Stewardship Plan for the Pollett River:

A Tributary of the Petitcodiac River

Fort Folly Habitat Recovery

Fort Folly First Nation

2024 Edition

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Disclaimer:

This document claims no authority by which to drive its implementation. Instead, it is intended simply to serve as a public resource that organizes available information and helps inform future decision making by identifying, and prioritizing needs and sites for restoration activities that will enhance habitat quality and promote species recovery. This is a reference, not intended to be read cover to cover. It is also a living document, current and definitive to the time of writing, but constantly evolving and will never assume an absolute “final” form. Instead, it will be updated and superseded by subsequent editions as additional information becomes available.

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Introduction

This Pollett River Stewardship Plan is one of a series of seven such documents compiling, detailing, and presenting information about tributaries of the Petitcodiac River and surrounding watersheds. The purpose of this series of documents is to enable prioritization and planning of restoration activities within the following watersheds: 1) Demoiselle Creek, a small watershed that drains directly into Shepody Bay, near the mouth of the Petitcodiac River estuary, 2) the Memramcook River, immediately adjacent to the mouth of the Petitcodiac River at Fort Folly Point, 3) the main-stem of the Petitcodiac extending between the Village of Petitcodiac (where the Petiticodiac “begins”) down to the head-of-tide at Salisbury, and four tributaries of the Petitcodiac River system, 4) Little River, 5) Pollett River, 6) Anagance River, and 7) the North River. The location of these watersheds in or near the Petitcodiac system, (just outside of Moncton New Brunswick) is presented below in Figure 1. Each watershed was assessed according to the four-level approach laid out in the Department of Fisheries and Oceans document, “Ecological Restoration of Degraded Aquatic Habitats: A Watershed Approach” (Melanson et. al 2006). Under this process the first level of assessment is an examination of the land use history of the watershed. The second level of assessment looks at the current impacts. The third level of assessment considers the aquatic and riparian habitat, and the fourth level of assessment then brings this information together to develop an aquatic habitat rehabilitation plan that identifies priorities and opportunities for interventions within each watershed to advance the goal of habitat restoration.

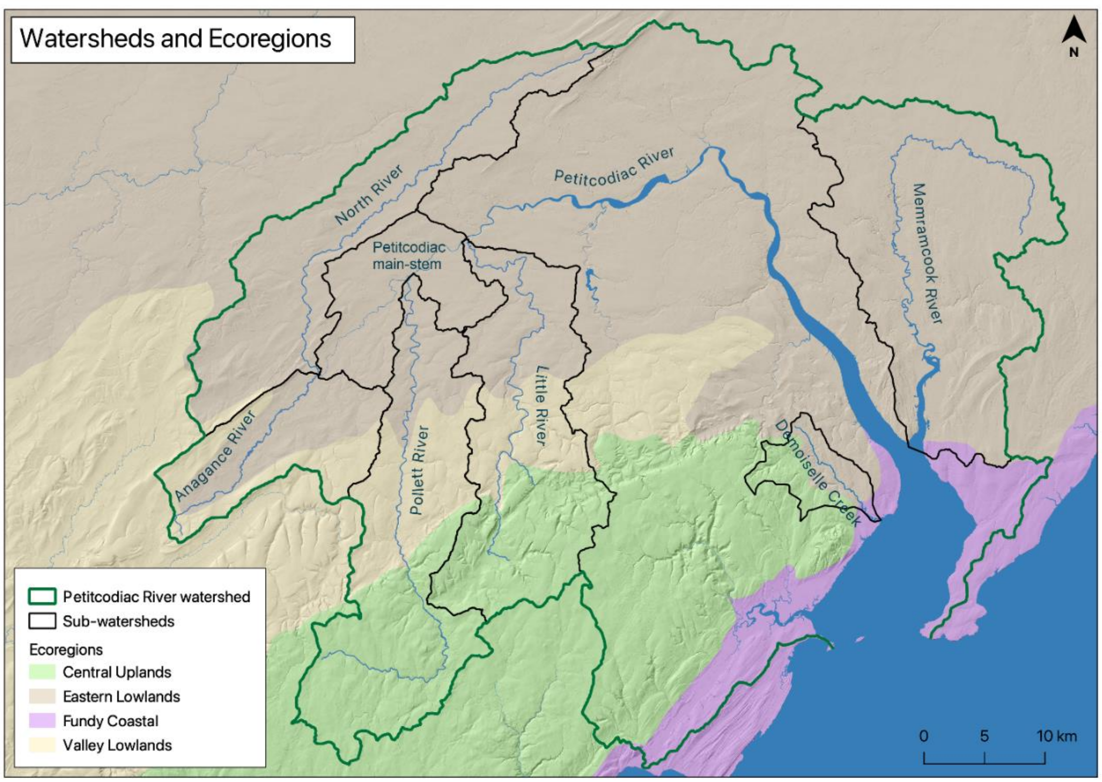

Figure 1: Location of examined watersheds within or near the Petitcodiac system

Pollett River

The Pollett River flows from Albert County into Westmorland County (Figure 2). It is the largest tributary in the Petitcodiac River watershed, with a basin that covers 314 square kilometers. Its headwaters surround Mechanic Lake near Fundy National Park in New Brunswick's Central Uplands Ecoregion (New Brunswick Department of Natural Resources 2007). From there, the 57 kilometer long river passes through Elgin in the Continental Lowlands Ecoregion and on to its mouth along the Petitcodiac, near Salisbury in the Eastern Lowlands Ecoregion, a short distance above the head of tide. From its top to the confluence with the Petitcodiac, the Pollett drops approximately 335 metres in elevation.

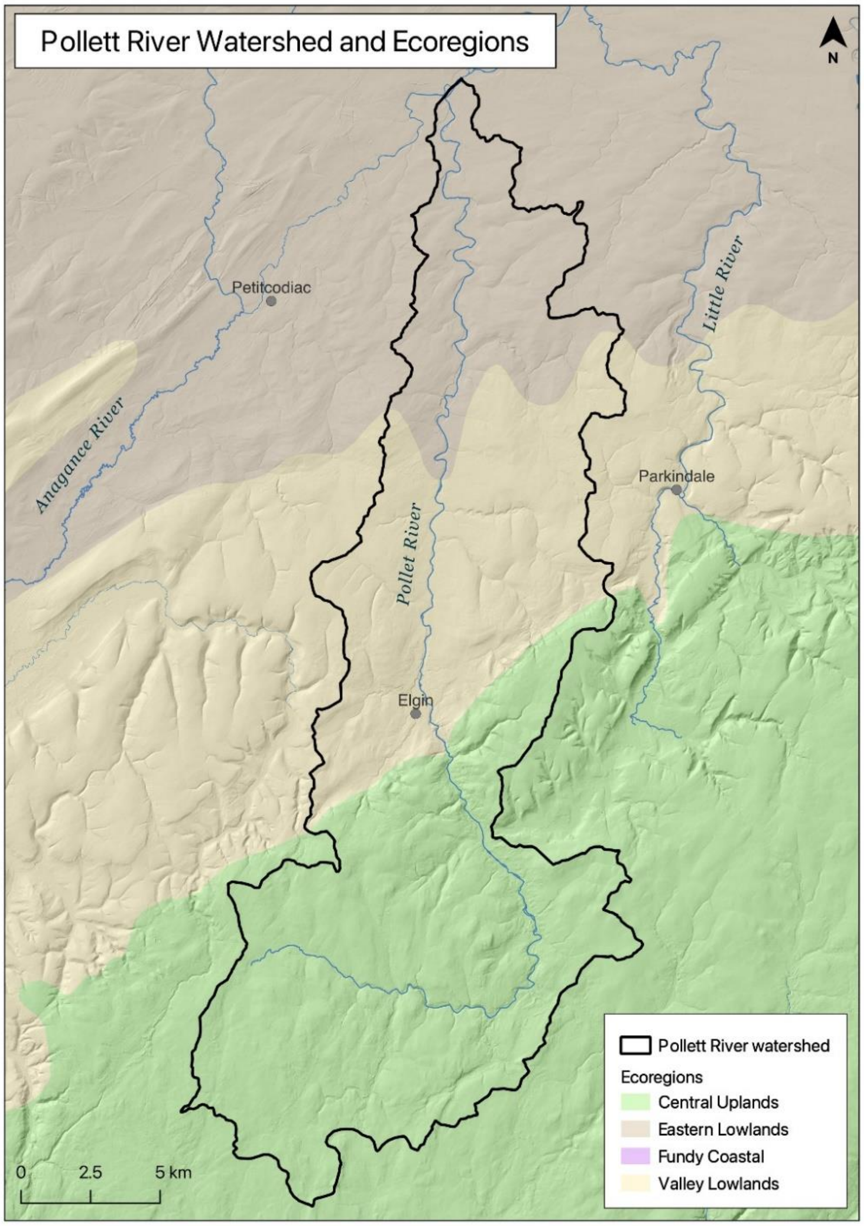

Figure 2: Pollett River watershed

In addition to its main stem, named tributaries of the Pollett River include: Barchard Brook; Bustin Brook; Campbell Brook; Colpitts Brook; Dry Brook; Grassy Lake Brook; Gibson Brook; Haslam Brook; Kelley Brook; Lee Brook; Mapleton Brook; McMain Brook; Mechanic Lake Brook; Miller Brook; Pinnacle Brook; Popple Intervale Brook; Shaffer Brook; Steeves Brook; and Webster Brook. The river usually runs clear, and often has a gravel bottom though in places bedrock is visible. During the spring freshet or after a storm it can become turbid for several days, before resuming its more normal condition. Rises of up to 1 metre can occur in the spring and fall, and surges of 2 to 3 metres have occurred in as little as 12 hours (Elson 1962).

In its upper reaches the Pollett flows through a steep valley covered with mixed conifer and deciduous forest and is separated from the lower reaches by a deep gorge over a kilometer long. Gordon Falls (cover, bottom photo) located near the midpoint along the gorge, drops 4.5 to 6 meters depending upon the level of flow in the river. Below the gorge from Elgin to its mouth the river is fairly consistent, with a gradient of about 3 meters per kilometer. It forms a series of shallow pools that alternate with long gentle rapids, flowing through stretches of forest broken up occasionally by scattered farmland and camps, that become increasingly frequent the closer to the mouth one gets.

The dominant land uses are forestry and agriculture. Approximately 90% of the watershed is forested, 48.3% of which is on small private woodlots, 26% is on crown land, and 25.6% is industrial freehold forest land owned by J.D. Irving. Though there is some fragmentation, 22% of the forest is considered mature (University of New Brunswick 2014). Approximately 5 % of the watershed has been cleared for agriculture, 59% of which is being used to grow row crops or grains, 22% pasture or hay, and 18% blueberries.

First Level Assessment – Land Use History of the watershed

An understanding of the historical land use within a watershed provides context that helps explain the causes of issues affecting the watershed today. The following sections outline the historical land use both within the Pollett River watershed, and in the surrounding communities in both Westmorland County and Albert County. Within the Pollett watershed this includes the communities of Elgin, Pollett River (or Forest Glen), and Kay Settlement. Neighboring communities outside the watershed include: the village of Petitcodiac to the west; the village of Salisbury downstream a short distance below the confluence of the Pollett and the Petitcodiac River; and the communities of Colpitts Settlement, and Parkindale to the east within another Petitcodiac tributary- the Little River watershed.

Table 1: Brief historical background summary for communities along or near the Pollett River

Community	Settlement Type and Dates	Notes
Colpitts Settlement *(Little River)*	Settled c.1786 by Colpitts family Farming	**1898** population 250, post office, store, 2 grist mills, church
Elgin *(Pollett River)*	Settled c.1811 by Geldart family Farming and lumbering	**1871** population 250 **1876** connected to the Intercolonial Railway at Petitcodiac by completion of branch line, The Elgin, Petitcodiac, & Havelock Railway **1898** post office, railway station, 6 stores, 3 hotels, 2 churches sawmill, grist mill, tannery, carriage shop, and cheese factory,
Kay Settlement *(Pollett River)*	Settled c. 1803 by Kay family Farming	**1898** population 25, post office, church
Parkindale *(Little River)*	Settled c.1817 by Parkin family Lumbering	**1898** population 150, post office, store, sawmill, church
Village of Petitcodiac *(Petitcodiac River)*	Settled c. 1786 by Blakeney family Farming and lumbering	**1898** population 700, Station on Intercolonial Railway, central depot for The Elgin, Petitcodiac, & Havelock Railway, post office, 6 stores, 2 hotels, tannery, sawmill, carriage factory, 4 churches
Pollett River / Forest Glen *(Pollett River)*	Farming and lumbering	**1898** population 125, post office, store, sawmill, and hall
River Glade *(Petitcodiac River)*	Farming and lumbering	**1861** named North River Platform **1871** population 100, Station on European and North American Railway **1898** population 75, 1 post office, 1 store, 1 sawmill **1903** renamed River Glade
Salisbury *(Petitcodiac River)*	Settled c.1774 Farming and lumbering	**1898** population 400, railway station, post office, 6 stores, 2 hotels, carriage factory, 3 churches

(Source: Provincial Archives of New Brunswick, 2023)

The Maritimes have had human inhabitants for the last 11,000 years (Wicken 2002), though for most of that time precise cultural identities are impossible to determine today. By the early 1600s, when Europeans arrived, much of the native population of coastal Atlantic Canada shared a common culture and language identifying themselves as the L'nuk, "the People", and recognized by Europeans as the Mi'kmaq. During this time, the Mi'kmaq lived in large villages along the coasts from April to November. They grew corn in small garden plots but were mostly dependent upon fish and game for nourishment. Therefore, they tended not to stay in one place for long given the need to follow their food sources so dispersed inland during the winter to hunt moose and caribou (Wicken 2002). Estimates of the pre-contact population vary between 15,000 to 35,000 in what is now Nova Scotia and New Brunswick (Miller 1976, Marble 1993). This declined between 75% to 90% due to social disruption and epidemics brought by Europeans (such as smallpox) during the first century of contact. By 1616, Jesuit priest Pierre Biard estimated the population as 3,500 (Mooney 1928). Physical impacts on the watershed were few compared to what was to follow.

The Mi'kmaq name for the Pollett River was Manoosaak' (Provincial Archives of New Brunswick, 2023), The English name for the river is reportedly a reference to Peter Paulet, a Mi'kmaq elder who lived near the mouth of the river (Hamilton, 1996), whose name suggests some degree of Acadian cultural influence. Presumably he was a member of the historical Mi'kmaq community that existed on the north side of the Petitcodiac River between the mouths of the Little & Pollett Rivers. Ganong's (1905) map of known First Nations villages and campsites includes this site at Salisbury located along the north bank of main stem of the Petitcodiac, near the head of tide between the mouths of Little River and the Pollett River. A native leaving Beaumont (where there was another camp in the lower Petitcodiac estuary) could ride the 13 km per hour tidal bore upstream to Salisbury, greatly facilitating such travel (Petitcodiac Heritage River Committee 2000). The importance of the Salisbury encampment was due to its location both at the head of tide and near the ends of a pair of portage routes leading to the Saint John River system. The more highly traveled of the two routes crossed from the main stem of the Petitcodiac River to the Canaan River (Ganong 1914) near what is now the Village of Petitcodiac, as doing so provided the best access to the upper St. John and on to the St. Lawrence (Petitcodiac Heritage River Committee 2000). The other route crossed from a tributary of the Petitcodiac, the Anagance River, to the Kennebecasis River (and from there to the lower portion of the Saint John River system). In fact the name Anagance comes from Wolastoqey "Oo-ne- guncé" meaning portage (Ganong 1896), presumably a reference to the link provided by that tributary.

In the 1630's the French began to make a serious effort to colonize Atlantic Canada, beginning to arrive in numbers significant enough to develop an enduring Acadian identity (Laxer 2006), at a fairly similar timeframe to the English colonies further south. By 1676 the first Acadian settlers arrived at Beaubassin, near the current Nova Scotia Visitor's Centre along the Trans-Canada Highway at the New Brunswick border (Larracey 1985). During this time there was much Acadian and Mi'kmaq intermarriage (Marshall 2011) weaving a complex web of family relationships. French authorities encouraged intermarriage to produce a colonial hybrid population, while further south the English tended to aggressively enforce racial segregation (Prins 1996). Meanwhile the Mi'kmaq had begun to adopt Catholicism from the French, while the British were Protestants, at a time when such differences added fuel to conflicts. Acadians also maintained good relations with the Mi'kmaq in part because the lands Acadians occupied either complemented native use, as with fur traders, or were in areas that were marginal to native concerns as in the case of the Acadian farmers on the tidal flats (Mancke 2005).

By 1710, Acadians and Mi'kmaq in peninsular Nova Scotia fell under British control, which was subsequently formalized in 1713 under the treaty of Utrecht. Previous to the treaty, the French had claimed that the borders of Acadia reached all the way to the Kennebec River (well within in what is now Maine). After the treaty however French Authorities claimed that Acadia was just Port Royal (renamed Annapolis Royal by the British after they seized it in 1710) and the peninsula (modern Nova Scotia excluding Cape Breton). Based on that assertion, the French continued to occupy the mainland (now New Brunswick), in addition to the territory they retained officially under the treaty (Martin 1995) i.e.: Île Saint-Jean (Prince Edward Island), and Île Royale (Cape Breton Island). The British were not in a position to contest this reality due to a lack of soldiers and settlers (Ganong 1901). By 1730 the Acadian community in the Petitcodiac was thriving precisely because they were under the jurisdiction of neither Great Brittan nor France (Faragher 2005). That situation did not last, however. With no agreed boundary between English and French territory provided by the Treaty of Utrecht, the French eventually adopted and defended the Missaquash River as the de facto boundary between the two powers (Milner 1911), the same boundary that is in modern use between New Brunswick and Nova Scotia. To Europeans the treaty had merely changed the status of Nova Scotia from a fairly uninhabited French territory with disputed boundaries, to a fairly uninhabited British territory with disputed boundaries (Martin 1995). It was rather more personal to the Mi'kmaq and Acadians who lived there.

Meanwhile, after 1713, New England fisherman pushed more aggressively into Nova Scotia's coastal waters sparking conflict with the Mi'kmaq (Wicken 2002). By 1726 the Mi'kmaq and the British signed the first of a series of Peace and Friendship treaties. What the British wanted from the agreement was native recognition of the Treaty of Utrecht whereby natives agreed not to molest His Majesty's subjects in "lawfully" made settlements, and the Crown could regulate the movement of European nationals into Acadia – i.e., exclude the French. In exchange the British agreed not to interfere with native hunting, fishing, planting activities.

In June 1749 Edward Cornwallis established Halifax with 2,500 settlers as a new capital for Nova Scotia (Beck 1979) and constructed the citadel there as a fortress to defend it. This marked the beginning of meaningful efforts by the British to settle the Maritimes. Prior to this time British authority at Annapolis Royal "had been no more than a mock government" that "did not extend beyond the cannon reach of the fort" (Philipps 1720). The Mi'kmaq immediately recognized the implications of this change and reacted with outrage to what they regarded as establishment of an unlawful settlement in violation of the Treaty of 1726, and theft of their land. No responsible indigenous leader could ignore the reality that environmental change brought about by such agricultural settlement was the most lethal threat that British imperial expansion posed to the existing economy, livelihood, and health of the Mi'kmaq (Reid 2013). Violence escalated until by late 1749 Governor Cornwallis proclaimed a policy aimed at "extirpation" of the Mi'kmaq (Paul 2000).

In 1751 the French built Fort Beausejour at the border to protect Acadian communities in what is now New Brunswick from attack by the British. By this time the Acadian population near the Fort had grown to 1,541 people, with an estimated additional 1,100 spread out at Shepody and along the Petitcodiac and Memramcook Rivers (Larracey 1985). The Acadians built dykes and tidal control structures turning marshland along the lower Petitcodiac estuary into pasture, and established their settlements nearby

(Wright 1955). Their physical impacts on the Pollett River, what for them was a remote hinterland, were limited.

In 1752 the British signed yet another treaty with the Mi'kmaq reaffirming the 1726 treaty and also modifying it to formalize a commercial relationship between the British and the Mi'kmaq (Wicken 2002), encouraging not only hunting and fishing, but ensuring "free liberty" to sell the products of such activities in Halifax or any other settlement. For the British this provision was critical as an attempt to wean the Mi'kmaq from their friendly relationships with the Acadians and French officials in Louisburg. This treaty subsequently formed the basis of the 1999 Supreme Court Marshall decision and subsequent ongoing modern lobster fishery disputes.

