MhB). The depth to the seasonally high water table is more than 5 feet and permeability is moderate.

2.8 General Stream Characteristics

A fluvial geomorphology study, funded with USFWS Tribal Wildlife funds, was undertaken in 2007 and 2008. The final report was completed in the spring of 2010. This report will aid in prioritizing bank stabilization needs and/or potential habitat restoration areas in Pearce Brook. Further bank stabilization efforts in the urban area of Pearce depend on future funding availability.

3. Water Quality & Quantity Conditions

3.1 Historic Water Quality Issues

Near the confluence with the Meduxnekeag River in Houlton, Pearce Brook runs through an area that has historically been known as "gasoline alley." In the late 1990's, Water Resources Staff at HBMI reported strong gasoline odors in an area of Pearce Brook. Investigations by MDEP prompted a Limited Phase I Environmental Site Assessment of properties near Pearce Brook completed in June, 2006. The purpose of the assessment was to identify current and/or historical use through records review, interviews, and site reconnaissance that may indicate an existing or past release of petroleum products resulting in a discharge to Pearce Brook. Historical data indicated 30 underground gas tanks had existed within 1,000 feet of Pearce Brook. Many of these tanks had not been registered and while many were removed in 1981, 1982 and early 1990's, it is unknown if all had been removed. Several of those tanks had leaked petroleum into the ground, following utility trenches that not only caused vapor issues for nearby businesses, but had/have a significant impact on the quality of Pearce Brook.

In 1998 an oil spill occurred at an Irving Oil Bulk Plant sending MTBE, Benzene and Toluene into the adjacent sewer line killing bacteria in the sewage treatment plant, and causing extensive ground contamination. Contaminated soil from the Irving spill was not cleaned up until 2005 and 2006 and was disposed of via land spreading outside the Pearce Brook watershed. This site is listed on the MDEP's Division of Remediation Sites List as part of the Voluntary Response Action Program (VRAP) with a status of "Operation and Maintenance," which means the site is still open and has not yet met cleanup criteria.

As noted in the Limited Phase I Environmental Site Assessment, 2003 investigations of a petroleum release to Pearce Brook from a stormwater drainage system at the former L.E. MacNair Superfund site found high levels of contaminated soil in borings. The borings indicated that petroleum release occurred to shallow soils on a nearby property where bulk tanks were offloaded from the railroad and migrated through groundwater flow to soils on the MacNair site, entering the surface water drainage system and discharging into Pearce Brook. This stormwater drainage system was relined in 2004. In 2005, the fuel racks at this site (now a Maine Potato Growers bulk plant), were upgraded to provide more effective containment of potential releases.

3.2 Current Water Quality

MDEP classifies the Meduxnekeag River from the outlet of Meduxnekeag Lake (aka Drews Lake) to the international boundary and its tributaries Class B unless otherwise specified. Pearce Brook is classified as Class B.

According to their 2008 Integrated Water Quality Monitoring and Assessment Report the Meduxnekeag falls into Category 2 – Rivers and Streams Attaining Some Designated

Uses – Insufficient Information for Other Uses, and Category 5-C Rivers and Streams Impaired by Legacy Pollutants with DDT listed as the cause. The Meduxnekeag is also listed as a category 4-A Rivers and Streams Impaired Use – TMDL Completed. The TMDL was approved by EPA March 8, 2001. Pearce Brook is not singled out in the 2008 Integrated Water Quality Monitoring Assessment Report.

In 2005, MDEP collected pore water samples along Pearce Brook in order to identify current and/or historical use of petroleum discharges through groundwater to surface water. In 2007, MDEP began an extensive contaminated soil clean-up in and around the area. The clean-up has been reported on extensively in the local media and the work continues to be highly visible to the community. Funding for future mitigation depends not only on the work being completed at identified sites but evaluating additional potential sites.

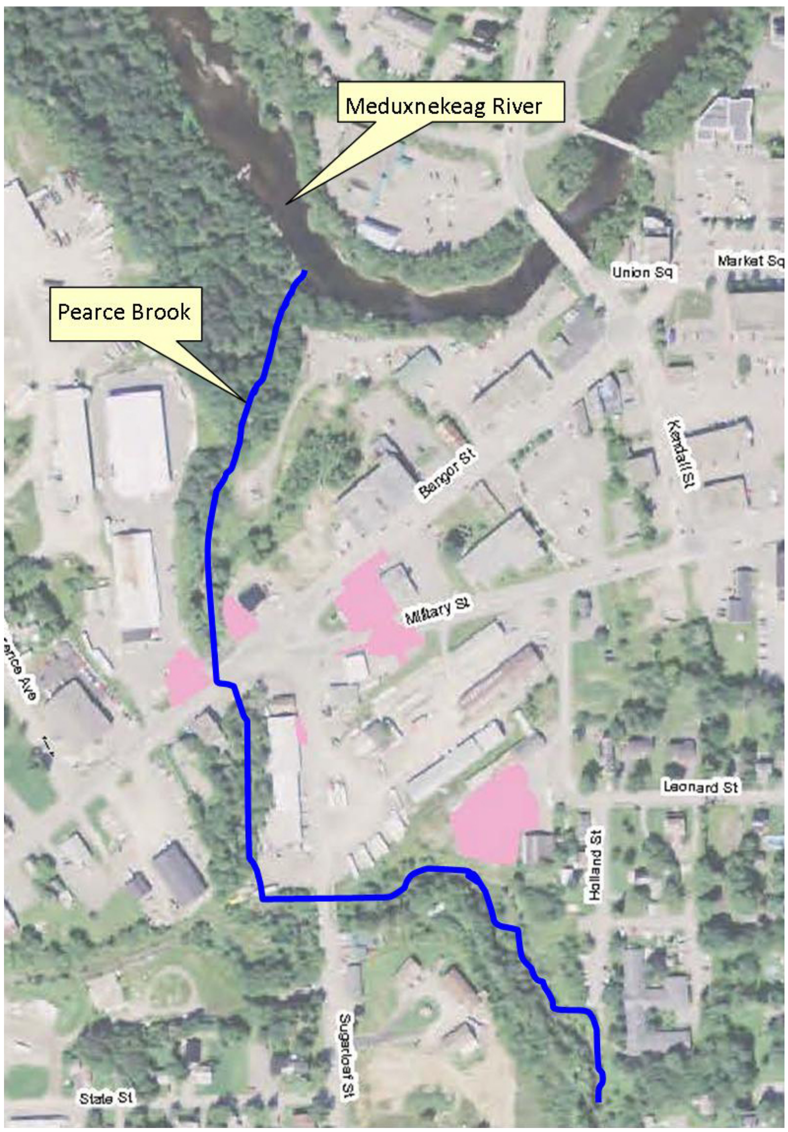

Figure 2, “Gasoline Alley”

Figure 2 – areas in pink indicates soil contamination cleanup in the “gasoline alley” portion of Houlton’s urban section.

In 2007 HBMI and the Town of Houlton organized a successful Pearce Brook clean-up day where over 20 community volunteers picked up over a thousand pounds of trash in the stream and along its banks. Additionally, in the photo to the right, a clean-up day in the mid-1990's shows the pervasive problem of "garbage dumping" along the banks of Pearce that continues today, especially in the rural areas of the watershed.

Since 1999, HBMI has monitored Pearce Brook for E.coli, Enterococcus, dissolved oxygen, pH, nutrients, water temperature and conductivity. The brook has also been sampled for aquatic invertebrates which indicate Pearce Brook meets its state water quality classification of B, while many of the other tributaries in the region attain the higher standard of Class A.

In recent years routine sampling conducted by HBMI indicates a potential bacteria issue in the Pearce Brook watershed. Preliminary data has been shared with MDEP and a sampling plan will be developed in order to determine any water classification violations as well as to isolate any pollutant sources. Sampling has increased along Pearce since 2003. Focused sampling could narrow down problem areas and inputs. HBMI's Water Resources Program currently monitors for E. coli bacteria by sampling within the storm drain system, at one storm drain outfall and on Brown Brook, a tributary to Pearce Brook. Water Resources staff monitor flow, temperature conductivity and nutrients on an annual basis at an established USGS partial gauge site at the stream crossing on Columbia Street.

3.3 Watershed Survey

As mentioned earlier in the description of the watershed, MWC undertook a NPS assessment of Pearce Brook in the Houlton area in 1996. Many instances of soil erosion were identified including stream bank erosion, eroding road ditches, sidewalks, driveways, and bridges, rotted cribwork along stream banks and sediment and trash in the stream. As a result of the assessment, MDEP awarded the Southern Aroostook Soil and Water Conservation District (SASWCD) Clean Water Act §319 grants in 1998 and 2003 for bank stabilization projects in two locations in Houlton. However, while the 1996 assessment helped secure funding for these two projects, the same assessment needed to be updated as it was over 10 years old, not documented with photos or mapped locations, and did not follow a consistent data gathering protocol.