Ganong (1899) notes that like First Nations, the French made use of the Kennebecasis- Petitcodiac portage along the Anagance in order to maintain communication between Fort Beausejour and Acadian settlements on the lower St. John. However the French route between the Canaan and the Petitcodiac to access the upper St. John was slightly different than the one favoured by First Nations, reportedly crossing overland to the Canaan from the North River, rather than the main stem of the Petitcodiac (Raymond 1891). From there messengers from Fort Beausejour, and the Fortress of Louisbourg passed up along the St John to reach Quebec.

After the fall of Fort Beausejour in 1755, the British attempted to expel the Acadians, to open up land for English settlers. There is a record of an Acadian settlement, Village Victuare, located nearby in Salisbury, close to the Mi'kmaq encampment there (Ganong 1930). It was documented in 1758 by British Major George Scott as he was forcefully removing Acadian families from the upper Petitcodiac (Scott 1758). The village appears to have been composed of approximately 10 homesteads, settled in about 1751, and was reportedly the largest Acadian village along the Petitcodiac upstream of Beausoleil Village, modern day Allison. Ganong (1930) suggests that it is likely that in the wake of the expulsion, Acadians briefly occupied locations such as Fourche-à-crapaud at the mouth of Turtle Creek, and on the Coverdale (Little), and Pollett Rivers in order to be near the head of tide and thus above the reach of English Ships. Major Scott apparently found the tidal bore on the Petitcodiac problematic during his raids in 1758, nearly losing two ships on one occasion (Pincombe and Larracey 1990).

The Mi'kmaq sided with the French (Wicken 2002), participating in the defense of Fort Beausejour, as well as the short guerilla war which followed its capture (Grenier 2008). There were several reasons that Mi'kmaq in New Brunswick did so. In addition to intermarriage, prior to the arrival of the British, native communities had already established trade networks with the Acadians for steel tools, weapons and other European goods (Walls 2010). Another source of friction was that the Mi'kmaq had begun to adopt Catholicism from the French, while the British were Protestants, at a time when such differences added fuel to conflicts. Acadians also had had good relations with the Mi'kmaq in part because the lands Acadians occupied either complemented native use, as with fur traders, or were in areas that were marginal to native concerns as in the case of the Acadian farmers on the tidal flats (Mancke 2005). English settlers on the other hand tended to seize land the Mi'kmaq valued, to clear the forest for agriculture (Francis et al. 2010).

Throughout 1760 and 1761 the British also signed a series of Peace and Friendship treaties with individual native communities, reaffirming the treaties of 1726 and 1752 (Wicken 2002), with the signature at Chignecto/ Missaquash occurring on July 8th, 1761. The important distinction with this iteration of the treaties was the provision by which natives agreed not to trade with the French. To ensure that such trade did not occur the British agreed to establish “truck houses” as points of trade near native communities.

The Treaty of Paris in 1763 ended the Seven Years War, with France ceding its territory in Canada and the Maritime region to Britain, except for the small islands of St. Pierre and Miquelon in the Gulf of St. Lawrence (Ganong 1901; Faragher 2005). The latter France retained in the interest of preserving its access the lucrative fishery in the Gulf of St. Lawrence and the Grand Banks (MacNutt 1970). Shortly there after a royal proclamation set the boundary between Canada (Québec) and Nova Scotia as being the watershed between the Saint Lawrence and points south until reaching the north coast of the Bay of Chaleur. All of Nova Scotia north of the Bay of Fundy (modern New Brunswick) was made part of Cumberland County. In 1765 that was changed to make the Saint John River into Sunbury County. There was no formally defined boundary between Sunbury and Cumberland Counties until 1770 when it was set as a somewhat arbitrary line beginning at Mispec (a short distance along the coast east of the mouth of the Saint John River) headed due north to the Canadian (Québec) border (Ganong 1901).

With peace, in 1763, Acadians throughout the region became British subjects, but this was not the case for First Nations, whose situation was more complex (Beaulieu 2014). The British defeat of France at Louisburg in 1758 encouraged the political collapse of the Mi’kmaq population in Nova Scotia as a fighting force as the peace and friendship treaties signed between 1760 and 1761 brought an end to Indigenous-French relations and alliances (Patterson 1993). Between typhus brought by the d’Anvill expedition, violence promoted by LeLoutre, and Cornwallis’ policy of Mi’kmaq extirpation, by 1763 First Nations had been decimated by decades of warfare and disease, with some estimates suggesting that there may have been fewer than 500 individuals remaining in the Maritimes (Statistics Canada 2020).

In 1764 the British government began to allow Acadians to resettle in Nova Scotia with the provision that they remain in small groups scattered throughout the province (MacNutt 1963). Initially they were not allowed to settle in groups larger than 10 persons, the goal being to keep them at great distances from each other, or even ultimately discourage them from remaining in the colony at all. Since the authorities did not give those Acadians who remained a fully legal position by making grants of land, their status was little better than squatters (MacNutt 1963). It is an important and sobering reminder that eighteenth-century people understood that military disruptions did not have the long-term permanence that they might want, without civil validation (Mancke 2019). Consequently, the ultimate dispossession of Acadians came not through the barrel of a gun, but through the power of the pen, and less in the heat of war, than in the quiet of peace.

During the American Revolution, control of Fort Cumberland (formerly Fort Beausejour) was briefly contested by rebels in 1776. Though unsuccessful, the participation of Mi’kmaq and Wolastoqiyik in the siege highlighted the vulnerability of Nova Scotia and prompted the Crown to enter into what became the final round of Maritime Peace and Friendship Treaties with First Nations in 1778 and 1779, reaffirming the previous treaties (Patterson 2009).

The Revolutionary War ended with yet another Treaty of Paris, this one in 1783 (MacNutt 1963, Ganong 1901). Early in the war the Americans had taken it for granted that winning their independence also implied the acquisition of the two provinces (Nova Scotia and Canada) that had not revolted. In the end however, the agreed terms established rough boundaries between British holdings and the newly recognized United States, that while not yet finalized along the St. Croix River, were distant from the Pollett River. The peace fell short of the hopes and expectations both sides had harbored during the war, but despite the distance from the border, was not without implications for the Pollett. For every Loyalist within British lines, there were five left living within territories dominated by the Continental Congress (MacNutt 1963). To such Loyalists, peace and recognition of the United States meant surrender of themselves and their possessions to those that had been their enemies. Although the Treaty of Paris promised Loyalists a safe return to their pre-war homes, persecution of "Tories" escalated with the rebel victory (Dallison 2003). An attractive and safer alternative became clear. Across the water lay Nova Scotia, a (comparatively) vacant land which remained beneath the British Crown (MacNutt 1963).

As things warmed in the spring of 1783 the movement began, with all parts of the coastline receiving refugees, many of which landed on the north shore of the Bay of Fundy (Squires 2000), of which approximately 11,000 eventually stayed on (Wynn 1981a), tripling the population from a little more than 5,000 to more than 16,000 in less than a year. Almost 10% of the refugees were black loyalists, and 10% of those (i.e., approximately 1% of total Loyalist refugees) arrived in the region as slaves. (Hodges 1996). The main point of penetration was the Saint John River Valley, however, the Petitcodiac, Memramcook, and Chignecto regions each received a share Loyalist refugees as well (Wright 1945, Milner 1967, Bowser 1986).

Even before departure from New York, Loyalists had begun to contemplate a separate and distinct province (Dallison 2003), and support for the concept only grew once they arrived in Nova Scotia. Governor Parr began escheating parts of pre-Revolution grants immediately to provide lands for the newcomers jamming into port towns clamouring for land (Fellows 1971). The need for land was paramount as it meant survival, food, and fuel- as well as status and wealth. Parr's inability to release land quickly enough frustrated Loyalists (Snowdon 1983) and was a key factor driving calls for partition (Gilroy 1933). Edward Winslow, an individual responsible for settling Loyalist Regiments in Nova Scotia became a leading proponent for partition arguing in a letter to his friend Ward Chipman in 1783, "Take the general map of this province (even as it is now bounded) observe how detached this part is from the rest, how vastly extensive it is, notice the rivers, harbours, etc. Consider the numberless inconveniences that must arise from its remoteness from the metropolis and the difficulty in communication. Think what multitudes have and will come here, and then judge whether it must not from the nature of things immediately become a separate government" (Winslow 1783).

Halifax was opposed to Nova Scotia being subdivided for obvious reasons (Chipman 1784), however the authorities in London agreed (Gilroy 1933). On June 18th, 1784, Nova Scotia was partitioned, and the north shore of the Bay of Fundy became New Brunswick, a self governing "Loyalist" province. Once again the Missaquash River was selected as the boundary (Allison 1916), with the Pollett watershed falling within what became Westmorland County (Ganong 1901). Thomas Carleton arrived in November 1784 to establish the new government and direct the colonization of New Brunswick (Fellows 1971). With access to title to land having been a driving factor in its formation, the newly established Province of New Brunswick required that existing land grants be re-registered both to facilitate escheat and to establish clear title for active landowners (Kernaghan 1981), and the House of Assembly focused on allocation of land as one of its initial priorities (Fellows 1971).

The dates that various communities listed in Table 1 were first settled (where available) indicate how movement by English colonists into the upper reaches of the Petitcodiac River above the head of tide occurred first along the more easily accessible main stem. Many of the early dates coincide with the arrival of United Empire loyalists from the 13 colonies (late 1770's - 1780's). After the arrival of the Loyalists, Mi'kmaq in what is now New Brunswick were moved off their lands and onto "reserves" (Walls 2010). This was done partially to provide land to incoming settlers, and partially to punish the Mi'kmaq for aligning themselves with the French.

Subsequent generations of English settler families and those that arrived after them then pushed further up the Petitcodiac and into its more remote tributaries such as the Little River, and the Pollett River (Wright 1945). An early example would be John Colpitts, the eldest son of Robert Colpitts who had settled near Salisbury in 1783. John Colpitts arrived from England as a teenager with his father, and had already moved on to develop his own homestead just a few years later, founding Colpitts Settlement on the Little River (Moncton Daily Times, Thursday August 26th 1920).

Forestry Practices

In 1811, when the first homesteaders (the Geldarts) reached the headwaters of the Pollett near what became Elgin, the area was described as unbroken wilderness, having no roads and extremely dense forest (St John Daily Telegraph October 14th, 1870). Such early settlers cleared the land to allow for agriculture, locally consuming cordwood for fuel, and lumber to build their homesteads, while generating income by selecting marketable timber to send downriver to be sold for shipbuilding or export. The latter became a significant aspect of the local economy.

A few years earlier, in 1803, war had broken out in Europe yet again- initially with limited implications for New Brunswick. At first British victory at sea in October 1805 at the Battle of Trafalgar kept the Napoleonic Wars remote, with the primary risk of conflict locally being with the Americans (MacNutt 1963, Mancke et al 2017). In February 1807 however, ports in the Baltic were closed to British shipping (Raymond 2010). Until this point Britain had been largely dependent upon the Baltic for its supply of naval stores (Davey 2011) Procurement of timber, hemp, iron, pitch, tar, and flax was essential to Britain not just militarily, sustaining its trade and economic power was reliant upon maintaining the capacity of its merchant fleet as well. By 1809 Edward Winslow, then the deputy surveyor of the King's Woods in New Brunswick noted, "The interruption of the Baltic trade and other causes have occasioned a most extraordinary demand for ton timber" (Winslow 1809). The Napoleonic blockade of the Baltic pushed England to expand New Brunswick's lumber production twentyfold, transforming what had been an "undeveloped backwater" of 25,000 people largely engaged in subsistence agriculture into a bustling colony of 190,000 with an export driven economy over a matter of just a few decades (Wynn 1981b, Gordon 2014).

Ship building and shipping were linked directly to the timber trade (Sager and Fischer 2007). Timber was the major cargo of colonial built vessels, with the ship itself often being sold along with its cargo upon reaching Great Britain. Even after the war, once the capacity had been established, the trade continued, stimulated until 1848 by a British tariff that favored supplies imported from North America (Bowser 1986). Shipbuilding enterprises sprung up wherever timber could be floated down river to the coast (Craik 1917).

Timber harvest in the Petitcodiac timber district as a whole grew from 260 tons in 1818 to 3,137 tons by 1836 (Wynn 1981b), though this paled in comparison cutting in other more accessible portions of the province such as in numerous timber districts along the Saint John and Miramichi Rivers where harvests taking place at the same time were in some cases an order of magnitude greater.

On the Pollett six or seven dams on streams and on the river itself would be simultaneously opened during the spring freshet to cause of surge of water that could carry logs cut over the winter to mills downstream (Jones et. al 1997), a practice which reportedly continued to supply the mill at Forest Glen (the community of Pollett River) up to 1947.

During the early 1800s white pine was gradually culled from New Brunswick Forests to meet the demand for masts for the Royal Navy (Wynn, 1981b). The White Pines Act of 1722 established the requirement of a royal license to fell white pines with a diameter exceeding 24 inches unless they were privately owned, and in 1729 Parliament reserved all such trees to the government except those already in private hands before 1690 (Purvis 1999). Since New Brunswick came under British control well after that time, this exception did not apply at all to its forests. During the American Revolution and the Napoleonic Wars from 80 to 90 percent of all masts supplied to the Royal Navy came from Canada, mostly New Brunswick (Williams 1992). Pines could still be found in 1850, but few of the magnificent trees the region was known for earlier in the century remained. Spruce was more abundant, but the largest had also been cut. Though there were not many extensive cutover tracts, by 1850 the character and composition of the forests in New Brunswick had been drastically modified over the course of just 50 years of harvesting.

There were no corporate, individual, or sales taxes at this time (Goodrich 2010). Consequently, the primary source of government revenue was import and export duties. It was only once the province began to collect duties on the timber and lumber shipped to England during and after the Napoleonic Wars- and the goods brought back from there- that in 1816 it had been finally able to get serious about building infrastructure such as the system of "Great Roads" linking principal population centres. The Westmorland Great Road from Saint John to the Nova Scotia border had been surveyed and well traveled by foot and horseback since the 1790s, locally following roughly of what is now route 106 from the Village of Petitcodiac through Moncton and on to Dorchester. By the mid 1830s this route had been fully graveled and was smooth enough to run a coach over at a full trot (when the weather was good), and regular mail and stagecoach service began.

The effects of this early economic activity were not limited to just the forests. By 1820 importation of food into New Brunswick was the rule rather than the exception, everything hinged on the timber trade, though there were warning signs of the danger of single source economy (DeMerchant 1983). James Robb, professor of Natural Science at Kings College in Fredericton (now the University of New Brunswick), was appointed Secretary of the Provincial Board of Agriculture when it was established in 1858. He warned that timber harvesting was so lucrative that it distorted development, and that when the market in Europe declined, the farmer neglecting his homestead to work in the woods would be "surprised to find his fences down, his fields grown up with bushes, and both himself and his snug little clearing generally all gone bad". It was not just agriculture that was falling short of its potential. In the years that shipbuilding boomed at St. John and other towns along the coast, even the fishing industry was neglected as men were drawn to the forest to supply wood (DeMerchant 1983).

Elson (1962) reports that there were several dams on the Pollett during this time to provide power to sawmills. He notes that one at the community of Pollett River/Forest Glen (Table 1) 16 kilometers above the mouth of the river, functioned for at least 150 years, which if accurate would be almost the entire period from early settlement up to his time of writing. Reportedly during much of that time it had no fishway and prevented Salmon from passing upstream. Beyond that dam another sawmill dam was located near Elgin (Table 1), 28 kilometers above the mouth of the river and less than a kilometer below Gordon Falls. Arguably with regards to salmon, the presence of that dam was rendered somewhat moot by the one below it. Aside from restricting passage, mill wastes were also a problem because at the time, other than burning, dumping into the river was one of the most common forms of disposal of sawdust, bark, and other waste (Department of Fisheries 1890). Such material sometimes covered river bottoms, smothering spawning sites. Despite the Pollett draining a larger watershed and being a longer river than the Little River, it is thought that following English settlement from the early 1800s to the 1970s, the Little River contributed more salmon smolts to the Petitcodiac than the Pollett did, due to the extent of human impacts on the Pollett (McLeod 1973).

By 1876 the completion of the railway branch line, The Elgin, Petitcodiac, & Havelock Railway connected the Pollett watershed to Intercolonial Railway, eliminating transportation as a constraint on timber harvesting. According to Dawson (2005) it entered the watershed following what is today Route 905 (which already existed then as a road) heading east from Petitcodiac until arriving at the Pollett at Forest Glen (another name for the community of Pollett River), near where Sanatorium Rd now meets the 905. From there it continued upstream, alongside the precursor of the modern 905 to Elgin.

The Chignecto Post in Sackville wrote of the railway opening on September 14th 1876, “Within a few months over 350 cars of lumber (which could not have otherwise profitably been put in the market) have been hauled over the railway. The estimated shipments of lumber per year is about six million. Besides this there is ship timber from the virgin forests of Elgin, bark, sleepers, cordwood, country produce, local and passenger traffic.” It goes on, “There is said to be enough timber in her (referring to the Elgin region) hills to keep the shipyards in Saint John busy for a century.” How “virgin” the forests may have been is an interesting question given a population at that time (Table 1) of over 250 people in Elgin, plus hundreds elsewhere in the watershed and surrounding communities who had been there, in some cases for much of the previous 50 years. Such things are relative however, given that, as noted previously, other more easily accessible portions of the Province, had experienced more intensive harvesting. Eleven months later The Daily Times of Moncton noted on August 15th 1877 that “during the year a great quantity of ship timber has been got out at Elgin for consumption in Saint John.”

At that point the age of wooden ships was beginning to wind down however, causing a reduction in the scale of the demand for timber exports both as wood and manufactured into ships. By the end of the Crimean war in 1856, virtually all of the ships in the British Royal Navy were already fitted with steam engines, rendering masts irrelevant (Evans 2004), and the conversion to iron hulls began within a decade thereafter.

A non-timber forest product that was commercially significant at the time was maple sugar. In the 1840s the Colpitts family was already producing marketable surpluses, gathering enough sap to produce 6200 pounds of maple sugar (Albert County Museum 2015). By 1851 the annual output of maple sugar from Elgin Parish (which also included all of the forested upper reaches of the Little River, immediately to the east of the Pollett) was approximately 80,000 pounds (Fellows 1980).

Agricultural Practices

As noted in the forestry section the population of New Brunswick quintupled in a matter of just a few decades to meet the needs of both the Royal Navy and merchant fleets for naval stores in response to the Napoleonic blockade of the Baltic (Wynn 1981b). While a lucrative trade, this distorted development, shifting what had been a Province with little more than subsistence agriculture into an export driven economy, while simultaneously adding numerous mouths to feed.

Before crops could be planted settlers were faced with cutting and clearing the forest. Stumps were often left a few years to rot, and crops were sown amongst them (DeMerchant, 1983). In Perley's (1857) Handbook of Information for Emigrants to New Brunswick, he suggests that "No emigrant should undertake to clear land and make a farm, unless he has the means of supporting his family for 12 months." However, it was not just a matter of the financial resources of individuals. Since in the early 1800's the province as a whole was not self-sufficient agriculturally, it is unlikely the communities along the Pollett River were either. However, given the logistical challenges of transporting food to remote homesteads, it is doubtful that importation of food was as practical as in urban centres. More likely for the early settlers, subsistence agriculture was supplemented with food available from the forest and river. In fact, Elson (1962) notes that the abundant supply of Salmon on the Pollett River was reported to have been one of the attractions for early settlers. This pattern had already been established a generation previously on the Petitcodiac River. In 1783 while Robert Colpitts first crop at his farm just downstream of the mouth of the Pollett was ripening, his family's main source of food was salmon (Moncton Daily Times, Thursday August 26th 1920).

About the same time that the Geldarts arrived in Elgin, in 1811 Joseph Gubbins reported in his Journals of his travels through the area that settlers on the Paulet (Pollett) told him that "From some unaccountable cause no salmon had been known to frequent a small river called the Paulet, which falls into the Petitcodiac, until one of the inhabitants brought a few and put them into it, since when it has been as well supplied with them as any other" (Gubbins 1980).

This description of events is improbable. The Pollett River and the Little River are recognized as the two primary salmon spawning streams in the Petitcodiac headwaters (McLeod 1973). Given that Kay Settlement was only settled in 1803 and Elgin not until 1811 there would have been few observers along the Pollett river prior to 1811, and not much time depth upon which for them to base such an assessment, having only been there just several short years. It seems more plausible there may have simply been several bad years for salmon returns on the Pollett (for whatever reason) in approximately the 1790s, just as settlers began to occupy the area.

There is even a plausible explanation for why salmon returns to the Pollett in the 1790s would have been poor, and then progressively rebounded. As noted above, in 1783 while Robert Colpitts first crop was ripening near Salisbury, he was reportedly feeding his family mostly salmon. That could mean something like ~100 salmon. Colpitts was not alone. After the end of the American Revolution, the arrival of the Loyalists suddenly caused the human population in New Brunswick to triple- swelling from 5,000 into 16,000 people in a little over a year- between 1783 and 1784 (Wynn 1981a).

Assuming Colpitts and his family were not unusual, then it is easy to imagine that returning salmon on the Petitcodiac got over fished at that time and so didn't make it back to the Pollett in significant numbers - despite being seen (and eaten) on the main stem- pretty much as described. The historic population of inner Bay of Fundy Atlantic salmon is estimated at 40,000 returning adults (COSEWIC 2006a), of which the Petitcodiac accounted for 20%. This means that historically on average the Petitcodiac was home to approximately 8,000 returning adult salmon during any given year. Therefore, as few as 50 newly arrived Loyalist families along the Petitcodiac, with few agricultural crops and perhaps each eating something like 100 fish per year, could rapidly consume approximately 60% of the salmon population- making returning salmon a lot harder to find as far upstream as the Pollett.

Then, as agriculture downstream along the main stem of the Petitcodiac became more productive, farmers there became more self sufficient (and perhaps grew tired of eating salmon). Once dependency on fishing salmon declined, salmon stocks could have naturally rebounded, because more fish made it back to the Pollett. Meanwhile, those "stocking" the Pollett credited themselves for "introducing" salmon to the Pollett, which was what they then reported to Gubbins during his visit in 1811.

By 1850 over 25% of the land in coastal Parishes such as Hopewell, Dorchester, and Westmoreland had been cleared for agriculture, and Sackville Parish had 16,000 of its 100,000 acres fit for cultivation. Of the eight remaining Parishes in Westmorland and Albert Counties, Elgin Parish was the only one at that time with less than 5,000 acres of cleared land (Wynn 1981b). What is more, in only both Elgin and Salisbury Parishes was the population density less than 5 people per square mile. The quality of the land was not the issue however. The Chignecto Post in Sackville on Thursday September 14th 1876 described Elgin as, "one of those richly dowered places to whose prospective growth no one need set a limit. The climate, owing perhaps to being shut by her hills from the turbulent Bay of Fundy – is delightful. Its reputation as a fruit growing district will someday rival the Valley of Annapolis." Hyperbole perhaps, as things didn't turn out that way, but the upper Pollett valley did become and has remained agriculturally productive.

By 1871 the census results for Elgin Parish indicated that approximately 84% of the adults reporting an occupation, said that they were either farmers or farm laborers (Kanner, 1994). In 1876 with the arrival of The Elgin, Petitcodiac, & Havelock Railway branch line, sale of cash crops in distant markets became a more viable option, with reports of potatoes being sent as far away as Boston in 1887 (Moncton Daily Times, Monday October 1887), and cattle to Saint John the following year (The Maple Leaf, Albert NB, Thursday October 18th 1888). Such ventures indicate that agriculture had reached the point where it was producing marketable surpluses.

Dawson (2005) shows that in 1878 the road network within the watershed looked quite recognizable to the modern eye, with roads of some kind already present along most of the routes that are significant enough to be paved today, though obviously these wouldn't have been developed to that extent then. Still, given that in 1811 the watershed was described as roadless, this represented major change during the intervening 67 years.

The sawmill dam at Elgin may also have supplied power to the grist mill (Table 1). As a means of grinding grains into flour this would have allowed the community to process food grown locally to facilitate consumption or storage, and added value as a cash crop to be transported to distant markets.

It was fortunate for settlers that agricultural productivity and transportation had improved since the ability of the growing population to supplement their diets with food from the river was diminishing. As early as 1852, concerns were being expressed about noticeable declines in the once abundant salmon population on the Petitcodiac. At the time it was presumed then to be a consequence of overfishing

(Elson 1962). The human population in the region had continued to grow, with the 1851 census recording 193,800 people in New Brunswick (Bollman and Clemenson 2008), more than 12 times as many as had been present in 1784 (and 38 times as many people as compared to 1783). Even if each of these people were eating fewer salmon, increasing numbers took a toll. In addition to over-fishing, by the 1870's the lack of fishways on the dams on the Pollett was also acknowledged to be part of the problem.

Though productive, commercial agriculture did not change the Pollett valley in the ways that early enthusiasts had hoped. Between the First and Second World Wars most of the scattered farms above Gordon Falls were abandoned and allowed to revert back to forest (Elson 1962). Dawson (2005) shows that in 1878 the density of roads in that area was quite high (compared to today), some of which probably served those farms. The Elgin, Petitcodiac, & Havelock Railway was never profitable, and went bankrupt in 1890. It was sold to the government in 1918 and operated by the Intercolonial Railway until that became part of Canadian National (New Brunswick Railway Museum 2014). Service ended in 1955 when the branch line from Petitcodiac to Elgin was shut down.

Mining Practices

A short-lived lime burning operation produced agricultural lime for the use of local farmers. It came from a now abandoned limestone quarry west of the community of Pollett River (Goudge 1934).

Other Practices

In 1910 an earth and concrete dam was built 10 kilometers above the mouth of the river to serve the Jordan Memorial Sanatorium. This institution was established at a community called The Glades, near Kay settlement, as part of a Provincial effort to treat tuberculosis (Elson 1962). The fish ladder was destroyed in the mid 1930's, and the dam became a barrier to fish passage until 1950 when a new fishway was built. This dam has since been removed as have all of the other dams along the Pollett.

Indian Affairs

As laid out in previous sections, the Mi'kmaq and the Crown entered into a series of Peace and Friendship treaties between 1726, and 1779 (Nova Scotia Archives 2020), which form the basis of treaty rights held by the Mi'kmaq today. These were not treaties that surrendered land, but negotiations between sovereign entities. The Mi'kmaq never surrendered title to Mi'kma'ki (Mi'gmawe'l Tplu'taqnn 2023). Treaty rights and aboriginal rights are recognized and affirmed in Section 35 of the Constitution Act 1982 (Sanderson 2017). Each treaty was briefly described in previous sections within the chronological context that gave rise to it, to track the evolution of the treaties. However, as these treaties are still in effect and still relevant in New Brunswick from that time up to today, there is also value in compiling these within a single section to provide focus, make them more easily accessible, and by doing so make them more easily understood in their entirety. The five treaties are listed and identified in Table 2. In several cases a given treaty has more than one year attached to it. That is because of the complexity of negotiations, the large number of signatory communities, and the distances between venues at a time when mobility and communications were challenging meant that in

Table 2: Peace and Friendship Treaties between the Mi'kmaq and the Crown

Year	British Objective	Mi'kmaq Objective
1726	Mi'kmaq Recognition of 1713 Utrecht Treaty, "Lawful" British Settlements to be left undisturbed. British right to regulate Europeans	British Recognition of the legitimacy of Mi'kmaq Hunting, Fishing, and Planting activities
Comment:	When signed, the application of this treaty was within British controlled territory. The British interpretation of the 1713 treaty of Utrecht between them and France was that it gave them claim to all of Acadia including the north shore of the Bay of Fundy (modern New Brunswick), but effectively British authority did not go outside of peninsular Nova Scotia. Arguably it "did not extend beyond the cannon reach of the fort" at Annapolis Royal.	
1749	Reaffirm 1726, to end King George's War addressing Mi'kmaq cooperation with the Duc d'Anville expedition, and antipathy to British expansion beyond Annapolis Royal i.e. founding of Halifax. From British perspective did not modify 1726 in any way.	Reaffirm 1726 - British recognition of hunting and fishing
Comment:	Nothing new was offered in the treaty, just reaffirmation of the 1726 treaty. The context however was that it demanded acceptance of the fact the British were becoming more assertive than they had been previously. Among the Mi'kmaq, only the community at Chignecto signed - others refused to do so because British founding of Halifax a few months earlier was considered to be a violation of 1726.	
1752	Reaffirm 1726, to calm the effects of Father LeLoutre's War. Formalized commercial relationship between British and Mi'kmaq to wean Mi'kmaq from relationships with Acadians and French officials in Louisburg.	Reaffirm 1726 - British recognition of hunting and fishing rights, and ensured the "free liberty" to sell the products of these activities in Halifax or any other settlement.
Comment:	By this point the French were actively defending the Missaquash River as the border with British territory in Father LeLoutre's War. Mi'kmaq in the Petitcodiac watershed were "on the front line", while those in peninsular Nova Scotia were "behind the lines", living amongst expanding British settlements. This treaty forms the basis of the Supreme Court of Canada 1999 Marshall Decision affirming the treaty rights of First Nations people all across Canada to hunt and fish and earn a moderate livelihood while doing so (Supreme Court of Canada 1999). Resistance to this ruling by non-native lobster fishermen prompted the Burnt Church Crisis between 1999 and 2002 (Wicken 2002). Recently tensions have flared up over lobster in Saint Mary's Bay	
1760/61	Reaffirm 1726 after defeat of the French in North America. This ended Indigenous-French relations and alliances, and required natives to end trade with the French.	Reaffirm 1726 - British recognition of hunting and fishing rights, and with the end of French alliances and trade the British pledged to establish "truck houses" near native communities to provide alternative trade now that trade with the French was prohibited.
Comment:	This marked the end direct relations between the French Government and Native communities in the Maritimes. That was finalized in 1763 with the Treaty of Paris which ended the Seven Years War in which France ceded its territory in Canada and the Maritime region to Britain, except for the small islands of St. Pierre and Miquelon in the Gulf of St. Lawrence, which France retained to preserve access to fisheries there.	
1778/1779	Reaffirm 1726 within the new context of British North America being fractured by the American Revolution	Reaffirm 1726 - British recognition of hunting and fishing rights, and maintain peace going forward to avoid being drawn into violence between the British and American revolutionaries
Comment:	While the French were no longer a concern, the participation of Mi'kmaq and Wolastoqiyik (albeit only a few) in Eddy's siege of Fort Cumberland in 1776, and Allan's expedition into the Saint John Valley in 1777 highlighted the vulnerability the Maritimes to attempts by US agents to stir rebellion against the British.	

several cases the signing process for a given treaty began on one year and was not completed until the following year.

After the arrival of the Loyalists in 1783, Mi'kmaq in New Brunswick were gradually moved onto "reserves" (Walls 2010), to provide land to incoming settlers. This was made possible in part by a legal technicality. The Treaty of Paris in 1763 ended the French presence in the Maritimes, and the subsequent Royal Proclamation of 1763 recognized the property rights of the native peoples in the recently won portions of North America, but it had never been construed as applying to New Brunswick, which had been part of Nova Scotia at that time (Upton 1974). Safeguards concerning Indian lands, however questionable their ultimate value elsewhere, did not even exist in New Brunswick. Initially there had been little practical need for a policy as Mi'kmaq were few in number, and so scattered that they were not considered a threat to incoming whites. With the arrival of the Loyalists, "the Indians were driven back into the wilderness without much ceremony". The first real expression of concern amongst the government arose during the lead up to the War of 1812 (Upton 1974) that discontent might become a problem if war with the United States created an opportunity for trouble. Despite the fact some lands had been allocated to native people, they still maintained their nomadic way of life; and the colonial government's refusal to do anything further for them led to a complaint of "an injurious distinction between them and the Indians of Canada on one side and those within the limits of the neighboring American States on the other." The first listing of reserved lands was not published until 1838 and it identified 15 reserves in the Province ranging from 10 up to 16,000 acres. About 60,000 total acres had been designated as Indian reserves in the early 1800s, but none were in Westmorland County (Goodrich 2020).

That changed in 1840 when the Provincial Government purchased 63 acres at Beaumont near Fort Folly Point (Goodrich 2020) at the head of Shepody Bay. The Province then conveyed this land to the Magistrates of Westmorland County in Dorchester to hold in trust as a reserve. Then 126 Mi'kmaq moved there from various places within Westmorland County that they had been living to form the Fort Folly Reserve (Perley 1841, Ganong 1899). The land was not turned over to the Mi'kmaq themselves, but vested in the county to be held for their exclusive use.

Second Level Assessment- Current Impacts

Forestry Practices

Forest tenure within the Pollett River watershed today is a mixture of private woodlots, industrial freehold, and crown land, which are subject to varying levels of management in terms of harvesting planting and thinning. As Figure 3 shows (according to data provided by the new Brunswick Department of Natural Resources in 2023), a difference in the proportions in of these categories of land ownership and usage between the upper and the lower portions of the river. These differences reflect the level of access and population between the two portions of the river, which, as is often the case, becomes increasingly remote and less populated the higher up in the watershed one goes.

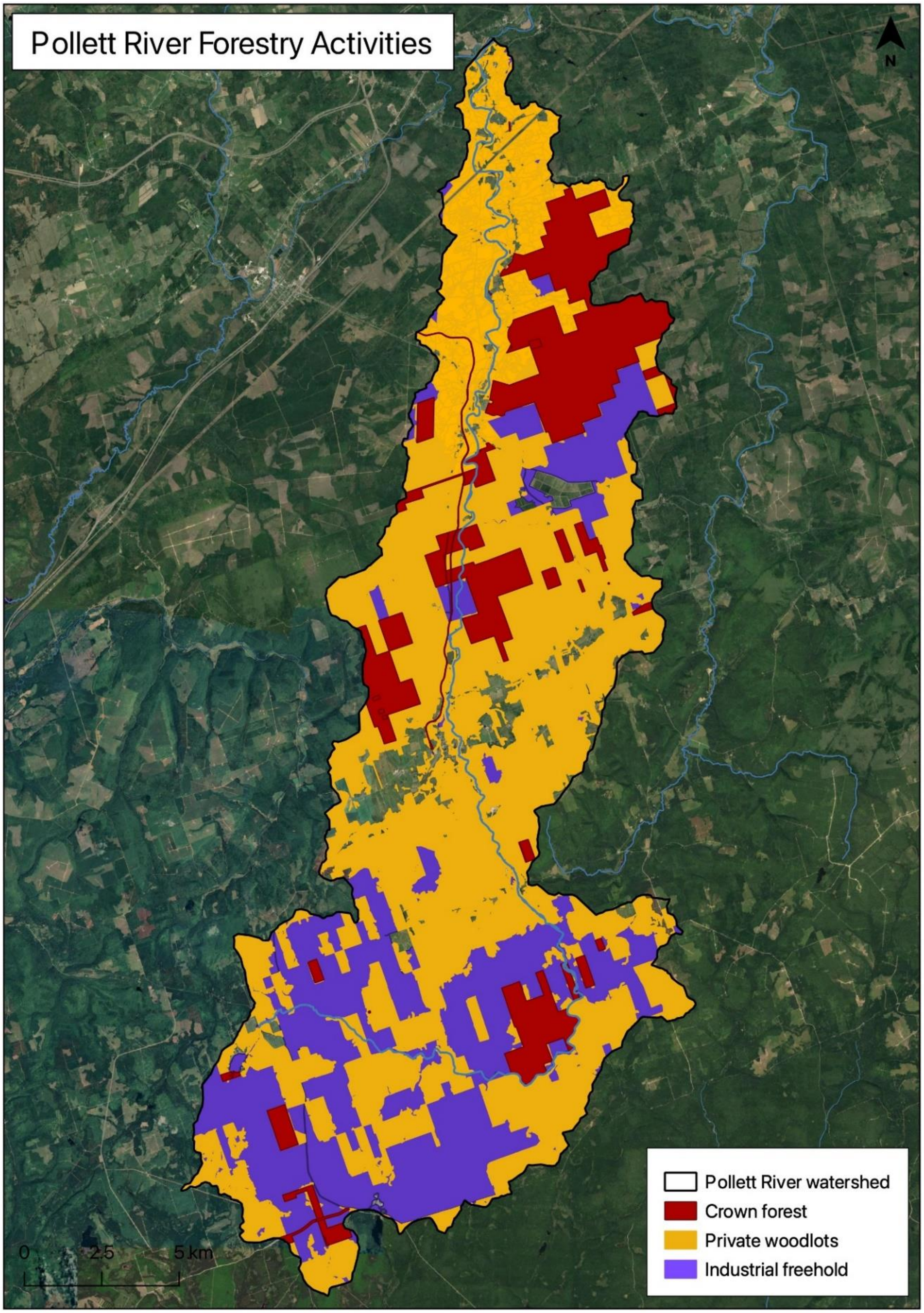

Figure 3: Forest Tenure within the Pollett River watershed

Maple syrup production remains a significant activity in the area. In addition to small scale private production there is a large commercial operation, Briggs Maples, tapping over 12,000 sugar maple trees in Albert County on both private and crown land near Fundy National Park (Briggs Maples 2015), with distribution in supermarkets through both Sobeys and CO-OP Atlantic.

Agricultural Practices

Agriculture is the dominant non-forest land use within the Pollett River watershed There are four working dairy farms in the watershed, and numerous hobby farms (Petitcodiac Watershed Alliance 2009), such that the watershed as a whole can be described as (aside from its 90% forest cover) 3% row crops and grains, 1.1% pastureland, and 1% blueberry fields. The uppermost reaches of the watershed are restricted to scattered blueberry fields. Just a little further downstream is the town of Elgin, still fairly high up within the watershed. None-the-less, well over half of the cultivated land (primarily crops and grains) found in the Pollett River valley lays in a broad band several kilometers immediately to the east or west of the Elgin town site (Figure 4).

As one continues downstream below Elgin, agriculture largely disappears for about 14 km until one nears the community of Pollett River, where the 905 is met by Parkindale Rd in the south and Sanatorium Rd further downstream to the north. Here, immediately along the river is some pasture land, and to a lesser extent crops and grains. Along Parkindale Rd, in the eastern portion of the watershed is a the Parkindale Seed Orchard operated by J.D. Irving Limited (JDI) produces up to 50 million seeds a year for use in its industrial tree nurseries, which then supply seedlings to its tree planting programs on land it manages across Atlantic Canada.

Below the point where Sanatorium Rd crosses onto the east side of the river, production begins to transition into primarily crops and grains. There are numerous scattered small fields along a narrow corridor between the Pollett River and Sanatorium Rd, mostly within about a kilometer of the river. This pattern continues even as the road network becomes more complex down near the confluence of the river with the Petitcodiac near Salisbury, increasing in density the closer one gets to the Pollett River's mouth.