During the course of annual water quality monitoring on Pearce Brook in 2010, HBMI Water Resources staff identified infestations of Purple Loosestrife, an invasive wetlands plant, south of the railroad line in the area between Franklin and Holland Streets on both sides of the Brook. If possible, these infestations should be eradicated. HBMI will continue to look for other Purple Loosestrife infestations.

3.4 Water Quantity Issues (Flooding)

The 1976 Flood Insurance Rate Map (FIRM) for the Town of Houlton shows a 100 to 200 foot wide flood zone on both sides of Pearce Brook. Some homes are located in this floodplain.

Maine Department of Transportation (MDOT) recently finished repairing Bangor Street adjacent to Pearce Brook. Repairs included replacing and upgrading Bangor Street's Pearce Brook crossing with a larger culvert that will improve fish passage and address road drainage issues. Much of this road and culvert work took place concurrently with MDEP's mitigation project which worked out well for these state agencies and minimized disruption area businesses experienced.

According to Leigh Stilwell, public works director for the Town of Houlton, past road work on Court Street by MDOT included new catch basins, street curbing and upsized culverts with smooth bore piping that increased overall water volumes and led to the Town of Houlton to upsize the Brown Brook culverts on Chandler Street. Consequently, because of the work conducted upstream, downstream areas are now affected negatively as they are not appropriately sized to handle the new water volume levels. This includes the MDOT owned Green Street Bridge that is too small to accommodate the increased water volume during higher rainfall amounts and is prone to flooding, especially after ice build-up around the bridge that creates, in essence, a small dam. According to the afore mentioned 2010 fluvial geomorphology study, this stream crossing "is on the Maine Department of Transportation's priority replacement list, so new culvert designs should plan for a channel spanning bottomless culvert to eliminate the severe constriction. Flood flows can overtop the low bridge and banks, so morphological effects are less severe."

Green Street Bridge, June 2012

The flooding affects not only the stream channel but the bridge, the road, and two homes. The personal and family records of Alison Gooding, owner of one of the two affected homes, indicate 9 flood events have taken place since 1958. Five (5) of those have occurred since 2005; all requiring the Gooding family to evacuate from their home. While there is much-needed work on the Green Street Bridge to be done, that work would then affect the culvert crossing on Sugarloaf Street, causing new problems there.

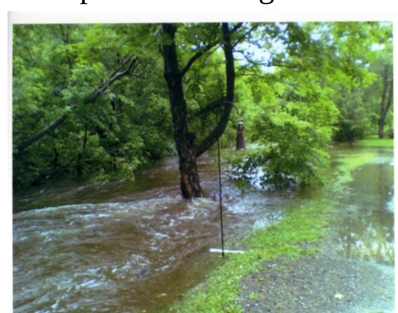

Photo courtesy: A. Gooding

The United States Geological Survey (USGS) has a gage station at the crossing of Route 1 that measures flow levels and is funded cooperatively between USGS and MDOT on a two year cycle. Measurements began in April, 2008 with continuous data collection beginning in June of that year. According to HBMI, USGS has never indicated anything unusual about the flow levels.

3.5 Fish Passage

Two natural bottom culverts on Pearce Brook have been installed recently along with the large culvert crossing on Bangor Street replaced in 2008 by MDOT. Based on an HBMI culvert study funded through a Tribal Wildlife Grant from US Fish and Wildlife Service (USFWS), there are at least three additional culverts in the immediate area that need replacement. These three are among the top ten list of culverts recommended for improvement in the Meduxnekeag watershed. Tribal Wildlife Grant funds will be used to design restoration plans for the three culverts.

Nine Mandatory Elements of the EPA Watershed-Based Plan

4. Identification of Causes and Sources [Element One]

4.1 Municipal or Industrial Wastewater Treatment Facilities

There are currently no licensed point source discharges in the Pearce Brook watershed. Twenty-five percent of the area is served by the Houlton Water Company's municipal wastewater collection system. There are no known combined sewer overflows (CSOs). In the past, Houlton Water Company has conducted smoke tests to identify illicit or accidental sewer line connections to the municipal stormdrain system. Additional testing over a greater span of time needs to be done to identify any other possible sewer line connections to the stormwater system.

4.2 Municipal Stormwater System

As mentioned in Section 3.4, past road work on Court Street by MDOT included new catch basins, street curbing and upsized culverts with smooth bore piping that increased overall water volumes and led to the Town of Houlton to upsize the Brown Brook culverts on Chandler Street.

Street sweeping in the Pearce Brook watershed is done each spring to clean up winter sand and debris and then on an as-needed basis. Since Houlton has a total of 800 catch basins and one cleaner, they are unable to realistically clean all of the catch basins on an annual basis. According to Leigh Stillwell, Houlton Public Works Director, they try to ensure that each basin gets cleaned at least once every two years. Problem basins at the bottom of slopes are prioritized. Some of the 800 catch basins are located in back yards and must be cleaned by hand. These are more difficult to access and maintain.

4.3 Agriculture

Agriculture makes up 39% of the Pearce Brook watershed and includes a small livestock farm with approximately 150 cow/calf pairs and several landowners with horses, estimated at no more than 20. Other agricultural fields are located in the watershed with the main farming operation located outside the watershed boundary. A small portion of those fields are in a grain and potato rotation and manure is applied and incorporated in the fall. Currently, a nutrient management plan is being followed by the livestock producer. Construction of a manure storage area in 2009 at the home farm has alleviated winter runoff issues at the off-farm manure storage location where the manure was precariously stored next to a wetland draining into a tributary of Pearce Brook. Non-point source pollution remains in the spring, summer and fall as cattle use a pasture pond as their primary drinking water source. This pond drains into a swale that is a direct route to a tributary of Pearce Brook. Additionally, those landowners with 1-3 horses each need education on proper manure storage and management to help control runoff in the watershed as manure is also a source of nutrients and bacteria in the watershed.

4.4 Forestry

Forestland makes up 59% of the rural area of the Pearce Brook watershed. As is visible in the riparian buffer analysis map in the Appendix, there are clear cuts near the brook. Many of these were examined as part of the spring 2009 watershed survey and several sites included dead swathes of forest caused by beaver dams, washouts, diverted stream channel and improper stream crossings.

One @ 350 acre woodland area off Hillview Road was cut in 2006 with sites approved by the Hodgdon planning board to sell as camp lots. This same forested area contains an ATV trail with deep ruts and runoff along the trail that are exacerbated with seasonal trail use and also from poorly constructed/maintained forest roads from the 2006 harvest.

4.5 Industrial/Commercial/Retail

- Due to a pesticide plume on the bank of Pearce Brook, the MacNair property, a site historically used to process pesticides, was declared a non-National Priorities List (NPL) Superfund site in April, 1989. The Superfund website http://cfpub.epa.gov/supercpad/cursites /srchsites.cfm lists the site as no further action required.
- A petroleum discharge was identified by MDEP in May, 2002 at the edge of Pearce Brook on this same property. At the request of MDEP, the URS Corporation prepared a site investigation report in 2003 and 2004 on a total of three identified petroleum sources to Pearce Brook. Sampling data was taken via a groundwater collection sump and trailer-mounted groundwater treatment system next to the discharge to treat the impacted groundwater. The report included recommendations to help mitigate the petroleum impacts to Pearce Brook. Many of the report’s recommendations have been implemented such as revamping a specific site’s AST overfill containment set-up. Other recommendations still need to be considered such as limited source removal or other remedial options for contaminated soil and groundwater on the former MacNair site. MDEP has not undertaken any removal activity due to the high cost and public water supply availability. An additional recommendation includes the continued use of MDEP’s installed sump to help recover impacted groundwater. Groundwater and stormwater are still being monitored in the spring and fall for gasoline and diesel fuel. However, the treatment system is no longer running.
- MDEP’s study of the banks of Pearce Brook in this area also indicates an old rail bed with petroleum concentrations which follow groundwater and feed into the brook. Data from soil borings indicated that a petroleum release may have migrated through groundwater flow. MDEP Bureau of Remediation and Waste Management recommended “soil removal activity, and possibly re-establish the old former drainage swale, and construct a natural filtration/wetlands area to remediate the groundwater prior to discharging to the brook” (letter from Paul Higgins, MDEP Geologist, 2004)
- This area includes several auto repair garages. Traditionally, auto repair shops had a drain in the floor of their shop and discharges were not regulated. Regulations for storage systems and underground discharge became effective in the mid- 1980’s, but based on observations from the 2009 watershed survey, oil residue was apparent on the ground just 25’ from the brook.