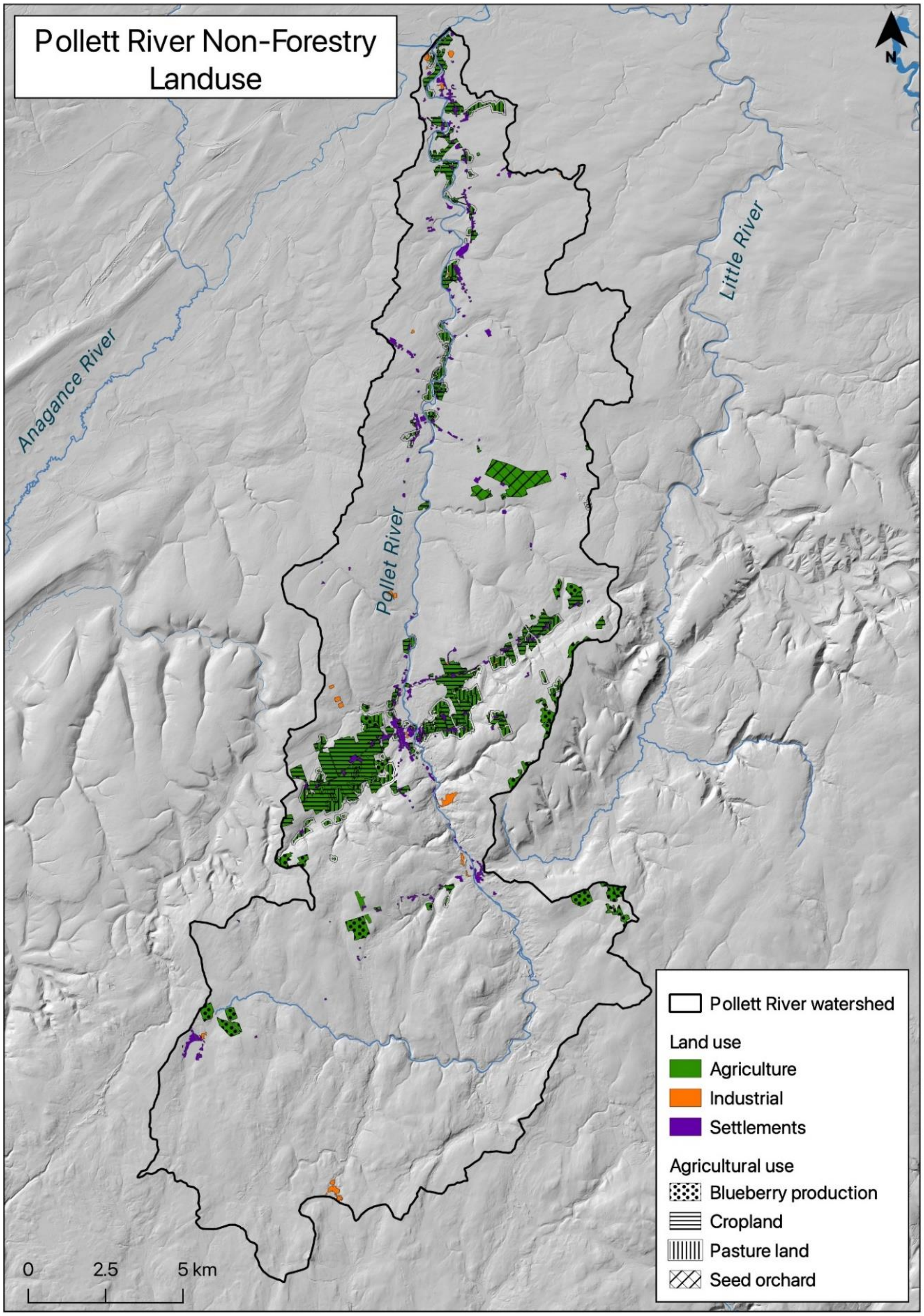

Figure 4: Agriculture and other non-forest usages of land in the Pollett River watershed

Transportation Development

A GIS layer of the road network (paved and unpaved) within the Pollett watershed was overlaid on the river and its tributaries, to yield Figure 5. In 2023 this process identified 81 crossings (52 unpaved and 29 paved) within the watershed. That was fewer than were identified with the data used in 2014 which at that time found 107 paved and 49 unpaved crossings. This is not to suggest that numbers of roads within the Pollett River watershed have declined over the intervening years, nor was such comparison the purpose of the exercise. Instead, here the goal was to provide a tool to help identify and catalogue crossings within the watershed to aid in tracking the impacts of such crossings on fish passage. One possibility at least for the unpaved crossings is that in 2014 railway crossings and powerlines may have been lumped into the overall total. However, that doesn't account for the lower number of paved crossings, which one would have expected to be more likely to show up in both analyses. Follow up to better understand differences in the data available is warranted. It is possible using the naked eye to note several locations in Figure 5 where both the paved and the unpaved road layers cross the water layer, yet a crossing wasn't flagged – perhaps due to the weight assigned to the watercourse. Likewise, there are several places where crossings were identified while a road is not displayed at all- suggesting not necessarily an error but a road not prominent enough to display. These differences may account for much of discrepancy in the GIS analyses between 2014 and 2023.

Fieldwork to physically survey the actual water crossings and assess the individual impacts of these structures on fish passage has been carried out by the Petitcodiac Watershed Alliance (PWA) between 2014 and 2022 throughout the Petitcodiac watershed as part of their Broken Brooks project. Annual reports detailing that work are available for download on the publications section of their website https://www.petitcodiacwatershed.org/ , the results of which are presented in Figure 6 and summarized below.

During their work the PWA located 78 crossings within the Pollett Watershed, quite comparable to the results of the 2023 GIS analysis noted above. Not surprisingly, a cursory comparison of their 78 crossings in Figure 6 lines up quite well with the 81 crossings identified during the GIS analysis presented in Figure 5. Most of the differences between the two is probably accounted for by a category of crossing that the PWA study identified as inaccessible- essentially a crossing that they had flagged to visit but were either unable to locate or gain access to.

The 78 crossings in the Pollett that the PWA successfully visited and assessed fell into five categories: Bridges (18); Dams (1); Culverts (39); Removed Culverts (1); Not Fish Habitat (19). Bridges are automatically defined as passable. Not Fish Habitat is self explanatory- a culvert located at a site fish don't use, so passage upstream of that site is not a cause for concern. Removed Culverts are likewise not a cause for concern. Dams are not necessarily automatically barrier to passage as structures such as fish ladders and spillways can create passage- so assessment is necessary. The 39 culverts that were identified in the Pollett Watershed required individual assessment, through which the PWA determined if they were: Passable (10); a Partial Barrier to Passage (8); or a Full Barrier to Passage (21). Passable culverts were not cause for concern, though Partial and Full Barriers to Passage were identified as problems, and where possible mitigations were prescribed. Proposed methods of mitigation identified varied depending upon the nature of the barrier to fish passage. These ranged from clearing debris, to building vortex rock weirs to raise the water in plunge pools below perched culverts, to modification of flow through the culvert through installation of baffles and / or an outflow chute.

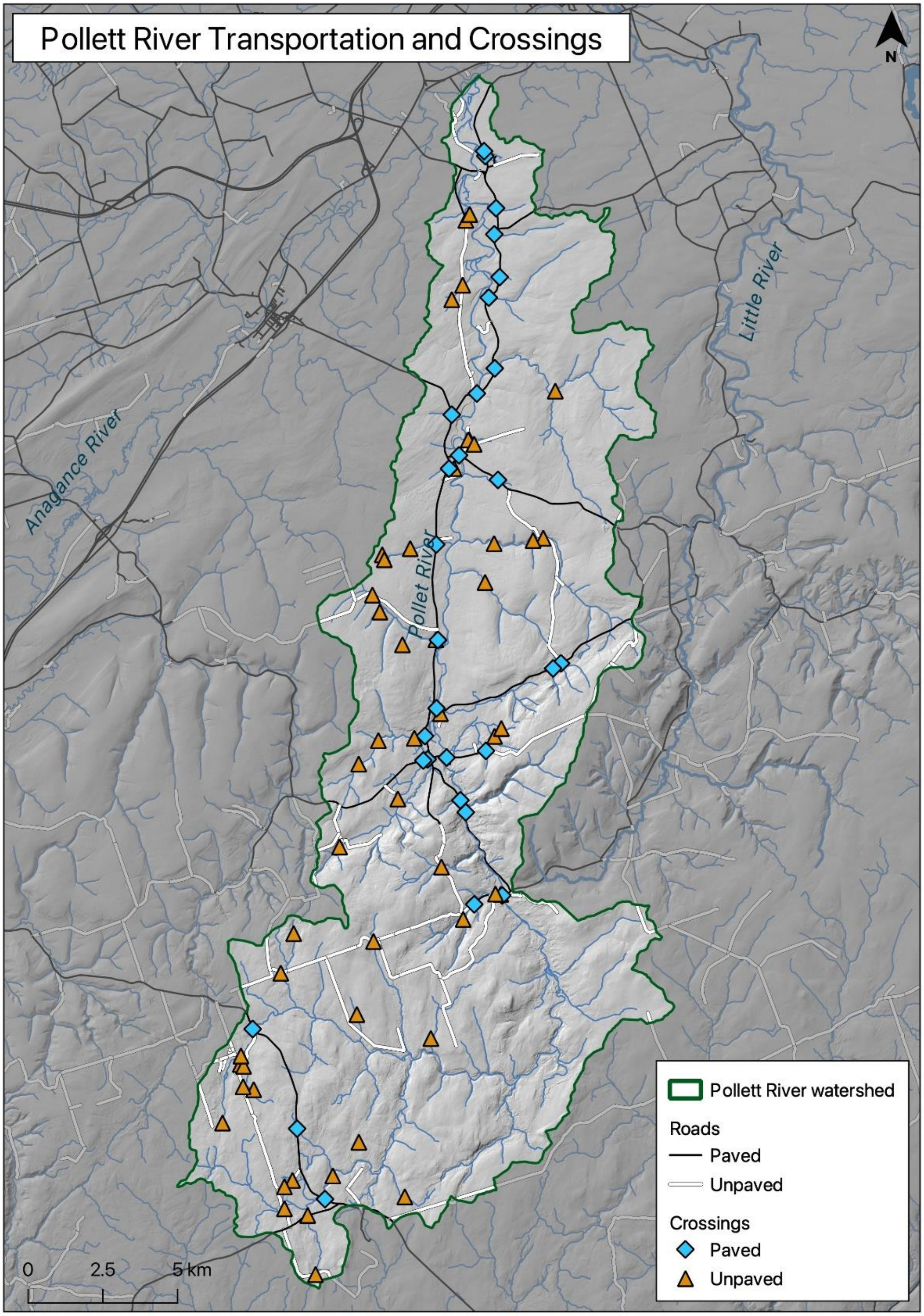

Figure 5: GIS analysis of locations of road / water crossings in the Pollett River watershed.

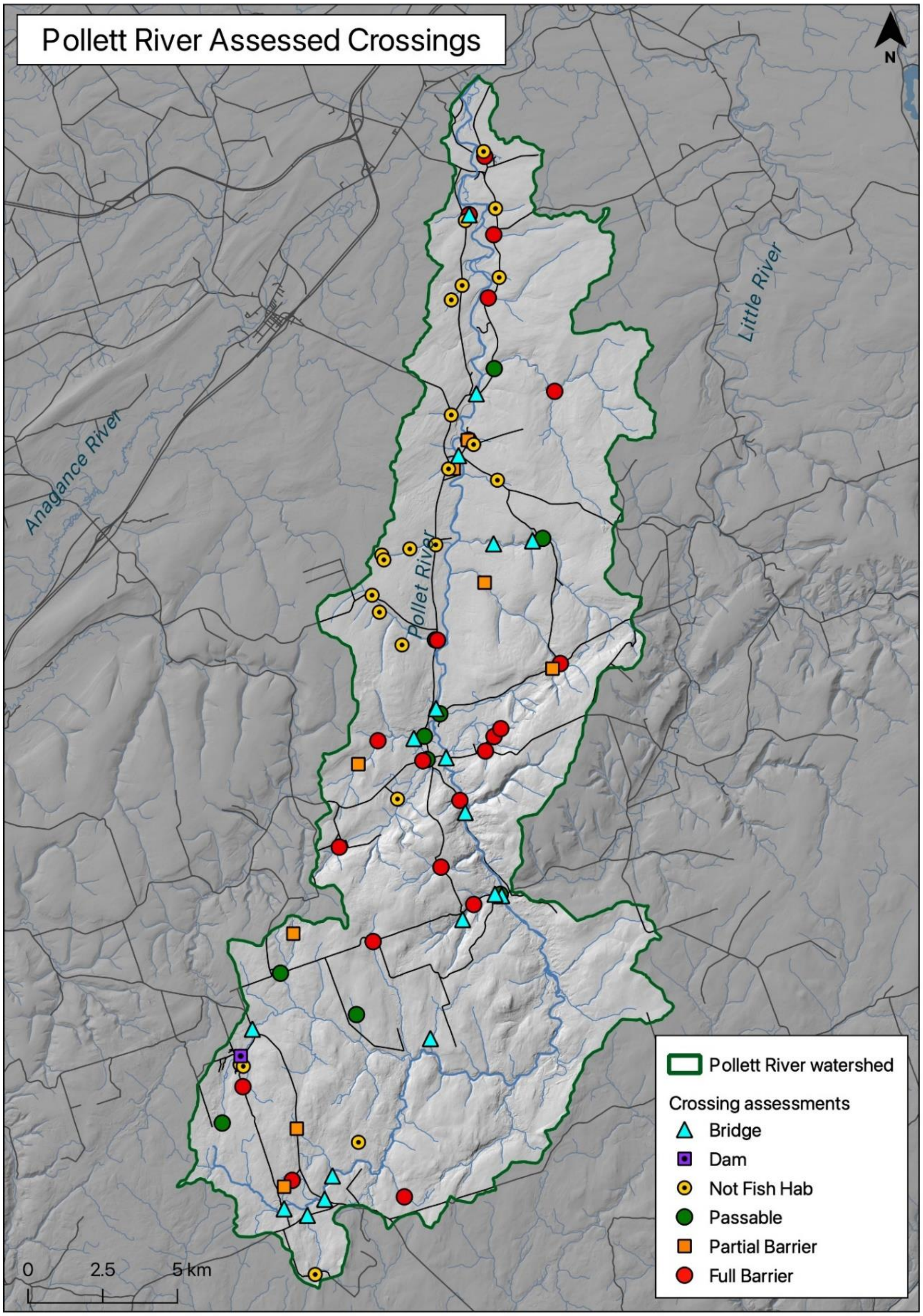

Figure 6: Water crossings visited and assessed by the Petitcodiac Watershed Alliance

While the New Brunswick Department of Transportation and Infrastructure (DTI) is responsible for bridges and culverts on the public paved roads, they are not responsible for the vast majority of those on the unpaved roads which are likely to be on either private woodlots, industrial freehold, or crown land. If a problem culvert is identified and there is a question of who is responsible (private landowner versus DTI), GPS coordinates should allow responsibility to be confirmed through further discussions with DTI.

Rail service to Elgin from Petitcodiac was discontinued and the line was abandoned by Canadian National in 1955 (New Brunswick Railway Museum 2014). Subsequently the New Brunswick All Terrain Vehicle Federation entered into a signed agreement with the Department of Natural Resources to allow development of an ATV trail along this line.

In 1968, 28 kilometers downstream of the Pollett along the Petitcodiac, the Maritime Marshland Rehabilitation Administration (MMRA) built the Moncton to Riverview Causeway (Rudin 2021). The purpose of this structure was to protect agricultural land upstream of it from tidal flooding and storm surges while also providing a second link for vehicular traffic between the two cities. A bridge combined with less expensive upgrades to the existing system of dykes and aboiteaux could have secured these lands just as well. Either option would have satisfied the transportation needs of greater Moncton, but with different implications in terms of both short-term matters connected with financing and long-term implications for the environment (Rudin 2021). The fishway built into the causeway proved to be ineffective (Locke et al 2003). The causeway gates created a barrier to fish passage with significant consequences for native fish species in the river, which led to the decline in the populations of species such as alewife, blueback herring, rainbow smelt, and sea-run brook trout. Some species disappeared altogether from the upland reaches of the Petitcodiac (such as the Pollett), including Atlantic tomcod, American shad, and striped bass. Atlantic salmon only remained present in the river as a consequence of ongoing stocking efforts (AMEC 2005)

In April 2010 the Moncton to Riverview Causeway gates were opened as part of the Petitcodiac River Restoration Project. From 2017 to 2021 a new bridge was built to partially replace the Petitcodiac Causeway. During April of 2021 the causeway was breached and a new 160-metre-wide channel was opened up underneath it. Following the restoration of fish passage in 2010, thirteen years of monitoring movement of anadromous fish have been carried out using a fish net trap at the head of tide in Salisbury (2010 to 2022). (Redfield 2023). On October 4th, 2021 (the first year with the new channel under the bridge) the trap caught the first wild returning salmon recorded since the monitoring program began. There were 170 striped bass caught that year at the trap, nearly as many as 2018 (65 striped bass), 2019 (65 striped bass), and 2020 (43 striped bass) combined. While additional returning wild salmon weren't caught in 2022, another 155 striped bass were - demonstrating that the 2021 result had not been a fluke. Meanwhile, numerous 40+ cm striped bass have been observed as high up in the system as a pool in the lower portion of the Pollett during snorkel surveys every year between 2018 and 2022 (except for 2021). Likewise American shad, American eels, and Atlantic tomcod have all been noted returning to the river. Of these, the latter two have shown sustained and progressive increases in numbers over the years, while invasive non-native smallmouth bass and chain pickerel have declined. Consequently, it is clear from these results that the fish community of the Petitcodiac has the capacity to recover, given the right conditions, and appears to be on its way to doing so.

Herbicide and Pesticide Use

Based on general information provided by Service New Brunswick, two forestry operators (JD Irving as Forest Patrol and Natural Resources) may have conducted work in the Pollett River watershed. While intended blocks of land to be treated were identified by operators that does not necessarily mean that they were treated with herbicides. Products used in these industries may contain the active ingredient glyphosate. Glyphosate is found in several formulations under the trade names Arsenal (PCP 23713), Forza (PCP 26401), Vantage (PCP 26884), Vision (PCP 19899) and Vision Max (PCP 27736). The active ingredient triclopyr has also been used in the past as Release (PCP 22093).

In addition, two industrial operators (Asplundh and NB Power Transmission) may have conducted work with respect to an industrial right-of way perspective (transmission lines) in the Pollett River watershed. These companies may have used tricoplyr as Garlon 4 (PCP 21053), Karmax (PCP 21252) and any of the aforementioned glyphosate products. Private growers must be individually certified (hold a valid pesticide applicator certificate) but do not report their usage. Likewise, vendors must report sales but do not provide a breakdown relevant to individual purchasers. It is difficult to find information of grower or vendor pesticide or herbicide use.

Mining Practices

Several fracked shale gas wells exist within the Pollett watershed (Petitcodiac Watershed Alliance 2009), with rights for fracking and gas extraction held by Headwater Exploration Inc. (Government of New Brunswick 2023a). The Alward government made a clear Provincial commitment to promoting shale gas development in New Brunswick (Alward 2014), and controversy erupted. Shortly there after the Gallant government came into office and enacted a moratorium on expansion (Canadian Broadcasting Corporation 2014). The concern if additional wells were added, impacts would include freshwater extraction from streams, habitat destruction and sedimentation during road building, and the potential for wastewater spills contaminating surface waters. The current Provincial government under Blaine Higgs has signalled openness to shale gas in recent years (Canadian Broadcasting Corporation 2023).

A granite quarry began operations in the Pollett watershed in 2009 (Petitcodiac Watershed Alliance 2009). The buffer between the main stem of the river and the quarry is adequate, however Gibson Brook, a tributary of the Pollett passes near the quarry and as the operation expands there is potential for the quarry to become a sediment source through deforestation, road building, and release of water due to ongoing drainage of the site.

Fort Folly First Nation

Mi’kmaq never surrendered title to Mi’kma’ki (Mi’gmawe’l Tplu’taqnn 2023), however have limited contemporary presence on Pollett (despite it being traditional territory). There are relatively few Mi’kmaq, and government policies concentrated these downstream on the Fort Folly reserve at Beaumont (in Shepody Bay), at the mouth of the Petitcodiac. Economic decline of the building stone quarries at Fort Folly Point in the 1890s, profoundly effected the reserve. Many families moved to Shediac or Richibucto, while others went to Dorchester and the surrounding area. By 1913 only three or four families remained at Beaumont, the last of which left in 1955. In 1958, Beaumont was no longer occupied, title was lost, which has been challenged in a land claim (Fort Folly First Nation 2021).

Mi'kmaq continued to be part of the community in and around Dorchester throughout the 1950s and 1960s after Beaumont ceased to be a reserve (Goodrich 2020), living as individual families with "status" but without a reserve. That changed in 1969 when the current Fort Folly First Nation Reserve was established near Dorchester at Palmer's Pond on Rte. 106. It was initially named Palmer's Pond Reserve (Fort Folly First Nation 2021), but the decision was soon made to rename it the Fort Folly Indian Reserve. The present band, which is mostly descended from those who had occupied Beaumont (Kristmason 2004), does not consider this to be a new foundation, but continuity, with a relocation from Beaumont (Goodrich 2020). Fort Folly, which had been the name of the original reserve at Beaumont, was named geographically for the location on which it existed (Perley 1841, Ganong 1899). Today the band has thirty-six members living on reserve, and a further ninety-six living off reserve.

Urban Development

There is no large urban centre within the Pollett, though along some of the more populated sections of the river, portions of private woodlots have been subdivided and sold as building lots for recreational properties such as camps (Petitcodiac Watershed Alliance 2009). In addition to the damage to the riparian buffer that results from adding new access roads, camp construction and clearing for lawns and views of the river, there is significant potential for sewage contamination if septic systems are poorly maintained. Local Governance Reform by the Province (Government of New Brunswick 2023b) divided the Pollett watershed between 2 local governments: Salisbury (from the mouth of the river up to a short distance below the Sanitorium Rd Bridge) and The Community of Three Rivers (almost all of the watershed above that to a short distance above the Church Hill Rd. Bridge). The headwaters above that up to the Kings County line as well as the Pollett side of Gowland Mountain remain unincorporated parts of Southeast Rural District RD 7, while Mechanic Lake is in Kings Rural District RD 8.