- As Pearce Brook enters the industrialized section of Houlton, the banks become prohibitively steep; the result of decades of placing fill in the floodplain to allow additional development. Thus, there are many sections that are subject to scouring and moderate to excessive erosion. HBMI conducted a survey along Pearce Brook in Houlton and rated the streambanks as stable, scouring, moderately eroding or eroding. On the following page, Figure 3 gives an overview of survey findings with major street names highlighted. There are multiple areas where the bank is slumping, and the bank stabilization structures are severely eroding e.g., a 15-20 foot high erosion/slump at the corner of Columbia and Brook Streets. Artificial channel straightening, decreased infiltration due to paved areas/impervious surfaces, and historical alterations to the brook's physical structure exacerbate the effects of peak flows. There is also minimal buffer in many places along the brook (refer to map in the Appendix for a Riparian Buffer Analysis) and there continues to be a need to clean up the stream banks in the industrial portion as debris remains such as large metal parts, double-axle truck tires, and a rusting vehicle(s).
- As shown in the Appendix, ArcGIS was used to determine the percentage of impervious surfaces within the Pearce Brook watershed. The map layer indicates that approximately 5% of the watershed has impervious surfaces, with most of that percentage located within the urbanized portion of Houlton proper. These include roads, driveways, parking lots and roofs. According to the map, Brown Brook is also affected by many impervious surfaces as it follows Route 1 and subsequently joins with Pearce Brook.

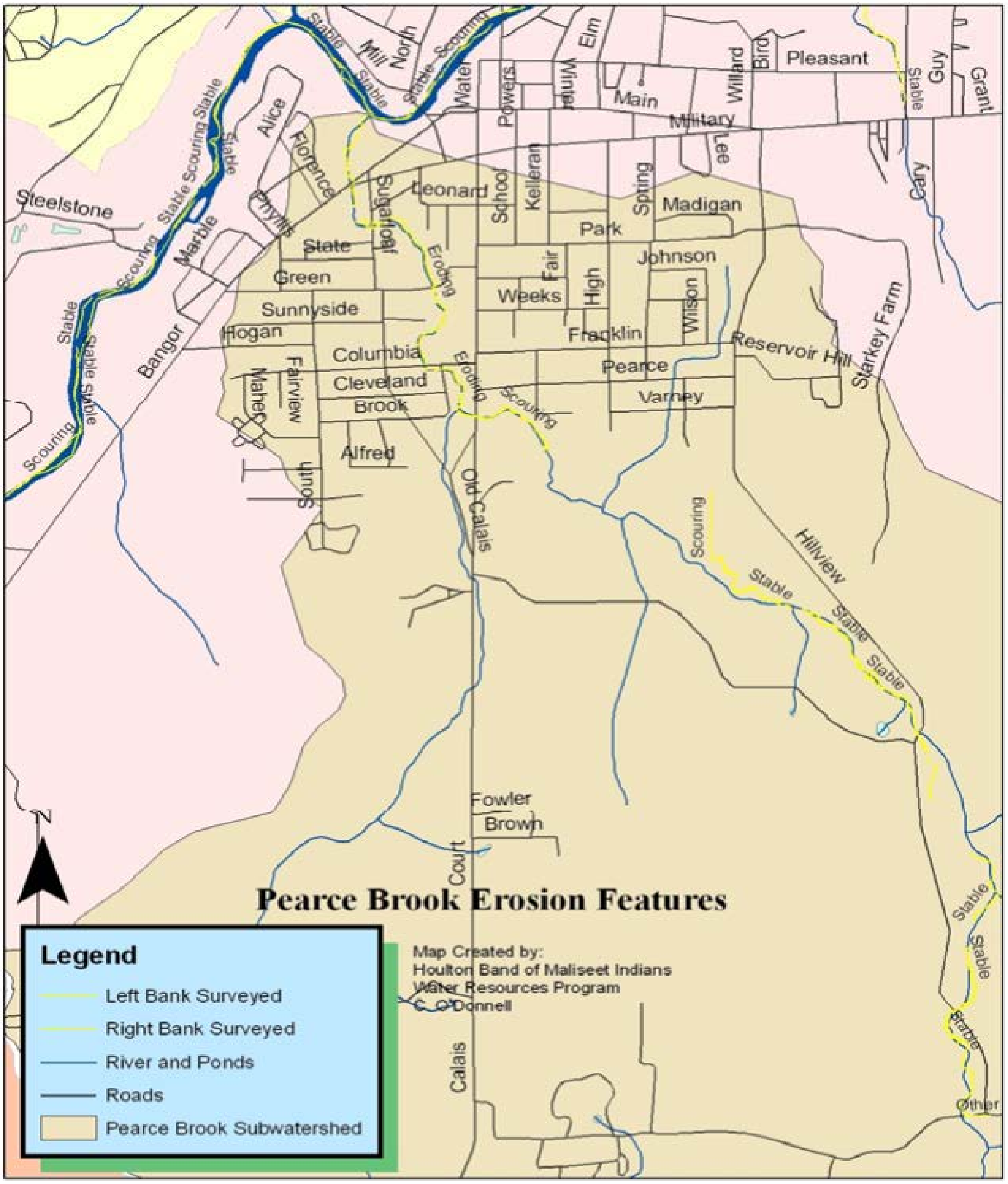
Pearce Brook Erosion Features
Legend
Left Bank Surveyed
Right Bank Surveyed
River and Ponds
Roads
Pearce Brook Subwatershed
Map Created by:
Houlton Band of Maliseet Indians
Water Resources Program
C. O'Donnell
N
Steelstone
Bangor
Marble
Alice
Florence
Phyllis
State
Green
Sunnyside
Hogan
Columbia
Cleveland
Brook
Alfred
Maher
Fairview
South
Sugarloaf
Leonard
School
Kelleran
Spring
Madigan
Park
Johnson
Fair
High
Weeks
Franklin
Wilson
Pearce
Varney
Reservoir Hill
Starkey Farm
Hillview
Old Calais
Court
Calais
Fowler
Brown
Water
Powers
Winter
Elm
Main
Military
Lee
Willard
Bird
Pleasant
Guy
Grant
Cary
Mill
North
Eroding
Scouring
Stable
Other

Figure 3

4.6 Residential

- Traveling on Hillview Road along the eastern part of the watershed from Houlton to Hodgdon, there is a historical problem of illegal garbage dumping along the roadside. This is probably due to the rural nature of a large part of the road where there are very few occupied homes, and the fees charged at the transfer station for depositing certain items such as tires, televisions and other appliances. Refrigerators and freezers built before 1979 may contain polychlorinated biphenyls (PCBs) and so-called "e-waste" may contain toxins and heavy metals. Hillview crosses Pearce Brook twice and each crossing is through part of a wetland.
- Much of Pearce runs through the forested portion of Hodgdon although residential lawns and fertilizing practices could affect many of the smaller tributaries east of Pearce. Within the boundaries of Houlton, Pearce flows through residential areas before traveling through the business section of town. In the spring 2009 survey, photos were taken of neighboring residential lawns that visually indicate a chemically-treated lawn versus a non-treated lawn containing a variety of grasses and weeds. These visual records reflect further education and outreach to the public on alternative lawn care is necessary. Storm drains within this section are the gateways for fertilizer run-off. As indicated in the Riparian Buffer Analysis map in the Appendix, much of Houlton's residential area also needs additional buffers to help with streambank erosion.
- In addition, there are the "every day" urban impacts of gas and oil drips, litter and pet waste that are likely to make their way to nearby storm drains. Many examples of this kind of residential waste were documented during the 2009 spring survey.

4.7 Transportation

- Town roads within Houlton proper indicate some road surface and shoulder erosion, particularly in the area where Pearce Brook and Brown Brook meet. As Brown connects with Pearce, there is short dirt road which runs alongside the stream that is a source of soil directly eroding into Pearce. Residents in this area brought a petition before the Houlton Town Council a few years ago requesting this short stretch of dirt road be closed but the petition was denied.
- As mentioned in Section 3.4, Maine Department of Transportation (MDOT) recently finished repairing Bangor Street adjacent to Pearce Brook. Repairs included replacing and upgrading Bangor Street's Pearce Brook crossing with a larger culvert that will improve fish passage and address road drainage issues. This culvert replacement could use naturalization, tree planting, safety structures, etc. This is a long culvert that could be deadly during high flows.
- Outside of Houlton's urban area, the 2009 spring survey showed many culvert crossings on town roads to be partially blocked, damaged, hanging or having unstable inlets and outlets. In addition, there are stream banks that need vegetation and stabilization.

5. Estimation of Load Reductions from Planned Management Measures [Element Two]

Fecal coliforms are bacteria that are associated with human or animal wastes. *E. coli* is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The state of Maine uses *E. coli* to identify violations of water classification in fresh water body systems. However, for this report, fecal coliform loads were considered as a whole and estimated using the best available information about four types of sources in the watershed. The calculations performed follow the same general framework as the computer model AVGWLF, produced by Dr. Barry M. Evans and Kenneth J. Corradini of Penn State. Like the computer model, the spreadsheet method is non-spatial. In other words, no consideration is made for where activities occur within the watershed. The spreadsheet generates an annual load estimate, rather than monthly estimates as in AVGWLF. Another difference is that several parameters were estimated directly, based on local watershed knowledge, rather than from regional GIS data. Many bacteria sources are difficult to quantify. The results of the spreadsheet are simply an estimate, based on documented sources and straightforward calculation methods that can provide one additional viewpoint of likely sources of water quality impairment.

There are four sources considered in the calculations:

- Septic systems which are malfunctioning;
- Polluted runoff from developed areas, which includes abandoned pet waste;
- Wildlife; and
- Farm animals.

The annual loading from each of these sources to the stream are summed to arrive at an overall annual estimate.

<u>Malfunctioning Septic Systems</u>

Septic systems, when operating properly, reduce bacteria in waters to virtually none. However, they can and do malfunction. Common sources of malfunction include (among others):

- Disposal field (or leach bed) clogged with solids;
- Leaking distribution pipes or septic tank;
- Permanent or temporary saturation of disposal field, which greatly increases bacterial transport through groundwater; and
- Overfull septic tank.

Many types of septic system malfunction can be invisible or unobtrusive enough to persist for years. For example, high bacterial transport due to a disposal field which sits submerged in groundwater can deliver bacteria to streams without ever drawing homeowner or neighbor attention.

A 2009 Houlton Water Company map of the existing sewer system indicates that the entire urbanized portion of the watershed, which is roughly the northern quarter of the watershed, is sewered. John Clark of the Houlton Water Company says there are no known sewer waivers within the public sewer area, no CSOs, and that the sewer lines have recently been relined. All of these factors reduce bacterial loading to streams. Leaks in the sewer infrastructure, occasional malfunctions or discharges, including pump failures, could be sources of bacteria contamination in the brook. For these calculations, however, they were assumed to be zero.

The remaining area of the watershed appears to be not connected to the sewer. Using the Houlton Water Company sewer map, a watershed outline provided by HBMI, and high resolution aerial photographs (accessed via Google Maps, January 2010), the number of houses in the remaining watershed was estimated at 114, and two people per house was assumed. Several studies (Noss and Billa 1988, Dix and Hoxie 2001) indicate that as septic systems age, they fail more frequently. A 10% failure rate corresponds to a system age of about 10-11 years, and was selected here. This corresponds to about 23 (10% of 228 people) people in the watershed who are using malfunctioning septic systems. Humans shed approximately $2x10^9$ bacteria per day (Metcalf and Eddy 1991), but even in a failing system, some attenuation is expected. Tanks allow some degree of settling and temporary retention. Overland flow across the surface allows die-off from sunlight. Flow through the ground allows at least some filtering and temporary retention. Zero attenuation would exist only when there is a direct and immediate conduit from toilet to stream, such as an open wastewater trench or straight pipe discharging into surface waters. A one-order of magnitude reduction is assumed, which means 10% of the bacteria going through a failing system reach the water.

People per House		Houses on Septic in Water-shed		Septic Failure Rate		Daily Bacteria Load per Person		Attenuation (orders of magnitude)		Days per Year		Annual Bacteria Load Estimate
2	x	114	x	10%	x	2.0E+09	►	1	x	365	=	1.7E+12

2.0E+08 per person daily load

<u>Developed Area Runoff</u>

Precipitation runoff from developed areas has been shown to contain many pollutants, including fecal coliform bacteria. These bacteria occur in part due to abandoned pet waste. The Center for Watershed Protection has reviewed runoff water quality data from over 1,000 storms, and found that for residential areas, the average concentration of FC bacteria is 7,000 counts / 100mL (Pitt, et al. 2004), when distributed over the course of each storm. This figure is called the Event Mean Concentration (EMC). The volume of runoff from a developed area has been correlated with its impervious cover ratio (Schueler 1987). Using Maine Office of GIS (MEGIS) data, this ratio was calculated, which then allowed the amount of annual runoff to be calculated. The USDA National Agricultural Statistics Service 30-year average annual precipitation for Houlton was multiplied by the runoff fraction and the EMC for residential land to arrive at this estimate.

EMC (org/100mL)		Developed Land Area (square miles)		Annual Precipita-tion (inches)		% Imper-viousness within Developed Area		Runoff Fraction		Annual Bacteria Load Estimate
7,000	x	0.97	x	38.6	x	49.6%	►	0.50	=	8.6E+13

1.22E + 106 = annual runoff volume (cubic meters)

emc x (1-dieoff rate) x (precipitation in inches-->meters) x (land area in sq mi-->sq meters) x runoff fraction x (convert cubic m to 100mL units)

Wildlife

Bacteria from wildlife is not considered a violation of water quality standards. However, due to the predominantly rural nature of the watershed, it is included in this plan. Wildlife estimates are the most difficult to obtain. There are very few studies that have calculated the amount of fecal coliform bacteria shed by the many species of wildlife found in Maine. We considered deer and moose. and we assumed that per pound of live weight, deer and moose produce equivalent numbers of bacteria. We used area of non-developed land from MEGIS, and Maine Inland Fisheries and Wildlife species density estimates to determine numbers of animals in the watershed. We assumed that most of their wastes accrue on land, and only 10% of bacteria make it to the water, via overland runoff. These estimates would be somewhat higher (up to an order of magnitude) if these animals spent a significant amount of time in streams.

Research provides only a deer FC loading rate,

Deer

Habitat Area (sq mi.)		Species Density (per sq mi.)		Daily Bacteria Load per Animal		1 minus Die-off Rate of 0.9		Days per Year		Annual Bacterial Load Estimate
8.9	X	4.8	X	1.4E+08	X	0.1	X	365	=	2.2E+11

43 estimated number of animals

Moose

Habitat Area (sq miles)		Species Density (per sq mi.)		Daily Bacteria Load per Animal		1 minus Die-off Rate of 0.9		Days per Year		Annual Bacterial Load Estimate
8.9	X	5.7	X	5.4E+08	X	0.1	X	365	=	1.0E+12

51 estimated number of animals

Farm Animals

The approach to estimating farm animal bacterial sources depends on many assumptions. Luckily, manure from many farm animals has been analyzed for FC concentrations (ASAE 2003). It is notable that horses produce far fewer FC bacteria than just about any other farm animal, per pound of live weight. We assumed that all farm animals spent 70% of their time in barnyards, and 30% grazing. Of the barnyard manure, we assumed that 50% was spread on fields, which allowed 6% of bacteria to run off to streams. The other 50% of barnyard manure was assumed to be stored under best management practices, with an estimated 2% running off. Of the grazing time, we assumed 90% was spent on land with 12% runoff (consistent with AVGWLF projections), and 10% standing in streams (with 100% reaching streams). All of these estimates can be easily modified, based on local knowledge, to better reflect conditions in the watershed, if needed. Finally, we applied an in-stream die-off of 50%, identical to the AVGWLF model.

Horses

Number of Animals		FC Produced per Day per Animal		Total FC Produced per Day	Total Loading from Farm Animal per Year
20	X	**4.2E+08**	=	**8.3E+09**	**1.9E+11**

Cows

Number of Animals		FC Produced per Day per Animal		Total FC Produced per Day	Total Loading from Farm Animal per Year
150	X	**1.2E+11**	=	**1.8E+13**	**3.0E+14**

Overall Estimate

The final estimate is simply the sum of the above sources. There is an unavoidable degree of uncertainty with some of the assumptions made here, in particular wildlife and septic system failure rates. Other parameters have been extensively researched, such as the amount of precipitation that runs off developed areas, and the concentration of pollutants within that runoff. In addition to an estimate of bacteria loads themselves, this method provides a framework for planning improvements to protect water quality.