Third Level Assessment – Aquatic and Riparian Habitat Assessment

Wildlife

Several species of wildlife warranting specific attention occur in the Pollett watershed: Atlantic salmon (*Salmo salar*), striped bass (*Morone saxatilis*), American eels (*Anguilla rostrata*), and (*Glyptemys insculpta*) wood turtles. Atlantic salmon Inner Bay of Fundy (iBoF) populations were listed as endangered under the Species at Risk Act in 2003 (DFO, 2010; SARA Registry, 2013a). Salmon are considered extirpated from the Petitcodiac, except for those introduced in stocking programs (AMEC, 2005). Locations where iBoF Atlantic Salmon have been observed are shown in Figure 7. Striped bass in the Bay of Fundy were designated "Endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2012 (COSEWIC 2014a) and are being considered for listing under the Federal Species at Risk Act (SARA), but currently have no status (SARA Registry 2018). American eels were designated as "Special Concern" by COSEWIC in 2006 (COSEWIC 2006b). Their status was re-examined

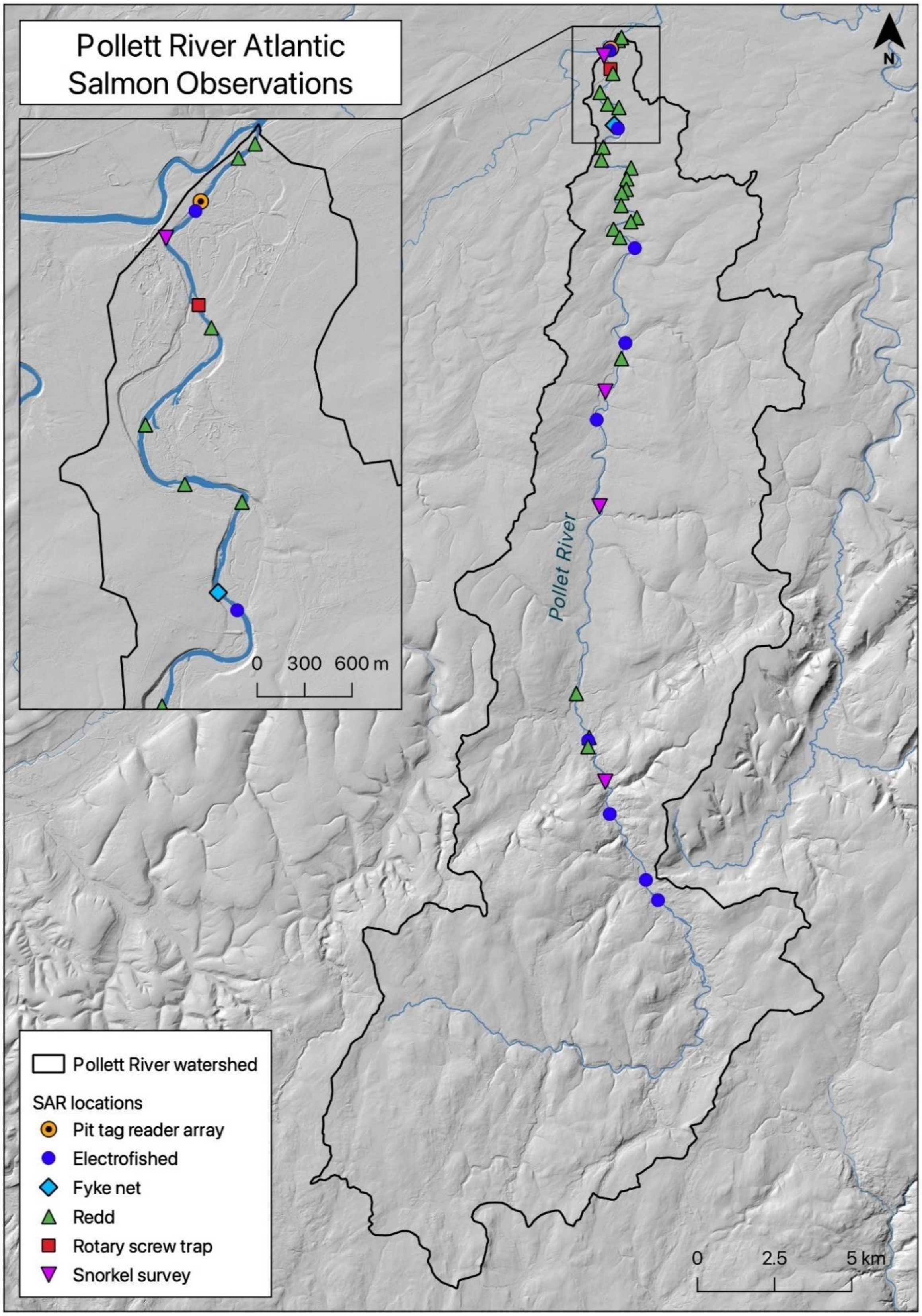

Figure 7: iBoF Atlantic salmon occurrences within the Pollett River

and raised to “Threatened” in 2012 (COSEWIC 2014b). This species is being considered for listing under the federal Species at Risk Act, but currently it has no status (SARA Registry, 2013b). Wood turtles were designated as “Special Concern” by COSEWIC in 1996 which was raised to “Threatened” in 2007 (COSEWIC 2007; COSEWIC 2011). This species is listed as “threatened” under the Species at Risk Act (SARA Registry 2012). Brook Floaters (*Alasmidonta varicosa*) have been noted on the main stem of the Petitcodiac and next door on the Little River but not within the Pollett River watershed. Guidelines for projects in areas with these species are in the Appendix.

The modern decline in iBoF salmon within the Petitcodiac is a marked contrast to the abundance described by early settlers. This, despite Gubbin’s 1811 report that salmon were introduced to the Pollett by English settlers shortly after their arrival (Gubbins 1980). As discussed in more detail in the First Level Assessment Agricultural Practices, that report makes little sense, and while settlers may have believed that they had done so, it is most likely a misinterpretation of events. Construction of the Moncton to Riverview causeway in 1968 eliminated fish passage for adult salmon and smolts and effectively (but for ongoing intervention) extirpated the species from a river system that represented 20% of the total iBoF population (Locke et al. 2003). That said numbers of this species had been decreasing for decades due to the impacts of other human activities (Elson 1962), long prior to construction of the causeway.

Survival and development of fry released along the Pollett since the causeway gates were opened in 2010 have been monitored by annual electrofishing at the release sites, and near the mouth of the river through operation of a Rotary Screw Trap (RST) or “smolt wheel” a counting fence, and fyke nets. Release sites included locations upstream of Gordon Falls, where quality habitat exists, even though there is some question if salmon would be unable to access it naturally. The decision was made to use that portion of the river as well since such areas could provide nursery habitat for juveniles (who then migrate out as smolts), despite them possibly being unable to return that far upstream as adults.

In recent years, adult salmon have been released into the river- both non-targeted fish from DFO’s Live Gene Bank at Mactaquac with the addition during the last several years of Fundy Salmon Recovery (FSR) adults grown to maturity in sea cages in Grand Manan. These FSR adults are of particular significance as they are wild exposed fish from the Petitcodiac River itself (Fundy Salmon recovery 2023). This means that unlike the DFO fish, which though wild exposed were collected as juveniles from the Big Salmon River (BSR), adult salmon released into the Petitcodiac as part of the FSR program were typically collected as juveniles (smolts of fall parr) within the Petitcodiac. These individuals would be either the offspring of DFO adults released into the Petitcodiac during previous years, or unfed fry from DFO’s Live Gene Bank. Having lived their early life stages within the Petitcodiac, juveniles collected there and sent to the FSR sea cages have 1) undergone natural selection for conditions in the Petitcodiac, and 2) recognize it as their natal stream, preferentially returning to it to spawn (rather than the BSR).

Data collected during this process bares this out. Most FSR adults are collected as juveniles on the Pollett River, with a small subset coming from next door on the Little River. In the late summer and fall of 2021 four PIT tagged salmon were detected returning to the Little River by an automated PIT tag reader antenna array FFHR operates located at the 895 bridge. Of these salmon three were FSR Little River origin fish, having been collected near that bridge in 2019 as smolts, raised to adulthood in Grand Manan and released on the Pollett River (where all FSR fish are released) in the fall of 2020. Yet in 2021, when these Little River salmon returned on their own to spawn yet again, they did so preferentially to their natal river. Subsequently, in 2022 electrofishing detected fry in that part of the Little River (where no fry or adults had been released) indicating that successful spawning took place nearby in 2021.

Completion of the new bridge between Moncton and Riverview in 2021 to partially replace the Petitcodiac Causeway has strongly advanced iBoF Atlantic salmon recovery efforts in the Petitcodiac. That fall, the first wild returning adult was captured downstream of the Pollett at the head-of-tide in Salisbury on October 4th. She lacked both a PIT tag and a floy tag. She showed no scars from having shed either type of tag, nor did it look as though a tissue sample had been taken from her caudal fin. In short, there was no sign that she had been previously handled- so scale and tissue samples were taken to allow further investigation. Stable Isotope Analysis carried out by the Stable Isotopes in Nature Laboratory (SINLAB) at the University of New Brunswick (UNB) confirmed that she was a returning wild iBoF Atlantic salmon (Samways personal communication 2021), never handled by FFHR prior to her capture.

Examination of the scale sample indicated that she was a 2-sea-winter (2SW) fish, who had smoltified and gone to sea in 2019 as a two-year old smolt. As such, she would have been at sea in both December 2020 and December 2019. Having been captured on the main stem of the Petitcodiac beyond the mouth of the Little River, it seems reasonable to speculate that she was on her way upstream back to the Pollett River. Based on that, it is likely that she exited the Pollett as part of the Spring 2019 smolt run. FFHR's 2019 data indicates a Bayesian Pollett smolt run size estimate of approximately 5,465 smolt. The tissue sample is still available and could be used for genetic analysis. Doing so may shed light on what part of the program she resulted from. One way or another, most smolt coming off the Pollett are present due to FFHR's stocking efforts. Being a two-year old smolt in 2019, she was probably either the offspring of the 126 Fundy Salmon Recovery adults released in October 2016 or one of 47,000 fry (directly sourced from the DFO Live Gene Bank at Mactaquac) released in May 2017. The adults in 2016 were split evenly by gender: 63 males and 63 females. In the upper Pollett 64 were released (35 male 29 female) and 62 were released in the lower Pollett (28 male and 34 female). All the redds found in 2016 were in the lower half of the Pollett- a typical result based on Figure 7. Fry released in 2017 were put into Webster Brook, in the upper Pollett near Elgin. Having come directly from Mactaquac there ought to be good records of the ancestry of the fry. If she wasn't released as a fry in Spring 2017 then one if not both of her parents were probably among the adults released in the Fall 2016.

She is probably not alone - the FNT merely samples what is in the river. Catching one indicates that numbers have reached a level where the trap can detect them. It is premature to attribute detection of the wild salmon in 2021 entirely to the new channel under the bridge. That said however, she must have passed under the bridge, and the improved passage can only have helped her to return. No additional returning wild adults were caught during the following year. The lack of such fish in 2022 was noteworthy, and though somewhat disappointing, not particularly surprising. It does not mean that the individual caught in 2021 was a fluke, but merely highlights the fact that catching the first wild return was an unusual event. Two things can be simultaneously true: i.e. that the odds of catching such a fish have increased as a result of ongoing iBoF Atlantic salmon recovery efforts, and that yet such fish are still uncommon enough that doing so remains unlikely.

Striped bass have been detected only at one location in the Pollett, a short distance above its confluence with the main stem of the Peticodiac (Figure 8). While the causeway gates were closed, striped bass were excluded from the Petitcodiac upstream of Moncton (Locke et al. 2003). Like salmon, striped bass are anadromous, however, though they use the upper estuary and lower freshwater reaches of the

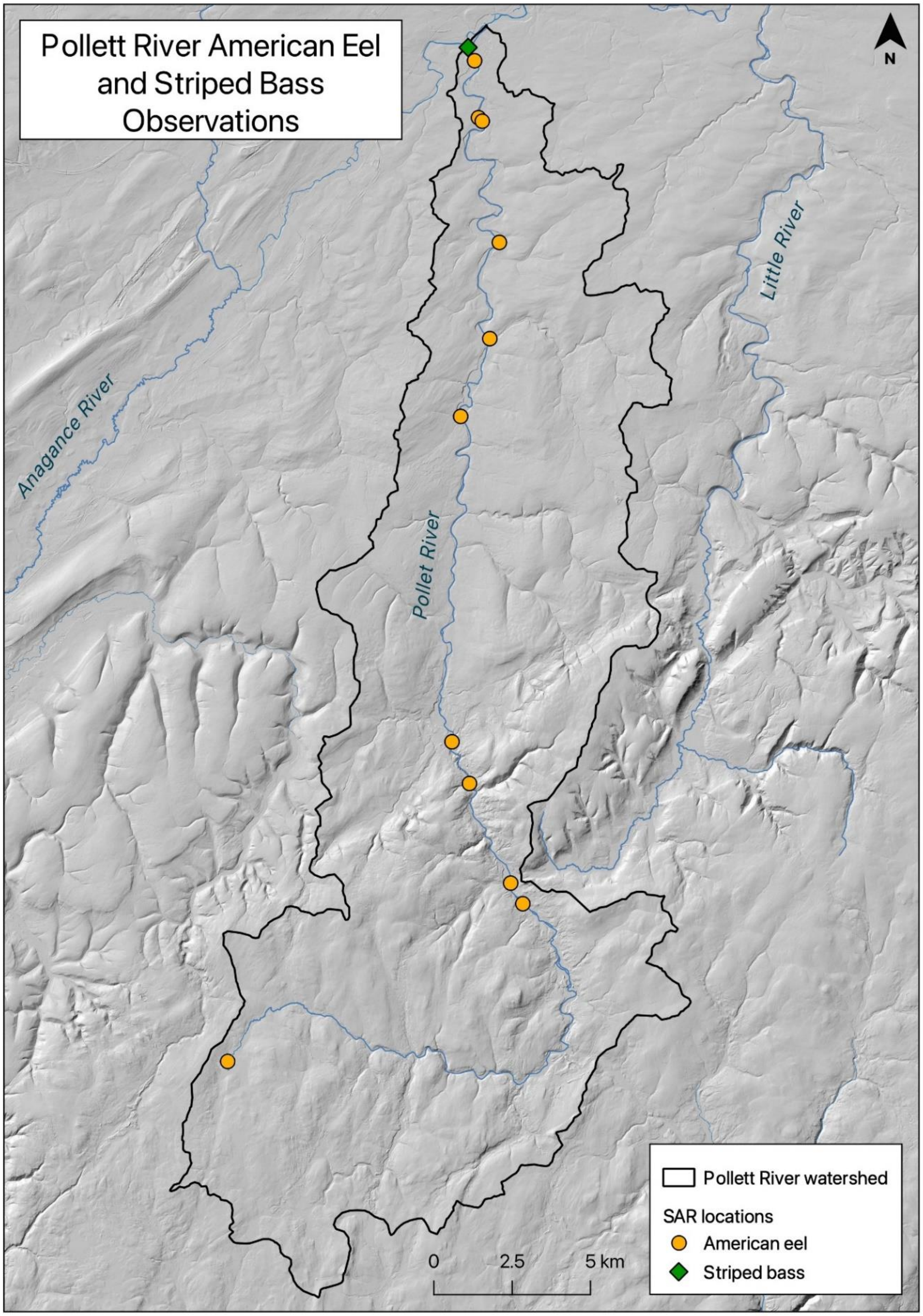

Figure 8: Striped bass and American eel occurrences in the Pollett River

Petitcodiac River as nursery habitat in which juveniles feed, mature bass are not known to spawn there (AMEC, 2005). The nearest spawning river is the Stewiacke in Nova Scotia (DFO, 2010a).

The gates were opened in 2010, and by 2011 striped bass were being detected by the trap FFHR operates at the head-of-tide in Salisbury. Genetic analysis of tissue collected at the FNT during the 2013 field season confirmed their ancestry (Mazerolle, 2014). These fish are expanding their nursery range into habitat upstream of the causeway, an area they had historically occupied prior to construction of the causeway in 1968. In August 2022, multiple 40+ cm striped bass were observed during a snorkle survey of the Pollett River. These, which was the same pool a short distance upstream of the confluence of the Pollett with the main stem of the Petitcodiac where they had previously been seen at approximately the same time of year in 2018, 2019, and 2020. The only year out of the last five when striped bass were not seen at that location was 2021 when a seal was observed in that pool. It is likely that the seal may have dispersed or eaten any striped bass it found there that year. It is noteworthy that this location (Figure 8a) is upstream of several salmon redd sites (Figure 7), and so striped bass are clearly now accessing salmon spawning habitat on the Pollett- with potential to prey on juveniles. Several anglers have independently reported catching striped bass on the main stem of the Petitcodiac as far upstream as the Village of Petitcodiac. Despite minor differences between 2021 and 2022, striped bass have made a strong return to the Petitcodiac, aided in part by the new channel under the bridge.

American eels were encountered at numerous sites (Figure 8a) the full length of the Pollett. Eels have been seen while electrofishing, in the Rotary Screw Trap (RST), and in Mechanic Lake at the very top of the Pollett – in eel pots. While the causeway gates were closed on the Petitcodiac, eels had more success than salmon or striped bass navigating the fishway and accessing the upper reaches of the river. Being catadromous, instead of anadromous like salmon, the eel population was less vulnerable to extirpation as they are not dependent upon consistently accessing a river to perpetuate future generations within that river. Instead, their spawning takes place in the Sargasso Sea, and young eels arrive at and reside in different rivers than those in which their parents had lived (COSEWIC, 2006b). This allowed for a steady stream of incoming eels, arriving to colonize the river anew each generation. The fact they are found at the very top of the Pollett in Mechanic Lake indicates that they can be assumed to be at least periodically present at any location downstream of that point. This suggests that eels have access to the entire Pollett watershed, which despite Gordon Falls is not surprising given the ability of this species to spend extended periods of time out of water while navigating overland around barriers (Van Den Avyle 1984), as well as the ability of juveniles to climb damp vertical surfaces.

Wood Turtles have frequently been encountered within the Pollett while conducting field work, and to a certain extent in many ways the locations where they have been seen is more a reflection of where FFHR does field work in the river than the result of years of surveys on the scale that yielded locations for salmon, striped bass, and eels. Due to their small home range, and vulnerability to poaching, encounters with wood turtles are considered to be sensitive information, and so are being withheld here. Wood turtles are terrestrial turtles that require forest cover, clean water courses, and access to gravel or sand for nesting. Disturbance caused by failing riverbanks appears to create gravel bar habitat favorable to Wood Turtles, prompting concern about impacts of bank stabilization projects on Wood Turtles in nearby habitat.

Water Quality

The PWA has been monitoring water quality within the Petitcodiac Watershed with the help of government organisations and volunteers since 1997, and has been collecting its own monthly water quality data since 1999 (Petitcodiac Watershed Alliance 2022). That being the case their data set has decades of time depth available for comparisons. PWA collects from a single fixed monitoring site, near the mouth of the Pollett River, the logic being to provide an indication of conditions for the entire watershed upstream of that point. Greater resolution would be challenging, as PWA also conducts similar monitoring for numerous other tributaries distributed across the Petitcodiac and Memramcook watersheds. The location on the Pollett monitoring site is the same pool where striped bass have been seen (Figure 8a). Data is collected monthly from May to October, measuring a range of parameters including those focused on below in Table 3: Dissolved Oxygen, Conductivity, pH, and Temperature.

Table 3: Water Quality on the Pollett River in 2021 (Petitcodiac Watershed Alliance 2022)

Monthly at Site	Dissolved Oxygen	Conductivity	Temperature °C	pH
May	12.9 mg/L	38.6 µS	8.1 °C	7.9
June	5.9 mg/L	54.5 µS	23.2 °C	7.3
July	8.5 mg/L	52.1 µS	21.6 °C	8.0
August	10.0 mg/L	43.2 µS	20.7 °C	7.2
September	9.9 mg/L	50.0 µS	12.8 °C	7.3
October	11.5 mg/L	53.3 µS	10.2 °C	7.3
Average	9.78 mg/L	48.62 µS	16.1 °C	7.5

Rapid Geomorphic Assessment (RGA)

The following is taken from the report prepared by 5R Environmental Consulting based upon the rapid geomorphic assessments (RGAs) Fort Folly Habitat Recovery conducted in 2021.