6. Description of Management Measures [Element Three]

Implementation of BMPs throughout the Pearce Brook watershed vary from solving erosion control problems, partnering with industrial businesses to address remediation efforts of past and current pollution and contamination problems, educating homeowners of better land maintenance practices along the stream banks, community beautification efforts through a "no dumping" outreach, adherence to nutrient management practices for agricultural and livestock producers, and road work, including culvert replacements. Based on the spring, 2009 survey findings, anticipated implementations are as follows:

6.1 Agriculture - Cropland

Agriculture accounts for 39% of land in the Pearce Brook watershed with most farmland located primarily in the upper watershed in the town of Hodgdon. The predominant soil type is Mapleton Shaly silt loam (MhB). This soil is considered Prime Farmland and is also potentially highly erodible. However, the cropland here averages below a 5% slope in most areas and steeper slopes have mostly been taken out of production either at the farmer's expense or enrollment through USDA's Conservation Reserve Program (CRP). The farms in the area utilize a potato, small grain rotation with limited underseeding. Cover crops and/or winter cover has been experimented with in this area as well, but adoption of these practices is low. Despite this, most farms experience a soil loss of 1.7 tons, which is below the tolerable soil loss of 2 tons for this soil type. However, since any soil loss into a water body is intolerable, this soil needs to remain in the field. The soil conditioning index (SCI) which measures organic matter is -0.1. This shows a trend of organic matter depletion in these soils which will increase the potential of soil erosion and reduce yields over time. Bare soil through the winter months also encourages erosion (most show visible signs of sheet and rill erosion after a heavy rain). Bare soil also provides poor wildlife food and cover. Increased use of conservation practices such as cover crops and winter cover will be addressed with encouraged adoption of these practices through NRCS's Environmental Quality Incentives Program (EQIP), and promotion of available bale processors for straw or hay mulch spreading through the SASWCD. Other BMPs for cropland include buffers, or grassed waterways that many times can be cost-shared through the Farm Service Agency's (FSA) Continuous Conservation Reserve Program (CRP).

6.2 Agriculture - Livestock

Additionally, there is a beef livestock operation in the upper watershed with approximately 150 cow/calves. As noted in section 4.3, this operation has had, in the past, no appropriate manure storage, nutrient management practices or buffers around streams. The producer has since built a manure storage facility and has a nutrient management plan. However, livestock continue to have access to a pasture pond during the spring, summer and fall months. Natural buffers and fencing should be implemented to prevent livestock from entering waterbodies and different watering systems explored to meet the needs of the operation.

The table below describes the current and future conditions (future condition = what is needed) of agricultural land in the Pearce Brook watershed. Thanks to funding through NRCS EQIP, there were practices implemented in 2009 such as the livestock waste storage and heavy use area that allow future condition needs to be met.

Conservation Practice	**Current Condition**	**Future Condition**	**Estimated Cost**
Waste Storage Structures (cf)	5400.0	51818.0	$140,047
Heavy Use Area (sf)	1000.0	20048.0	$139,333
Filter Area (ac)	0.1	0.8	$418.13
Nutrient Management (ac)	<10.0	160.0	$5,143.47
*Grassed Waterways (no.)	4.0	2.0	$17,726.60
Pest Management (ac)	<10.0	398.4	$18,525.60
Prescribed Grazing (ac)	<10.0	78.0	$3,022.24
Riparian Buffers (ac)	<10.0	3.0	$8,691.72
Conservation Crop Rotation (2yr)	238.4	238.4	$53,012.21
Cover Crops (ac)	>10.1	50.0	$3,371.47
Mulching (ac)	>10.1	188.4	$64,103.73

Table (on previous page): Current and Future Conditions courtesy of NRCS Houlton field office, 10/2009
**Assumes 1 acre per waterway*

6.3 Residential

Information gathered during the Pearce Brook watershed survey determined that the best use of resources in this category is to provide public education and outreach to change the way homeowners view and manage their property and pets. Such an effort will require long term planning, re-evaluation, creativity, and persistence. An outreach plan will be developed with assistance from MDEP's Nonpoint Source Program.

The Plan, based on survey results, could include encouraging the use of common BMPs to support should be vegetated buffers, placement of rain gardens, streambank erosion control and alternative, natural lawn-care programs. Education/outreach methods could include storm drain stenciling, "doorknob" brochures with information such as pet waste management and depictions of where storm water flows, and lawn care posters distributed to local garden centers. Educational information can be posted on HBMI and SASWCD websites and HBMI's Natural Resource Department newsletters. These outreach and education measures are the highest priority for residential sections of Houlton, as both Pearce and Brown Brook flow through a large portion of Houlton proper. In the more rural areas of the watershed, there will be additional opportunities to implement primarily vegetative BMPs. As observed during the survey, depending on the individual site, these may include vegetated buffers, streambank erosion control or culvert cleanouts.

There are also opportunities to work with the Towns of Houlton and Hodgdon to encourage Low Impact Development (LID) practices. These could include workshop(s) or site visits to developments incorporating LID for the town's code enforcement officers and planning boards. Maine's Nonpoint Education for Municipal Officials (NEMO) is a leading resource for towns on LID and information linking land use to water quality.

6.4 Industrial/Commercial/Retail

As a result of historically underground fuel contamination in "gasoline alley" and the declared Superfund site located in the Pearce watershed, MDEP has spent the past several years digging up and replacing contaminated soil with clean soil, reducing the contamination impact to Pearce Brook.

MDEP's 2003 funded monitoring site and subsequent URS project report indicates that one additional site needs to be re-evaluated. Possible residual petroleum constituents migrating to Pearce Brook should be investigated to determine impact although any clean-up work depends on extent of contamination and availability of funding.

Other issues include impervious surfaces such as runoff from parking lots, roofs, gutters, roads and the like. Municipal ordinances can incorporate such LID measures as ensuring appropriately sized parking lots, encouraging pavement removal during reconstruction and/or the use of pervious pavement.

Debris and bank erosion and slumping continue to be a problem especially near Bangor Road where there are auto garages and a lumber/hardware store located adjacent to

Pearce. Some bank work has been completed as part of the Bangor Road culvert replacement but additional vegetation needs to be planted and banks stabilized. As mentioned in Section 4.2, upgrading the Green Street bridge without making improvements to downstream culverts could further negatively affect this area that is already vulnerable in places.

6.5 Municipal Wastewater Collection System

While many of the sewer system pipes have been relined within the watershed boundaries in Houlton, the Houlton Water Company can continue to look for cross connections and perform regular maintenance and inspections.

7. Description of Technical and Financial Assistance [Element Four]

Likely sources of assistance to implement this 10-year watershed plan include:

- EPA-funded §319 projects which are MDEP administered grants for nonpoint source pollution control projects. Grant funds work to restore or protect lakes, streams or coastal waters that are polluted or threatened.
- Watershed implementation grants that focus on encouraging successful community-based approaches and management techniques to protect and restore watersheds.
- Cost-share programs through NRCS EQIP and Farm Service Agency's CRP to implement practices such as forest management plans, nutrient management plans, riparian buffers, watering facilities, crop rotations, winter cover, among others.
- Federal funds administered by the MDEP for soil contamination removal projects. This may include Brownfield projects which clean up and reinvest in properties where hazardous substances, pollutants, or contaminants may be present.
- HUD Community Development Block Grants.
- Maine Outdoor Heritage Grants.
- Maine Department of Conservation (MDOC) ATV program.
- MDOT for culvert replacements and road work.
- Irving Oil Corp. Grants http:/www.irvingoil.com/in_the_community/sponsorships _and_donations/community_fuel_grant_program.
- Municipal dollars and in-kind match.

Contingent on ongoing and consistent federal funding, HBMI will continue water quality monitoring and data analysis at Pearce and Brown Brooks. USGS Maine Water Science Center anticipates that Pearce Brook USGS station at Route 1/Court Street will continue to collect continuous flow data into the future. Local area partnerships with Cooperative Extension, the Maine Forest Service, NRCS and SASWCD will be instrumental in providing education and outreach covering BMPs for many land uses in the watershed including agriculture, residential and forestry. The Towns of Houlton and Hodgdon will enforce local and state ordinances that address stream quality issues while the Town of Houlton and Houlton Water Company will address pollutant issues such as illicit sewer connections and stormdrain maintenance.

8. Information and Education Outreach [Element Five]

As mentioned in Section 3.1, the historical "gasoline alley" clean-up projects by MDEP have been reported on extensively in the local media and the work continues to be highly visible to the community. The community's current level of awareness of environmental problems in Pearce Brook provides an ideal opportunity to evolve from individual awareness to community action. The Southern Aroostook area has a history of strong partnerships among community organizations and public education continues to be a large component of their combined work. Pooling organizational resources allows for greater dissemination of information and a greater chance for on-the-ground BMPs to be implemented.

8.1 Agriculture and Forestry

In regards to nutrient management education, agricultural producers and so-called hobby farms will be targeted through SASWCD's annual winter "ag" school and outreach with NRCS's EQIP. Many of the small hobby farms have been sourced through development of SASWCD's local foods brochure and the District's mailing list has expanded due to the winter "ag" school and their annual tree and shrub sale. In addition, there are a couple of area riding clubs that could be targeted as a way to approach the many local horse owners with proper manure handling and management. These nonpoint source pollution problems can be successfully addressed with either simple practice changes, better understanding of manure handling and storage problems and/or potential cost-share assistance through grants or USDA programs.

In the past, agricultural demonstrations through grant-funded field days have proven beneficial in working with producers on practices such as reduced tillage or winter cover while providing a hands-on, practical opportunity to other farmers to adopt new erosion-control practices.

Forestry/woodlot management classes through winter "ag" school and special workshops will be held providing forestry certification credits and an opportunity to educate woodlot owners and those in the industry on sustainable forestry practices and BMPs. Because a major multi-use recreational trail travels through the forested part of Pearce, local ATV clubs will be targeted to provide technical assistance on trail maintenance and proper stream crossings.

8.2 Residential

Information and "backyard conservation" education will focus on the urban residential community to reduce NPS pollution. Much like a "lake-friendly tip sheet", information can be developed for those residences in the Pearce Brook watershed outlining simple "Pearce Brook" friendly tips. Think Blue Maine has a website that provides tools and resources for municipalities, homeowners and educators. Homeowner resources include lawn care information and keeping pet waste out of storm drains. Cumberland County Soil and Water Conservation District is experimenting with using the local Adult Education Program to share this information. Other platforms for education and outreach to homeowners include (but are not limited to) local access TV, municipal reports, local internet providers, water/sewer bills, twitter and Facebook.

The Maine Stream Team Program (MSTP) is a way to get the community involved around a stream such as Pearce Brook. A "stream team" is a group of people who have banded together to promote stewardship of their local stream while supporting stream protection activities. Pearce Brook's historical significance and path through residential and urban Houlton make it a good candidate for such a "stream team" network to be developed.

For municipalities, there are several water quality planning tools available. EPA released a "Water Quality Scorecard" in 2009 to help towns identify opportunities for better water quality protection. EPA also has published a guide exploring "Green Street Development". The guide offers ways to incorporate green infrastructure into streets using a natural systems approach to, among others, reduce stormwater flow, improve water quality, and beautify neighborhoods. LID workshops and planning assistance through NEMO are tools for building of developments or incorporating into each town's comprehensive management plan.

Storm drain stenciling is another good outreach tool as it links what flows in the town's storm drains to our streams and rivers.

8.3 Industrial/Commercial/Retail

For general stormwater and NPS issues for commercial interests, green business program models are available such as Maine's Environmental Leader Program or the development of a Green Business Program where business members and government work collaboratively on sustainability issues. Potential partners include the Towns of Houlton and Hodgdon and Houlton's Chamber of Commerce and Rotary Club.

9. Implementation Schedule [Element Six]

2013: Culvert restoration plan designed for three culverts on Pearce Brook.

2013: MDEP will remove and clean up the last known gasoline contaminated site at Bangor Street and Pearce Brook in Houlton.

2013 – indefinite: Continuous flow data captured at USGS gage station on Pearce Brook.

2013 - indefinite: MDEP will continue monitoring up to 12 sites for contamination in Houlton.

2013 – 2020: HBMI will continue monitoring E. coli during wet and dry events on Brown and Pearce Brook.

2013 – 2020: SASWCD will provide "backyard conservation," nutrient management, and woodlot forestry topics during its annual winter "ag" school.

2014: Additional crop lands will incorporate nutrient management plans, apply winter cover crops or mulch for erosion control, while pasture land will have adequate riparian buffers and watering facilities.

GIS development by Houlton Water Company and analysis of Pearce Brook watershed utilizing town sewer lines and the relative proximity of this parameter to Pearce Brook will help define source problems and quantify future loading estimates.

Based on future funding, a culvert (at a site owned by a private railroad company) will be removed facilitating MDEP contaminated soil clean-up.

10. Milestones to Measure Progress Implementing Management Measures [Element Seven]

Fluvial Geomorphology study report: Report findings implemented in Pearce with streambank stabilization in critical areas along the brook by 2014.

Culvert restoration plan: Of the three culverts named by MDOT as needing replacement in the Pearce watershed, at least one will be replaced by 2014.

2013 – indefinite: Continuous flow data captured at USGS gage station on Pearce Brook will be used an part of overall data analysis by HBMI and kept as records.

2013 - indefinite: MDEP's monitoring of up to 12 sites for gasoline contamination in Houlton will provide basis for future federal funding for cleanup, as funds become available.

2020: HBMI's E. coli monitoring during wet and dry events on Brown and Pearce Brooks for the past ten years.

2020: At least twenty "backyard conservation," nutrient management, and woodlot forestry topic classes will have been held during SASWCD's annual winter "ag" school.

2014: An additional 100 crop acres will have incorporated winter cover crops or mulch for erosion control. One additional livestock producer will develop a nutrient management plan, and 2 producers' pasture land will have 100' of riparian buffers established.

2013 & annually: Houlton Water Company will use GIS to update the town sewer line map, including and I&I work, testing and system updates.

2015: Culvert at site owned by private railroad company will be removed and area will have contaminated soil cleaned up. This project will be a joint collaboration between MDEP and MDOT.

11. Criteria to Determine Progress in Attaining WQ Standards & Load Reductions [Element Eight]

<u>Attaining Water Quality Standards</u>

The Pearce Brook watershed lies within the Meduxnekeag Watershed, a Maine Priority Watershed. Because of its direct influence on the quality of the Meduxnekeag River, HBMI will continue monitoring Pearce and Brown Brooks using various parameters to determine if water quality standards are being met.

Load Reductions

For the majority of major BMPs that are implemented, pollutant load reduction estimates will be made using methods approved and recommended by EPA/NRCS.

12. Monitoring Progress Compared to Criteria [Element Nine]

HBMI will periodically monitor progress as follows:

Attaining Water Quality Standards

HBMI will consistently monitor water quality in Pearce Brook watershed during the spring, summer and fall months each year. Monitoring will include testing for E. coli, dissolved oxygen, nutrients, water temperature, conductivity and flow. This data will be used to track seasonal and long-term trends in the watershed. Data analysis will also be valuable in alerting HBMI of any changes in water quality and allow for adjustments to be made to the watershed-based plan.

Load Reductions

Estimates of NPS pollutant load reductions and resources protected should be prepared as project work is secured through grant funding or MDEP projects. BMP installations at NPS sites and appropriate field measurements should be recorded to provide information for estimates of pollutant load reductions.

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Paul Higgins, Maine Department of Environmental Protection
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flooding around Green Street Bridge

Appendices

- Bacteria Load Estimation References
- Land Use Map
- Riparian Buffer Analysis Map
- Impervious Surface Map
- Soil Erodibility Potential Map
- Phosphorus Loading Estimation for Pearce Brook