Geomorphic Analysis

Data collected from the Rapid Geomorphic Assessment (RGA) was used to evaluate the geomorphic condition and stability of the assessed reaches of the Pollett River. In order to interpret the geomorphic data, the included maps of the watercourse are highlighted according to reach stability as well as the Primary Geomorphic Processes, and Secondary Geomorphic Processes impacting each reach.

Rapid Geomorphic Assessments are used to quantify channel stability based on the presence and (or) absence of key indicators of channel adjustment with respect to four categories: 1) Aggradation, 2) Degradation, 3) Channel Widening, and 4) Planimetric Form Adjustment. Each indicator is described in detail below.

Aggradation

Channel aggradation may occur when the sediment load to a river increases (due to natural processes or human activities) and it lacks the capacity to carry it. Piles of sediment in the river can re-direct flows against the banks, leading to erosion and channel widening.

Typical indicators used to identify aggradation include:

- Shallow pool depths.
- Abundant sediment deposition on point bars.
- Extensive sediment deposition around obstructions, channel constrictions, at upstream ends of tight meander bends, and in the overbank zone.
- Most of the channel bed is exposed during typical low flow periods.
- High frequency of debris jams.
- Coarse gravels, cobbles, and boulders may be embedded with sand/silt and fine gravel.
- Soft, unconsolidated bed.
- Mid-channel and lateral bars.

Degradation

Degradation occurs as the river cuts deeper into the land and decreases its gradient. This can occur from a rapid removal of streambed material due to an increase in discharge, water velocity, or a decrease in sediment supply. Bed lowering can move in both an upstream (as a headcut or nick point) and/or downstream direction. Indicators of degradation include:

- Elevated tree roots.
- Bank height increases as you move downstream.
- Absence of depositional features such as bars.
- Head cutting of the channel bed.
- Cut face on bar forms.
- Channel worn into undisturbed overburden/bedrock.

Widening

Widening typically follows or occurs in conjunction with aggradation or degradation. With aggradation, banks collapse when flows are forced on the outside, and the river starts to widen. Wide, shallow watercourses have a lower capacity to transport sediment and flows continue to concentrate towards the banks. Widening can be seen with degradation, as it occurs with an increase in flows or decrease in sediment supply. Widening occurs because the stream bottom materials become more resistant to erosion (harder to move) by flowing waters than the stream banks. Indicators of widening include:

- Active undermining of bank vegetation on both sides of the channel, and many unstable bank overhangs that have little vegetation holding soils together.
- Erosion on both right and left banks in riffle sections.
- Recently exposed tree roots.
- Fracture lines at the top of banks that appear as cracks parallel to the river, which is evidence of landslides and mass failures.
- Deposition on mid-channel bars and shoals.
- Urbanization and storm water outfalls leading to higher rate and duration of runoff and channel enlargement typically in small watersheds with >10% impervious surface.

Planform Adjustment

These are the changes that can be seen from the air when looking down at the river. The river's pattern has changed. This can happen because of channel management activities (such as straightening the bends of the river 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. Planform adjustments typically are responses to aggradation, degradation, or widening geomorphic phases. Indicators include:

- Flood chutes, which are longitudinal depressions where the stream has straightened and cut a more direct route usually across the inside of a meander bend.
- Channel avulsions, where the stream has suddenly abandoned a previous channel.
- Change or loss in bed form, sometimes resulting in a mix of plane bed and pool-riffle forms.
- Island formation and/or multiple channels.
- Additional large deposition and scour features in the channel length typically occupied by a single riffle/pool sequence (may result from the lateral extension of meanders).
- Thalweg not lined up with planform. In meandering streams, the thalweg typically travels from the outside of a meander bend to the outside of the next meander bend.
- During planform adjustments, the thalweg may not line up with this pattern.

Upon completion of the field inspection, indicators are tallied for each category to produce an overall reach stability index. The index classified the channel in one of three stability classes (Table 4):

Table 4: RGA reach stability index classification

Factor Value	Classification	Interpretation
≤0.20	In Regime or Stable (Least Sensitive)	The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes.
0.21-0.40	Transitional or Stressed (Moderately Sensitive)	Channel morphology is within the range of variance for streams of similar hydrographic characteristics, but the evidence of instability is frequent.
≥0.41	In Adjustment (Most Sensitive)	Channel morphology is not within the range of variance and evidence of instability is widespread.

The RGA stability index results for the Pollett River found that approximately 64% of the reaches are in adjustment - as per Table 5, the most sensitive state. Only 10% of the reaches assessed were found to be stable (in regime). The remaining 26% was transitional between these two states. Figure 9 shows that while conditions start out fairly good at reach 1 at Highway 114, as the channel stability is lost, and the river falls into "In adjustment" it remains that way for most of its length.

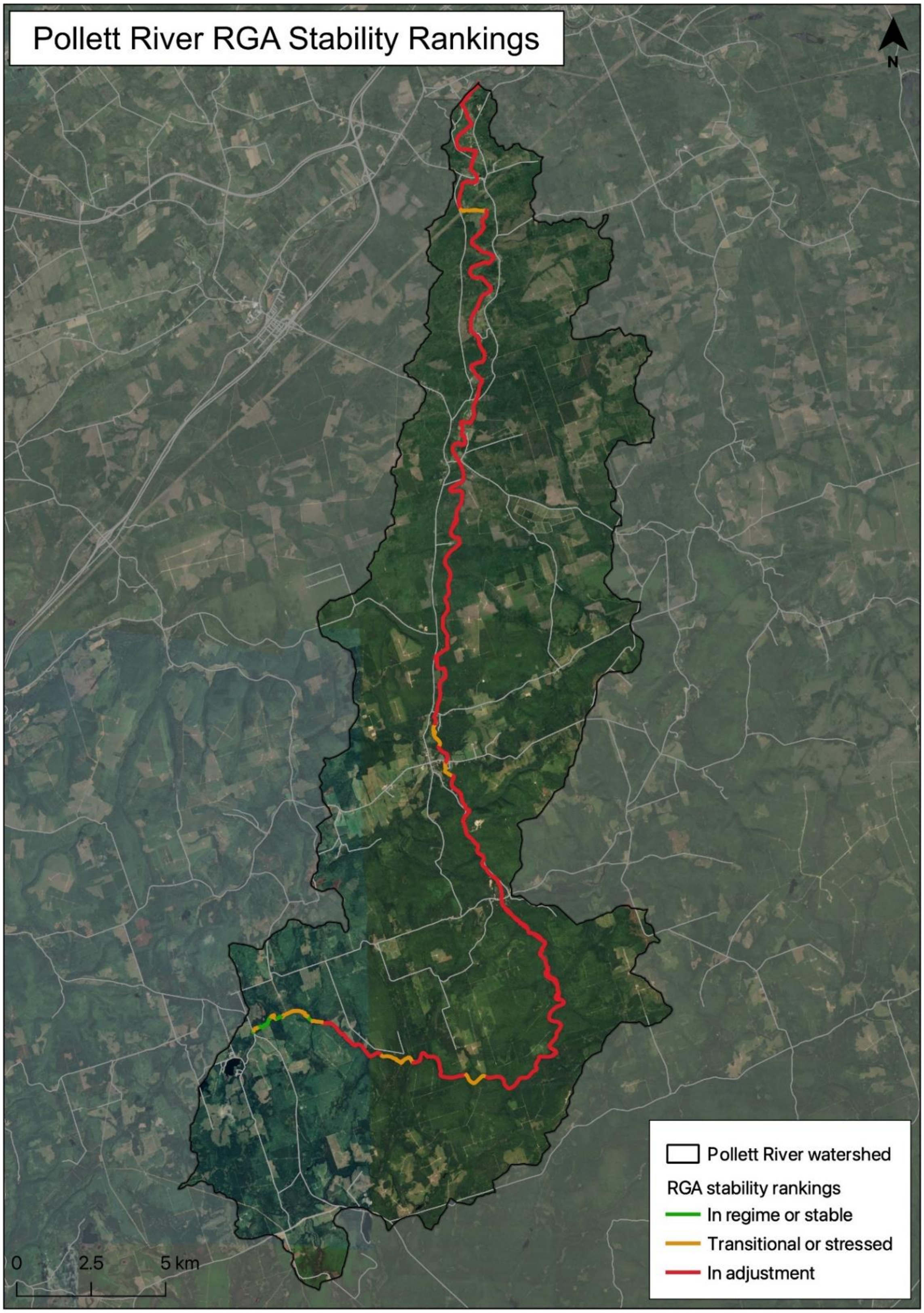

Figure 9: Pollett River RGA Stability Rankings

Table 5: Pollett River Stability Index Scores from RGA Surveys

Reach	Stability Index	Class		Reach	Stability Index	Class		Reach	Stability Index	Class
R1	0.067	Stable		R25	0.375	Transitional		R49	0.438	In adjustment
R2	0.225	Transitional		R26	0.509	In adjustment		R50	0.636	In adjustment
R3	0.123	Stable		R27	0.501	In adjustment		R51	0.826	In adjustment
R4	0.123	Stable		R28	0.407	In adjustment		R52	0.731	In adjustment
R5	0.154	Stable		R29	0.320	Transitional		R53	0.573	In adjustment
R6	0.150	Stable		R30	0.541	In adjustment		R54	0.483	In adjustment
R7	0.150	Stable		R31	0.501	In adjustment		R55	0.514	In adjustment
R8	0.214	Transitional		R32	0.545	In adjustment		R56	0.454	In adjustment
R9	0.272	Transitional		R33	0.671	In adjustment		R57	0.462	In adjustment
R10	0.209	Transitional		R34	0.628	In adjustment		R58	0.502	In adjustment
R11	0.284	Transitional		R35	0.577	In adjustment		R59	0.585	In adjustment
R12	0.265	Transitional		R36	0.474	In adjustment		R60	0.430	In adjustment
R13	0.230	Transitional		R37	0.612	In adjustment		R61	0.505	In adjustment
R14	0.297	Transitional		R38	0.545	In adjustment		R62	0.663	In adjustment
R15	0.360	Transitional		R39	0.553	In adjustment		R63	0.660	In adjustment
R16	0.221	Transitional		R40	0.210	Transitional		R64	0.462	In adjustment
R17	0.186	Stable		R41	0.450	In adjustment		R65	0.410	In adjustment
R18	0.250	Transitional		R42	0.379	Transitional		R66	0.442	In adjustment
R19	0.483	In adjustment		R43	0.455	In adjustment		R67	0.351	Transitional
R20	0.553	In adjustment		R44	0.415	In adjustment		R68	0.632	In adjustment
R21	0.565	In adjustment		R45	0.415	In adjustment		R69	0.663	In adjustment
R22	0.375	Transitional		R46	0.530	In adjustment		R70	0.655	In adjustment
R23	0.375	Transitional		R47	0.502	In adjustment		R71	0.691	In adjustment
R24	0.249	Transitional		R48	0.692	In adjustment		R72	0.735	In adjustment

Limitations of the ranking regime are reflected in the loss of some of the variability within the stability index down the length of the Pollett in Figure 10 - due to the wide range between ranks. Initially the average Stability Index starts out "stable" (low <0.2), but the values rapidly increase into the "transitional" range (0.21 to 0.40), and then the average remains "in adjustment" (≥0.41) for the remainder of the river's length (with the occasional individual reach dipping back into "transitional"). That could be misconstrued to mean that conditions in the thinly populated headwaters are better than further downstream. It does not. If conditions in the headwaters were better, then they would not show the steepest rise (i.e., sharpest and most consistent decline in stability). Problems in the river move one direction- downstream. By the time one reaches the lower portions of the Pollett instability is common- but variable and has plateaued somewhat. The average in Figure 10 first peaks at reach 39 just above the gorge. Below Elgin it falls (becomes more stable). It starts to rise again at reach 48 a short distance above Beaman's Hole, and then reaches its ultimate peak below the Parkindale Bridge. From that point onwards stability improves somewhat as one moves further downstream, but not to such an extent that it shifts from "In adjustment" to "transitional" and remains there.

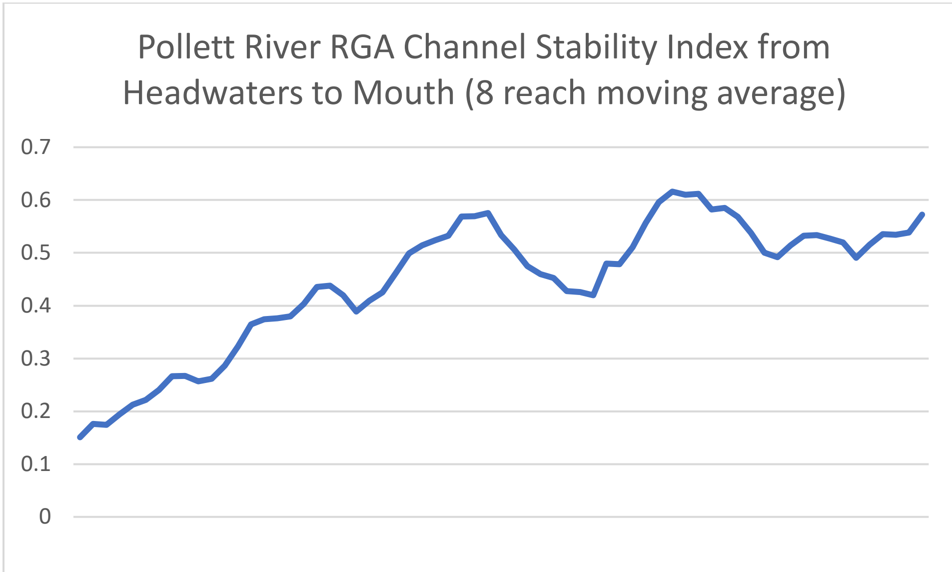

Figure 10: Variations in RGA Stability Index as one moves downstream

Variation in length of reaches is also a factor. According to Figure 11, calculated based on the number of reaches in the Pollett, 63.9 % of the reaches are stressed, 26.4% of the reaches are going through a state of transition and only 9.7% of the reaches assessed are in a state of regime (stable).

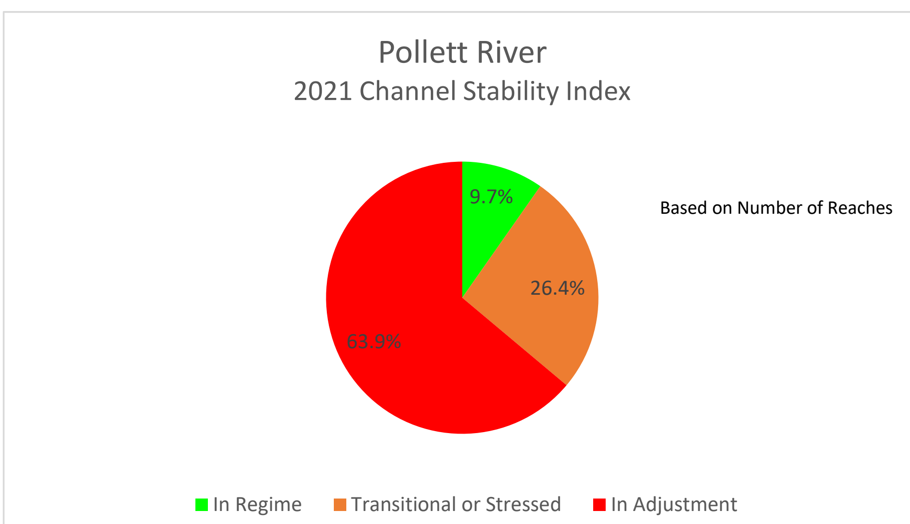

Figure 11: Pollett Channel Stability Index Based on the Number of Reaches

However, in Figure 12, comparing reach length to overall assessed channel length, the amount of assessed channel that is in a state of adjustment increases to approximately 86%. The actual amount of channel length that is relatively stable drops down to just under 2%.

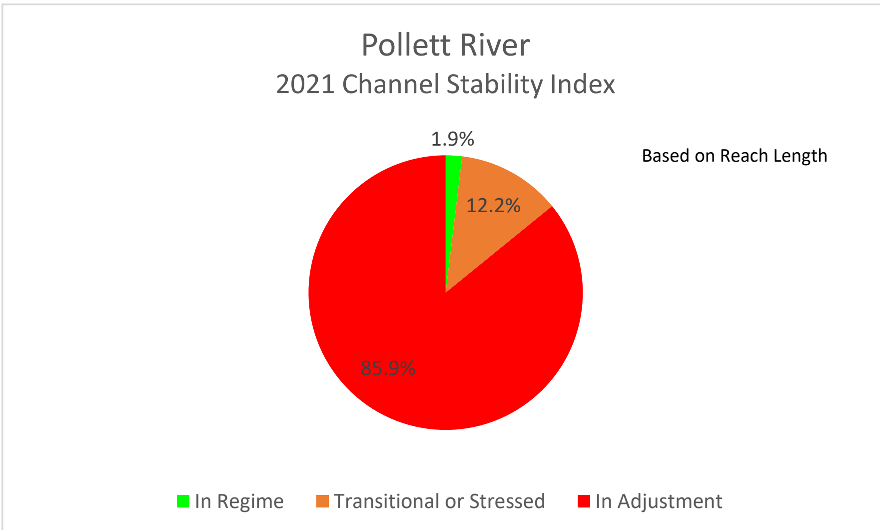

Figure 12: Pollett Channel Stability Index Based on reach length

Primary Geomorphic Processes

The primary geomorphic process identified on the assessed reaches of the Pollett River, whether comparing individual reaches to overall number of reaches or length of the assessed channel to individual reach lengths, indicate that aggradation is the dominant process occurring. Identifying the source of the material creating the channel aggradation situation would be a priority before any instream channel or habitat restoration work was implemented. Photographs of the reaches do show some bank scour and bedload deposition in the channel, particularly below Reach 18. Reviewing historical aerial photographs indicates that the headwaters of the Pollett River has been continually under the pressure of deforestation for various wood products. Many of the cut blocks have been replanted with what appears to be softwood tees, which is typical in the province of New Brunswick. This continual commercial forestry activity in the Pollett River watershed in combination with the significant rain and freshet events of the past 12 years should certainly be considered as a contributing factor to the aggradation of the streambed and channel widening, that was identified as the two dominant geomorphic process occurring on the assessed reaches of the Pollett River.

Figure 13 shows the primary geomorphic processes in each of the 72 reaches along the Pollett. Channel aggradation was driving conditions in 43.1% percent of the reaches while widening was identified as the primary geomorphic process in 30.6% of the reaches.

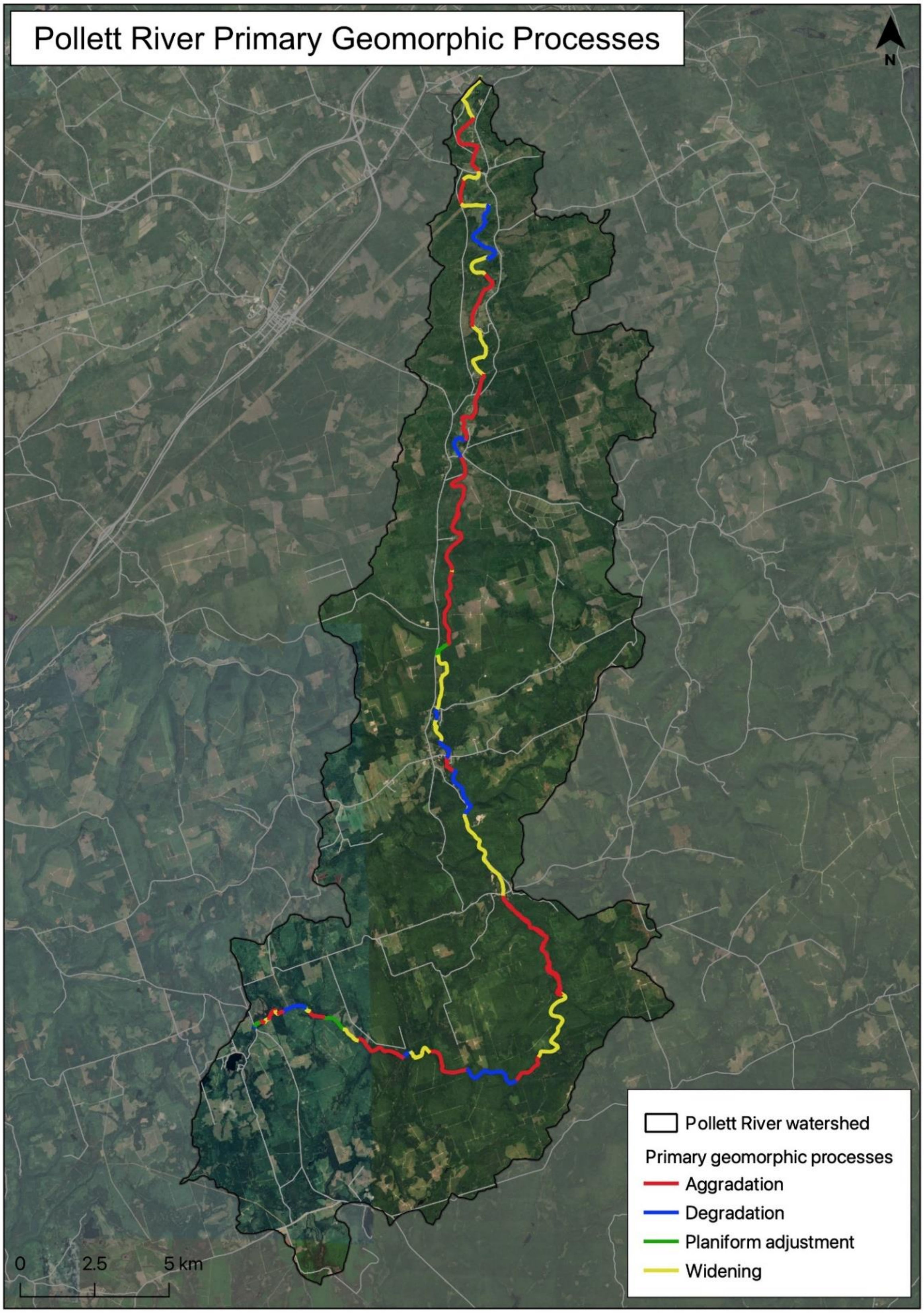

Figure 13: Pollett River Primary Geomorphic Processes

Figure 14 shows that channel aggradation was occurring in 43.1% percent of the reaches that were assesses on the Pollett River with channel widening identified in 30.6% of the reaches. When reach length is compared to overall assessed channel length, aggradation is still the dominate geomorphic process occurring followed by channel widening.