Appendix 1: Bacteria Load Estimation References

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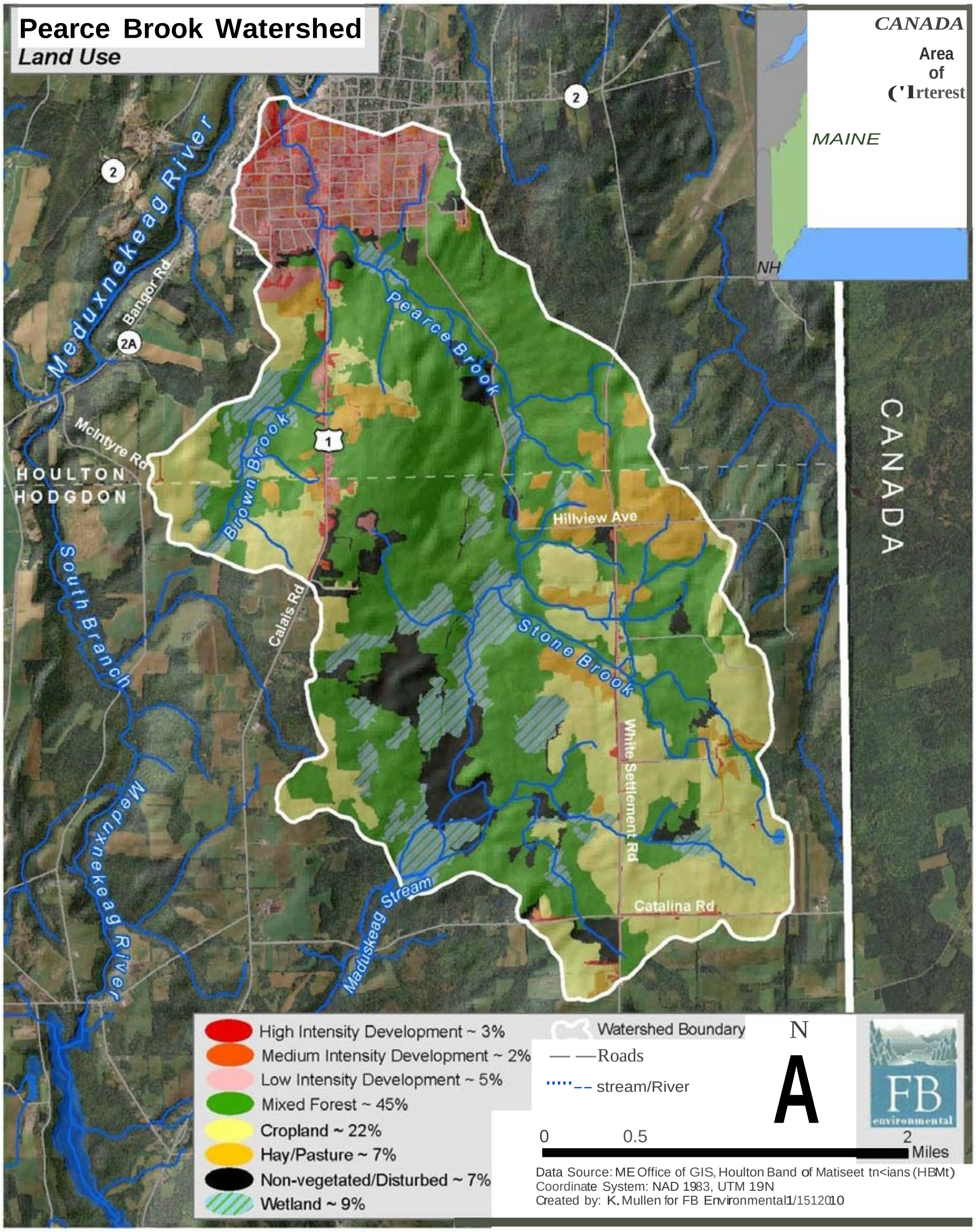
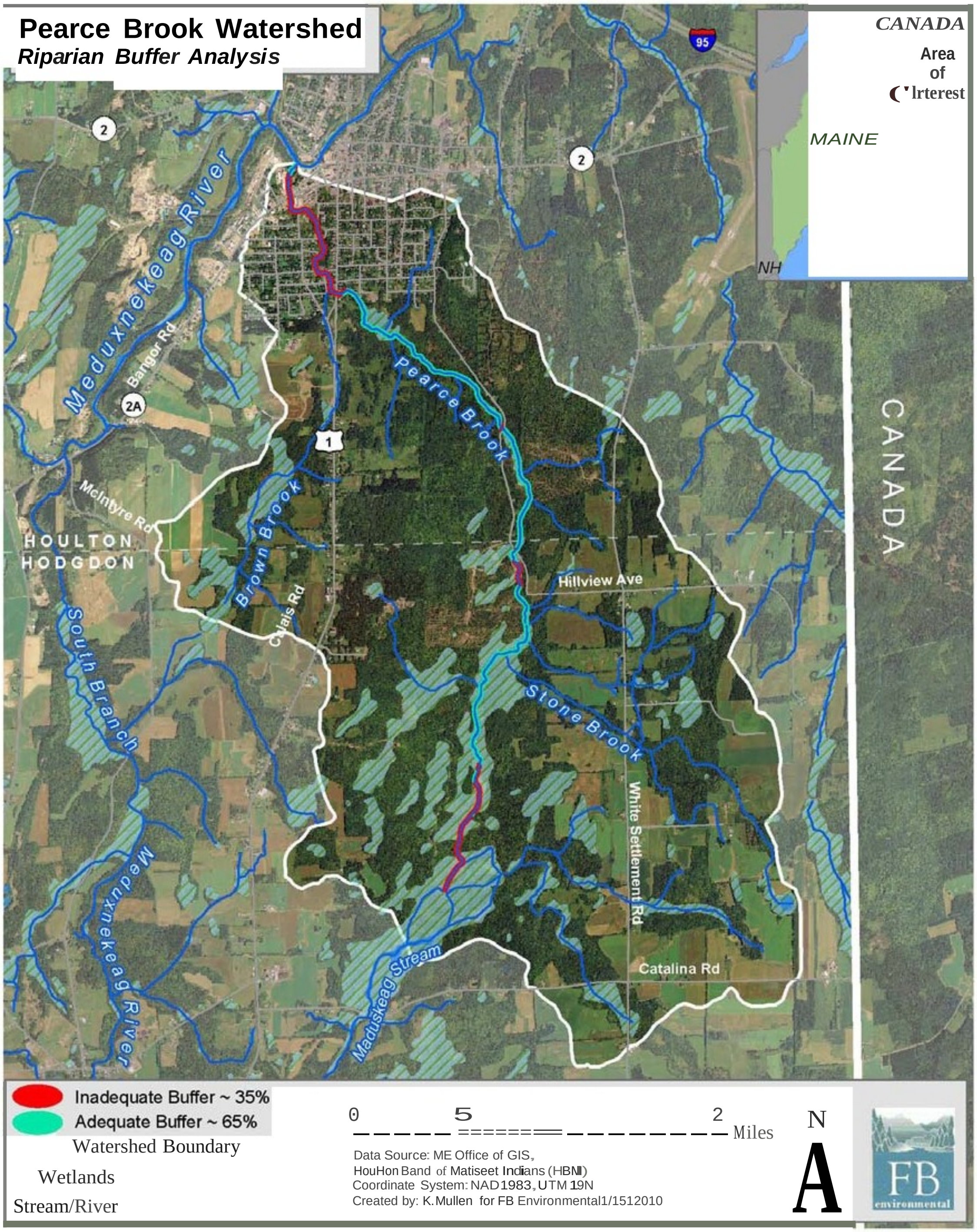
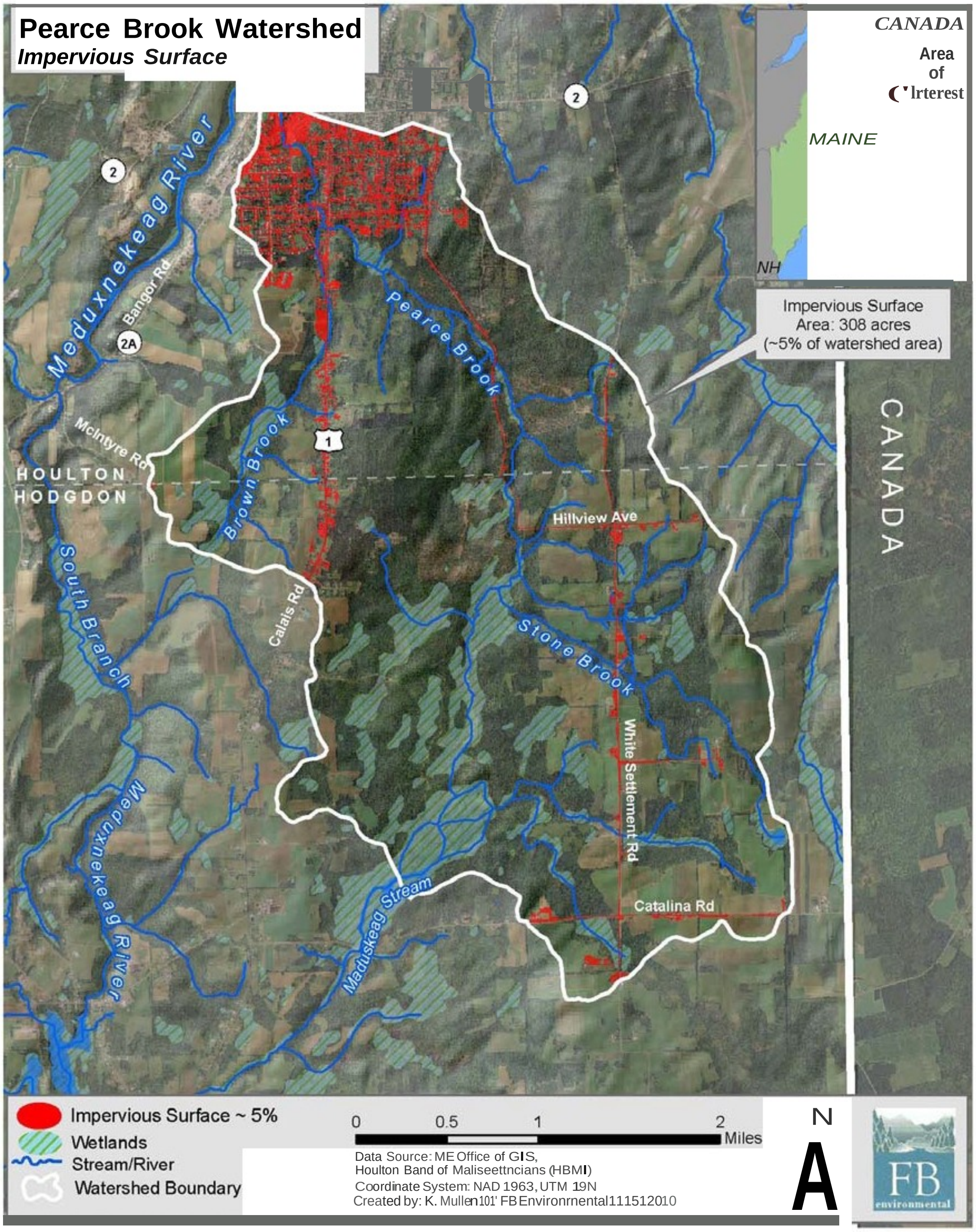
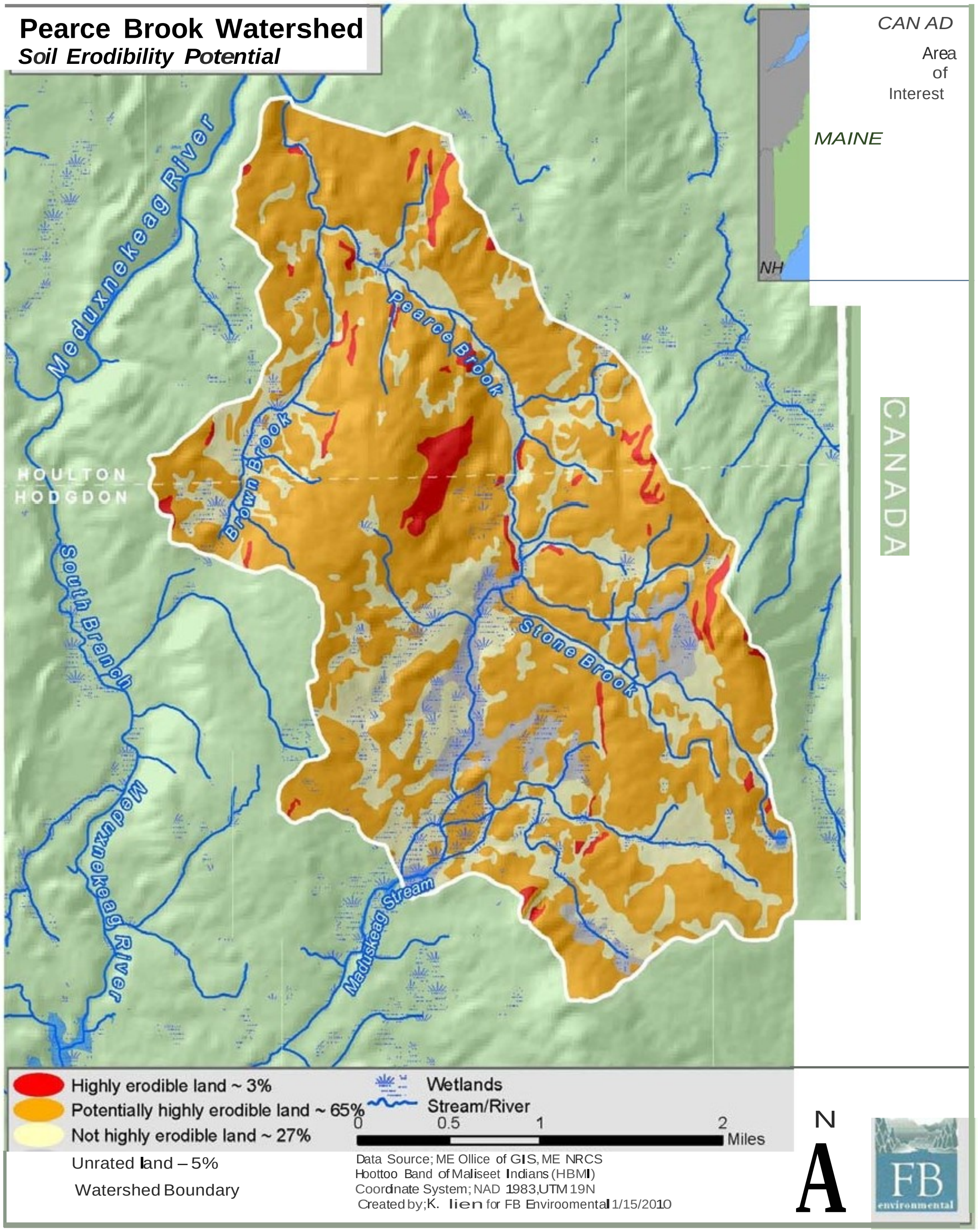


Pearce Brook Watershed
Land Use
CANADA
Area
of
MAINE
NH
Meduxnekeag River
Bangor Rd
McIntyre Rd
HOULTON
HODGDON
South Branch
Meduxnekeag River
Brown Brook
Pearce Brook
Calais Rd
Hillview Ave
Stone Brook
White Settlement Rd
Catalina Rd
Maduskeag Stream
CANADA
High Intensity Development ~ 3%
Medium Intensity Development ~ 2%
Low Intensity Development ~ 5%
Mixed Forest ~ 45%
Cropland ~ 22%
Hay/Pasture ~ 7%
Non-vegetated/Disturbed ~ 7%
Wetland ~ 9%
Watershed Boundary
Roads
stream/River
N
0 0.5 2 Miles
FB environmental
Data Source: ME Office of GIS, Houlton Band of Matiseet tn<ians (HBMt)
Coordinate System: NAD 1983, UTM 19N
Created by: K. Mullen for FB Environmental 1/1512010


Pearce Brook Watershed
Riparian Buffer Analysis
CANADA
Area of Interest
MAINE
NH
95
2
2A
1
Meduxnekeag River
Bangor Rd
McIntyre Rd
HOULTON
HODGDON
Brown Brook
Calais Rd
Pearce Brook
Hillview Ave
Stone Brook
South Branch
Meduxnekeag River
White Settlement Rd
Meduxnekeag Stream
Catalina Rd
CANADA
Inadequate Buffer ~ 35%
Adequate Buffer ~ 65%
Watershed Boundary
Wetlands
Stream/River
0 5 2 Miles
N
Data Source: ME Office of GIS,
Houlton Band of Maliseet Indians (HBMI)
Coordinate System: NAD 1983, UTM 19N
Created by: K. Mullen for FB Environmental 1/15/2010
FB environmental


Pearce Brook Watershed
Impervious Surface
CANADA
Area of Interest
MAINE
NH
Impervious Surface Area: 308 acres (~5% of watershed area)
CANADA
Meduxnekeag River
Bangor Rd
McIntyre Rd
HOULTON
HODGDON
South Branch
Brown Brook
Pearce Brook
Calais Rd
Hillview Ave
Stone Brook
White Settlement Rd
Catalina Rd
Meduskeag Stream
Meduxnekeag River
Impervious Surface ~ 5%
Wetlands
Stream/River
Watershed Boundary
0 0.5 1 2 Miles
Data Source: ME Office of GIS, Houlton Band of Maliseet Indians (HBMI)
Coordinate System: NAD 1983, UTM 19N
N



Pearce Brook Watershed
Soil Erodibility Potential
CAN AD
Area
of
Interest
MAINE
NH
CANADA
Meduxnekeag River
HOULTON
HODGDON
South Branch
Brown Brook
Pearce Brook
Stone Brook
Meduxnekeag River
Maduxkeag Stream
Highly erodible land ~ 3%
Potentially highly erodible land ~ 65%
Not highly erodible land ~ 27%
Unrated land – 5%
Watershed Boundary
Wetlands
Stream/River
0
0.5
1
2
Miles
N
Data Source; ME Ollice of GIS, ME NRCS
Hoottoo Band of Maliseet Indians (HBMI)
Coordinate System; NAD 1983,UTM 19N
Created by;K. lien for FB Enviroomental 1/15/2010
FB
environmental