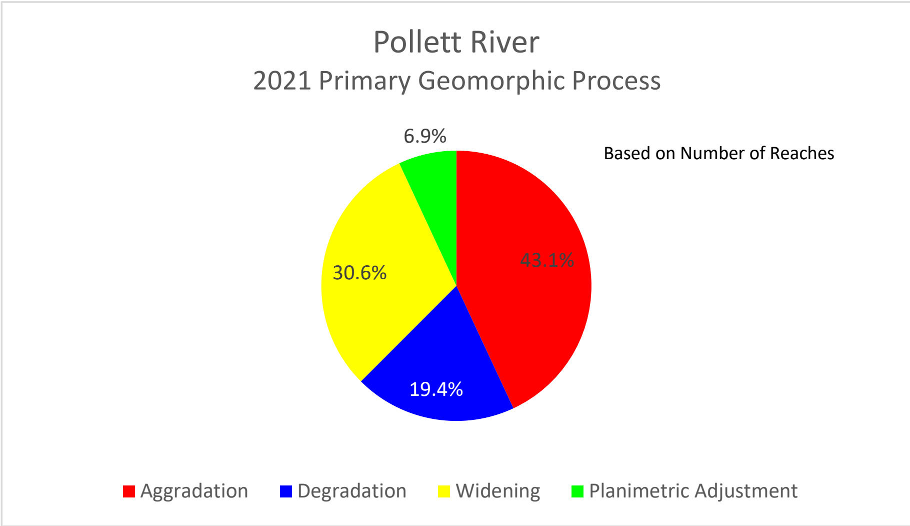

Figure 14: Pollett River Primary geomorphic processes based upon number of reaches

Based on channel length and reach length (Figure 15) aggradation is happening in 47.8% of the Pollett River channel. As almost half of the assessed channel, or approximately 28 km of the Pollett River, is in a state of channel aggradation, it is imperative that some focus on the source of this channel aggradation be identified. This could be an indication of land use practices increasing sediment load to the system, an increase in runoff during rain or freshet events, or an adjustment to the channel depth and width due to impacts from climate change.

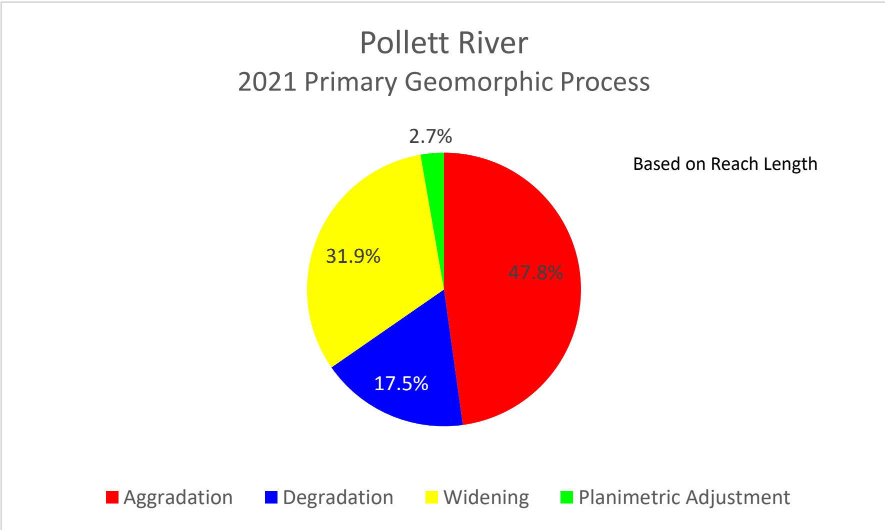

Figure 15: Pollett River Primary Geomorphic Processes based upon assessed channel length

Secondary Geomorphic Processes

Secondary Geomorphic Processes (Figure 16) are a bit more evenly distributed. Aggradation and widening still dominate as the two secondary processes occurring, however degradation and planimetric adjustment are found more frequently here than these were among the primary processes.

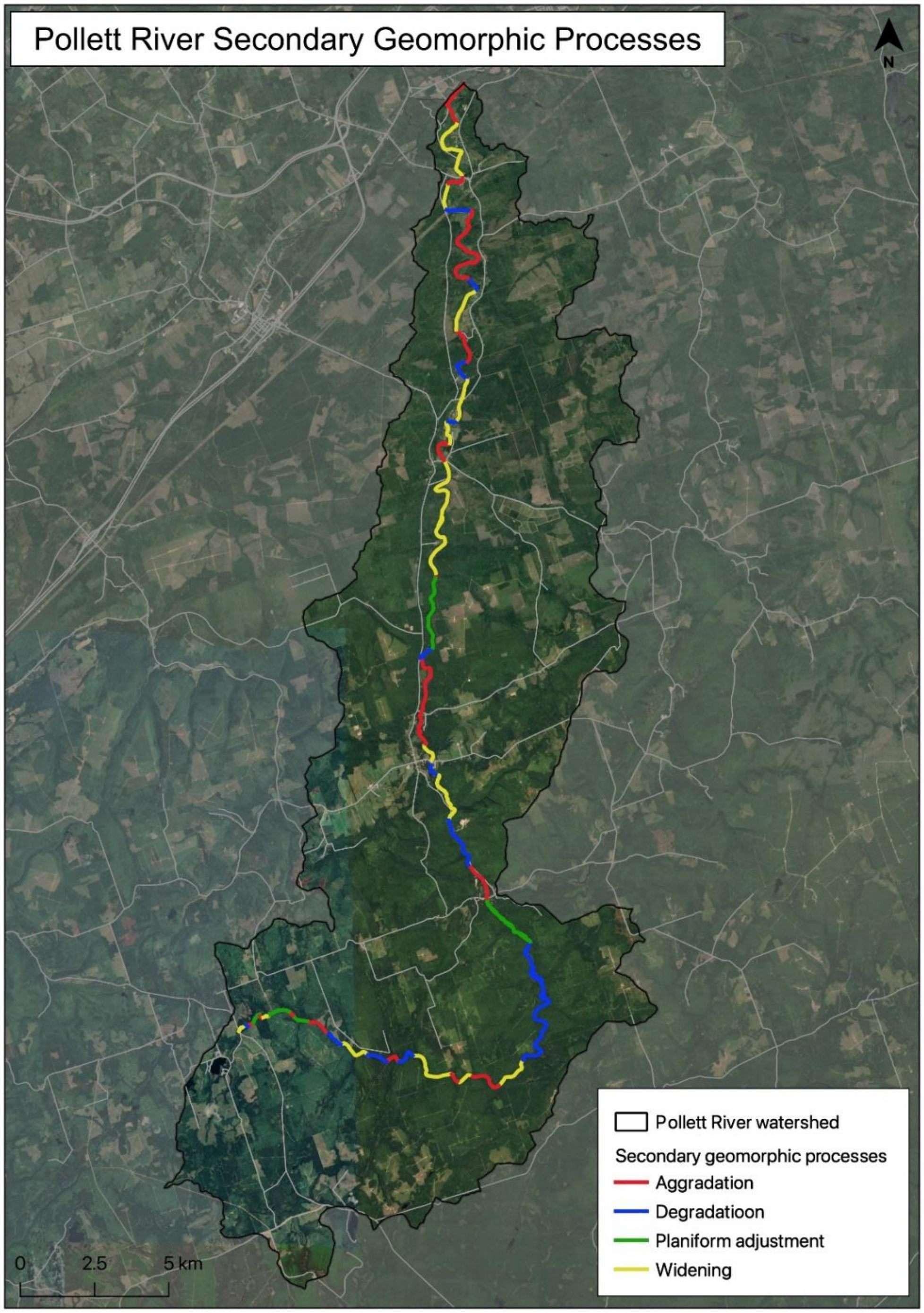

Figure 16: Pollett River Secondary Geomorphic Processes

Comparing reach length to over all assessed channel length, aggradation is still the most prevalent secondary process occurring in 33.3% of the reaches (Figure 17). Channel aggradation is closely followed by channel widening, which was identified as the secondary geomorphic process occurring in 29.2% of the assessed reaches. When looking at channel aggradation as a dominate primary and secondary geomorphic process, this equates to nearly 45 kilometres or approximately 77% of the assessed channel length of the Pollett River.

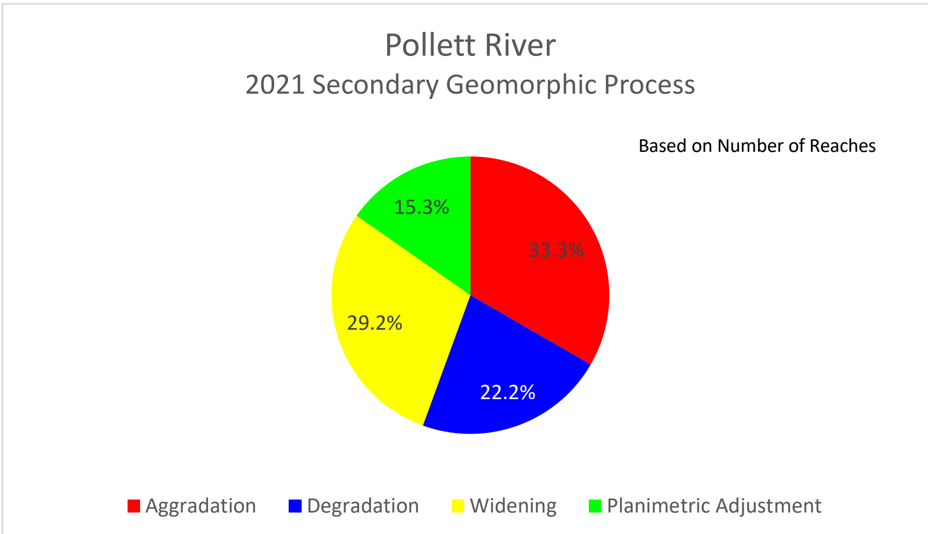

Figure 17: Pollett River Secondary Geomorphic Processes based on number of reaches

Beginning in the headwaters, the first 18 reaches of the assessed channel of Pollett River show the channel stability index fluctuate between being in a state of regime or transitional/stressed. The reaches identified as traditional/stressed in the first 18 reaches are very close to being in a state of regime. There have been some indications, based on the photographs of the reaches, that beaver activity does occur in these upper reaches of the Pollett River. However, it appears that the integrity of the constructed dams cannot withstand flooding events or the spring freshet. It should also be noted that in Reach 3 there had been some instream habitat work in the form of digger log installations. The year of installation is unknown, but the digger logs do not appear to have created adverse changes to the channel morphology. This is most likely due to the low banks, narrow channel width, and substrate size. The banks are well vegetated and significant channel flows would easily be connected to the floodplain. This would reduce any excessive scour of the channel or banks that is typically generated by digger logs.

Reaches with aggradation factor score of greater than 0.5 should be considered priority reaches for instream habitat or channel restoration activities. However, as mentioned, identifying the source of the aggradation would be the first priority so any works completed instream would not be buried by excess sediment or bedload material. Once the source of channel aggradation has been identified, any instream restoration techniques or designs would need to consider the management of the excess channel material so that it is dispersed or relocated in areas that are natural depositional locations. The installation of bank restoration techniques or instream structures will also need to be designed around attaining the channel back to a more natural width. The correct channel width should be calculated for each reach to ensure that the channel width is able to accommodate the flows based on the hydraulic flow conditions of that reach.

Fourth Level Assessment - Aquatic Habitat Rehabilitation Plan

Summary of Issues Identified from Information on Current Impacts

Culvert surveys conducted by the Petitcodiac Watershed Alliance as part of their Broken Brooks program noted 21 culverts that were full barriers to passage and 8 culverts that were partial barriers to passage (Figure 6) within the Pollett River watershed, a total of 29 impacted culverts. The PWA reports having taken steps to remediate 8 of these culverts- 4 full barriers and 4 partial barriers, suggesting that at least 21 culverts remain which require attention. Considering that the partial barriers were blocked by woody debris which was cleared- and that this was done in 2014, some of those culverts may need to revisited.

Summary of Issues Identified from Aquatic and Riparian Habitat Assessment

Based on length – Rapid Geomorphic Assessments (RGAs) identified roughly 86% of the Pollett River as "in adjustment" indicating that instability is widespread. In less than 2% of the Pollett River's length was Channel Stability found to be "stable". Aggradation (raising of the riverbed through extensive sediment deposition) is the primary geomorphic process taking place within 43 % of reaches. Meanwhile it is the secondary geomorphic process in an additional 33% of reaches. That is a combined 76% of reaches in the river where aggradation is either the primary or secondary geomorphic process underway. Aggradation leads to piles of sediment in the river that re-direct flows against the banks, causing erosion and channel widening. An example of this is the situation in Figure 18 from reach 61, where the bank is failing and widening is occurring due to aggradation, as the gravel bar builds up in reach 60. Sediment put in motion from sites like this can bury salmon redds, suffocating the eggs within.

Figure 18: Aggradation (gravel bar) in Reach 60 promoting widening (bank failure) in Reach 61

Identifying the reaches most strongly impacted allows interventions to address these issues to selected and prioritized. That is the essence of the stewardship planning process. Knowledge of instability within the river can be brought together with other factors such as the locations of spawning gravel of endangered species such as iBoF salmon to prioritize and target efforts within the river to produce the maximum conservation benefit.

Restoration Activities Undertaken

To date restoration activities already conducted within the Pollett River have taken the three main forms shown in Figure 19: Bank Stabilization, Dump Site Clean up, and culvert remediation. Bank Stabilization work is known to have been done by the Petitcodiac Watershed Alliance (PWA), Fort Folly Habitat Recovery FFHR), and by a Private Landowner. Clean up of illegal dump sites has been done collaboratively by PWA and FFHR. Culvert Remediation has been done by the PWA.

Bank Stabilization

Pollett, near mouth 2014 (Petitcodiac Watershed Alliance)

The first bank stabilization project documented here on the Pollett River was done by the Petitcodiac Watershed Alliance in 2014 near the confluence of the Pollett with the main stem of the Petitcodiac. It is the lower of the two projects shown near the mouth of the Pollett (Figure 19). This project involved a significant volume of riprap 25 tons of large rock and another 100 tons of smaller rock (Figure 20), after which 100 Silver Maples and 4,000 live willow stakes were planted high on the bank above the rocks.

Browsing by deer and competition with weeds killed most of the silver maple seedlings within the first year or so, while there was a poor rate of establishment by the willow live stakes perhaps due to issues with quality control during collection, and competition with weeds. Large vehicle sized chunks of ice tend to get piled up on the site during the winter and stranded across the floodplain during winter storms. It is likely that in previous years scour from this ice played a role in scoring the bank and undermining the large trees present in the first place. Mechanical damage from this ice may also have taken a toll on the woody vegetation planted as a part of this project. However, the rock did its job, the bank remains stable, and the existing large silver maple (Figure 20) that was in danger of being washed out and collapsing into the river carrying much of the bank with it, is now instead helping to anchor and shade the site. While there is not the degree of newly planted robust woody vegetation additionally helping to bind the bank together as would have been ideal, over the years herbaceous vegetation has gradually become well established across the site.

After this bank stabilization project was carried out, on multiple occasions salmon redds have been detected below it (in both 2016 and 2019) at several sites approximately 100 m downstream. These are the final 2 redd sites before the Pollett joins the Petitcodiac shown in Figure 7.

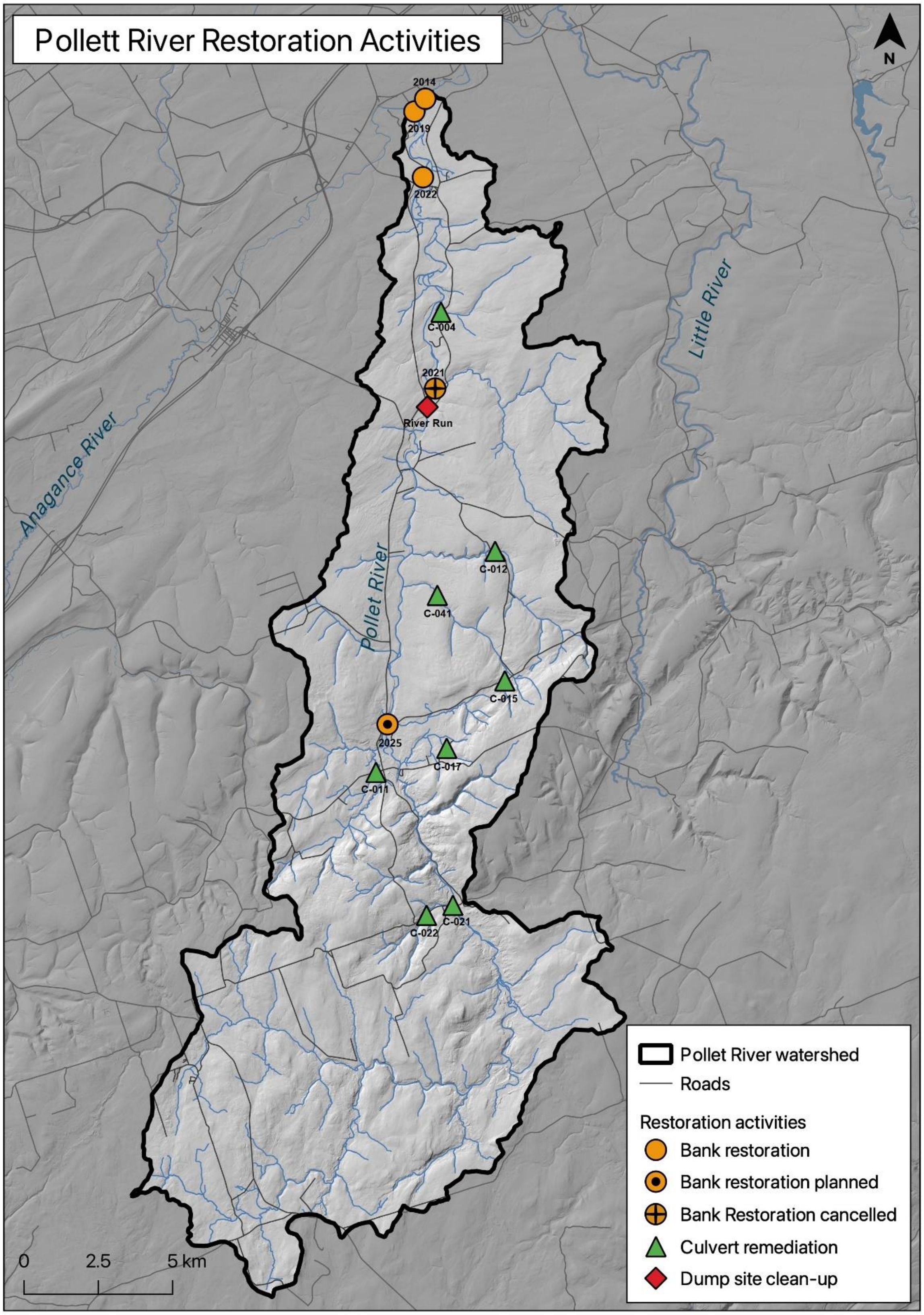

Figure 19: Restoration Activities Undertaken within the Pollett River Watershed

Figure 20: 2014 site before (2013) and after (up to 2019)

Pollett, first pool 2019 (Fort Folly Habitat Recovery)

A second bank stabilization project was undertaken on the Pollett in 2019, this one by Fort Folly Habitat Recovery, at a location (cover, top photo) a little over 500 metres further upstream from the portion of the riverbank that the PWA worked on in 2014. The base of the bank was stabilized with a rock toe and the slope was reconstructed to produce a more stable angle of repose Figure 21 and Figure 22. The site was then seeded with grass, and the lower portion planted with live stakes of willow and dogwood while top of the mid-slope of the bank was planted with silver maple, and the top with white pine, and red spruce seedlings (Figure 23).

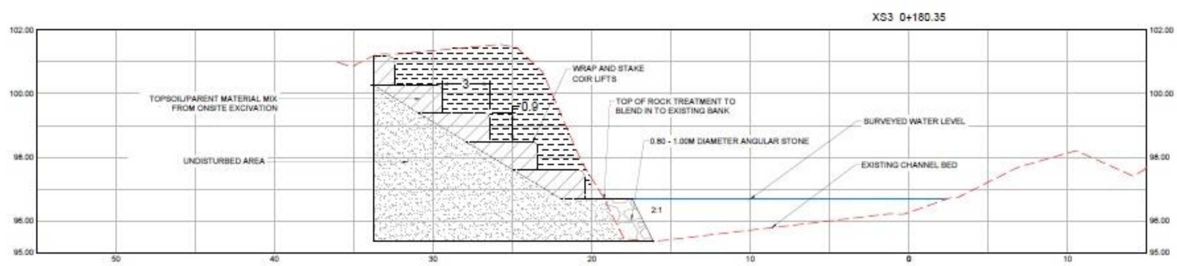

Figure 21: 2019 Project Design cross-section

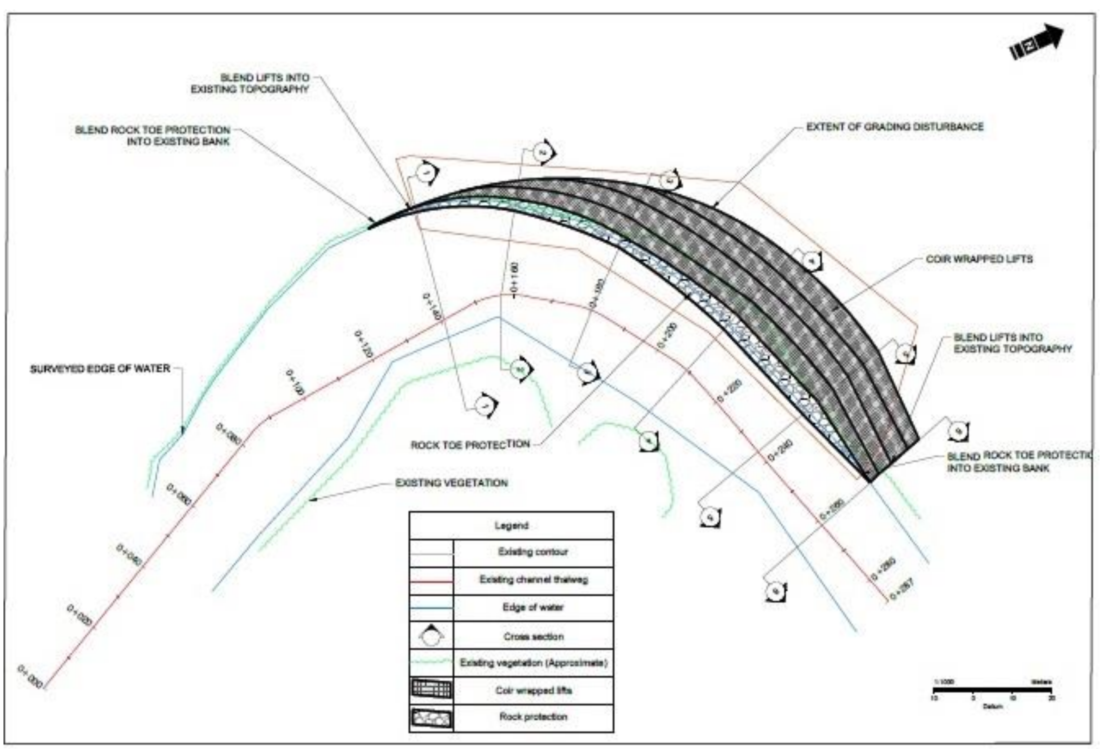

Figure 22: 2019 Project Design view from above

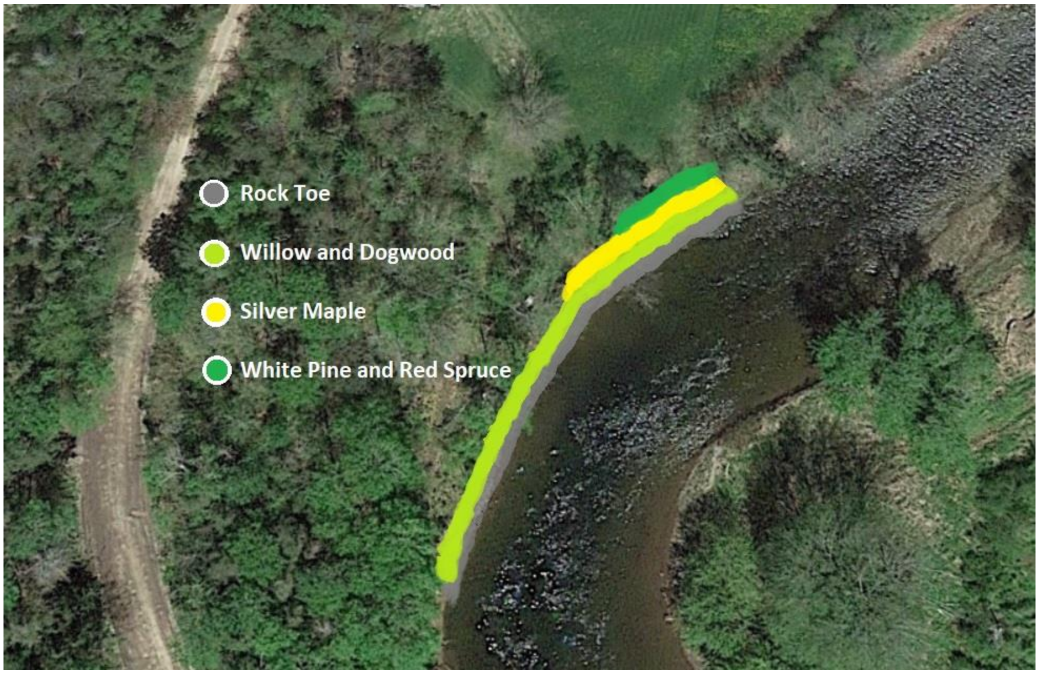

Figure 23: Distribution of vegetation planted at 2019 site

Initial density across the entire 350 m^2 of revegetated bank averaged approximately 1.7 stems per m^2. Some live stakes failed to become established while others grew but have since been lost to competition with grasses. Tree seedlings higher on the bank experienced similar challenges however, their numbers were augmented by supplementary planting. Table 6 lists the woody vegetation on site in 2022.

Table 6: Survival of woody vegetation planted at 2019 site to 2022

Species	2019	2022	Establishment and Survival
Willow	455	158	35%
Dogwood	115	48	42%
Silver Maple	40	9	23%
White Pine	5	6	Supplementary planting
Red Spruce	4	6	Supplementary planting
Balsam Fir	1	2	Natural Recruitment
Trembling Aspen	-	9	Natural Recruitment
Red Oak	-	130	Natural Recruitment
Choke Cherry	-	14	Natural Recruitment
Pin Cherry	-	3	Natural Recruitment
Paper Birch	-	11	Natural Recruitment
Hawthorn	-	1	Natural Recruitment
Speckled Alder	-	1	Natural Recruitment
Common Elderberry	-	1	Natural Recruitment
Smooth Blackberry	-	12	Natural Recruitment
Total	620	411	66% of original
% recruits		44%	

The impressive recruitment of 130 red oak seedlings to the site (32% of total stocking) was largely a consequence of a fortuitously timed heavy crop of acorns landing on bare mineral soil just as the site was being reconstructed in 2019 (Figure 24). Oaks are naturally abundant on the site, and as a result there had been an intention to include oaks among the seedlings being planted since they clearly do well there. However, once trees present on the site naturally seeded it themselves, doing so was deemed redundant, especially since promotion of the native population of oaks on the site would be preferable. Three years later, in 2022 the resulting seedlings are thriving (Figure 25).

Figure 24: Acorn crop at 2019 site

Figure 25: Oak recruitment at 2019 site

Figure 26 shows a repeat photography time series of photos of the site taken from upstream looking downstream, from 2018 (before work was done there) until 2022. Since 2019, in addition to the vegetation becoming well established, slope stability has remained high. This observation was documented and quantified by surveying a series of cross sections across the length of the site, post construction in 2019, and subsequently repeating the survey in 2022 to allow comparison. Other long-term monitoring ongoing at the site compared to 2019 pre-construction baselines includes electrofishing to assess how fish are responding to the work done, and Canadian Aquatic Biomonitoring Network (CABIN) wadeable streams monitoring (CABIN 2012). The latter examines aquatic insect populations - particularly Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddisflies)- EPT species- as these are typically the most sensitive to habitat disturbance. Even distribution and high numbers serve as good indicators of water quality. As residents of the site the state of such populations can provide longer term insights into conditions there than conventional water sampling which provides only a snapshot in time.

Figure 26: 2019 site before (2018) and after (up to 2022)

Several other significant observations make this site noteworthy, despite not being directly related to monitoring of the restoration work done there. These include the occasional adult salmon observed holding in the pool there. These are likely present due to salmon recovery efforts within the system- both releases by Fundy Salmon Recovery, and DFO's Live Gene Bank. Likewise, numerous large 40 cm to 60 cm striped bass (Figure 27) have been consistently detected in the same pool in August during four of the last five years (2018, 2019, 2020, and 2022). The only exception was in 2021. No striped bass were observed there August 2021, perhaps because several weeks earlier in July a seal (Figure 28) was seen in it by the PWA while they were there to collect their monthly water sample (this is also the station where the water quality samples reported in Table 3 are collected). It seems possible that this seal either dispersed or consumed any striped bass that had been in the pool that year. The salmon, the striped bass, and the seal are all only present here on the Pollett because of improved passage downstream due to the Province of New Brunswick's Petitcodiac River Restoration Project opening the causeway gates in 2010, and then the wider channel under the new bridge in 2021.

Figure 27: Striped bass in pool at 2019 Restoration site in 2022

Figure 28: Seal in pool at 2019 Restoration site in 2021

Pollett, below Sanitorium Bridge 2021 (Fort Folly Habitat Recovery)

A Bank stabilization project was planned in 2021 but had to be cancelled. Implementation of the project was planned to take place in September of 2021 along the bank of the Pollett River. To do so, the site was surveyed in the fall of 2020, a design was developed, and submitted in December 2020 as a supporting document to seek funding to undertake the work. The project was awarded funding, and in the spring of 2021 preparations began. Among the tasks was meeting in April with neighbors to discuss the project. It was at this point that the first indication of a potential problem became apparent as the neighbors across the river called attention to the presence of many wood turtles (*Glyptemys insculpta*) utilizing a gravel bar which the design called for making major modifications to. Wood turtles have a SARA status of Schedule 1, Threatened.

The presence of wood turtles on the gravel bar was a red flag. There is zero likelihood of getting the required Watercourse and Wetland Alteration (WAWA) Permit to disturb wood turtle habitat by modifying a gravel bar which they were using. Nor even if somehow such a permit application were to be successful, would FFHR have a desire to proceed with the work as planned. Policy as laid out in Appendix (Checklist for Projects in Wood Turtle (*Glyptemys insculpta*) habitat), item 6 prohibits such activity on sites with most of the characteristics found here (exception: aspect of gravel bar here is SE not SW). Wood turtles are distributed through much of the Petitcodiac Watershed, and FFHR did undertake a previous project on the Little River in 2017 with numerous wood turtles in the area. In that case it was possible to work around them. The fact wood turtles intermittently transited through that site was a notably different situation than the need to directly excavate a gravel bar which they were occupying, possibly nesting in. Consequently, an alternative design was developed and proposed to the landowner. This intervention avoided the gravel bar entirely, focusing all the work on the bank instead to compensate for taking no action against the gravel bar. The WAWA permit was granted for the new design, however as the date to break ground approached the landowner expressed reservations about the change in plans and ultimately FFHR decided it would be best not to go forward with the project.

It is unfortunate that due to the wood turtles occupying the gravel bar on opposite bank, the work was not possible as originally planned. The proposed alternative would have improved the stability of the bank within budget, and without impinging upon use of the waterfront, but was not what had originally been proposed. That said, on the plus side, with regards to wood turtles, the system worked as it should have. A project that was underway but found out to be contraindicated due to its impact on wood turtles, was forced to adapt or be terminated. The proposed adaption did not meet with the needs of the landowner, and in the end project termination proved to be the most viable option.

In hindsight the gravel bar in question was somewhat obvious as potential wood turtle habitat. A project requiring excavation of such a feature as a fundamental aspect of all of the initial three enhancement options identified (ranging from least to most expensive) was bound to run into complications. Wood turtles thrive in precisely the conditions (aggradation) that result from the sort of instability that bank stabilization projects are frequently called upon to address. Consequently, one take away lesson from this situation is to be more aware of the potential for wood turtles to become a complicating factor during the project selection phase. To prevent a recurrence of this problem in the future, selection should ensure that projects are properly screened to ensure that those likely to require similar modifications to a gravel bar are vetted for the presence of wood turtles or avoided altogether.

Pollett, below the Sanitorium Rd bridge at Riverglade, 2022 (Private Landowner)

A private landowner financed their own bank stabilization project on the Pollett in 2022 to protect their house, which was in danger of being lost to the river. They did so working independently with the same consulting partner that designs projects for FFHR , 5R Environmental Consulting. The physical work for this project was carried out by a contractor who the landowner hired to implement the design 5R developed for them. It would have undergone to the same regulatory and permitting process a projects done by FFHR or the PWA. FFHR won't be doing formalized monitoring at this site since it isn't an FFHR project. That said, this portion of the river gets visited with some regularity as a few hundred metres upstream is a site FFHR monitors annually as part of its long-term electrofishing to document the response of the fish community river to the opening of the Petitcodiac Causeway, and iBoF Atlantic salmon recovery efforts.

Figure 29: 2022 Project undertaken by private landowner to protect their house on a failing riverbank

Culvert Remediation

Work to remediate culverts identified as barriers to fish passage has been undertaken by the Petitcodiac Watershed Alliance as part of their Broken Brooks project between 2014 and 2022 (Table 7). At several sites more than one form of culvert remediation has been employed, in some cases during the same year, and in other cases over the course of several years.

Table 7: Petitcodiac Watershed Alliance "Broken Brooks" Culvert assessment and mitigation

Culvert ID	Latitude	Longitude	Assessment	Debris Removal	Rock Weir	Outflow Chute	Upstream habitat gain
C-004	N 45.93545	W -65.08030	Full Barrier		2017		4.5 km
C-011	N 45.79643	W -65.11240	Full Barrier	2017	2017	2020	3 km
C-012	N 45.86286	W -65.05899	Partial Barrier	2014			8 km
C-015	N 46.00437	W -65.24290	Partial Barrier		2017		1 km
C-017	N 45.80346	W -65.08150	Full Barrier		2017	2020	1 km
C-021	N 45.75567	W -65.08011	Partial Barrier	2017			5 km
C-022	N 45.78429	W -65.09698	Full Barrier	2017			4 km
C-041	N 45.84985	W -65.08439	Partial Barrier	2014			7 km

Debris removal has been the most common culvert remediation method- used at five of the eight culverts worked on within the Pollett River watershed. Where needed, doing so is certainly useful and relatively simple compared to options such as building rock weirs or installing outflow chutes. The need to do so however is partially a function of time as the presence of debris, woody and otherwise is a result of accumulation, and / or the growth of vegetation. Consequently, no doubt sites where such work was warranted in 2014, such as C-012 (Figure 30) and C-041 (Figure 31) probably need to be revisited by 2022.

Culvert C-011 was the site of both debris removal and a rock weir in 2017 to improve passage. It was subsequently revisited in 2020 to `install a more sophisticated intervention- an outflow chute (Figure 33) built for the PWA by students at the New Brunswick Community College (NBCC) Metals Processing and Construction Department (Figure 34). The project involved installation of a baffle to slow the movement of water within the culvert, as well as the outflow chute at the culvert's outflow to improve the access of fish to the culvert. This concrete box culvert is on Steeves Brook, a tributary of Webster Brook, which flows into the Pollett near Elgin.

Figure 30: Before and after photos of C-012 in 2014, located where Kaye Road crosses Colpitts Brook.

Figure 31: Before and after photos of C-022, located where Church Hill Road crosses Sheffer Brook

Figure 32: Before and after photos of C-041, where a logging road crosses Popple Intervale Brook.

Figure 33: C-011 A) before baffle; B) after baffle; C) before chute; D) after chute installation

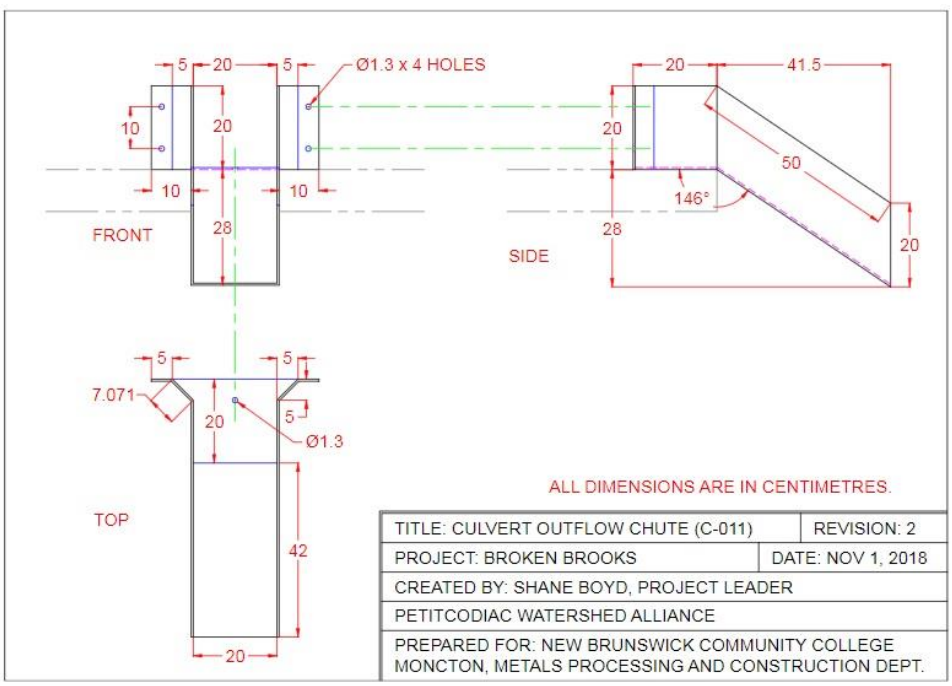

Figure 34: Front, top, and side views with dimensions of outflow chute for Culvert C-011

In 2017 a rock weir was installed by PWA at Culvert C-017 on a private road through a field off of Stewart Rd. east of Elgin. An outflow drop of less than 15 cm can be sufficiently addressed by such a rock weir, however as can be seen in Figure 35 the outflow drop from the perched culvert at this site is greater than that, warranting the use of a combination of a rock weir to raise the plunge pool and an outflow chute to focus the flow and provide fish with easier access the culvert. Like at C-011, the outflow chute for C-017 was built for the PWA by students at the NBCC Metals Processing and Construction Department (Figure 36).

Figure 35: Outflow cute installed on Culvert C-017

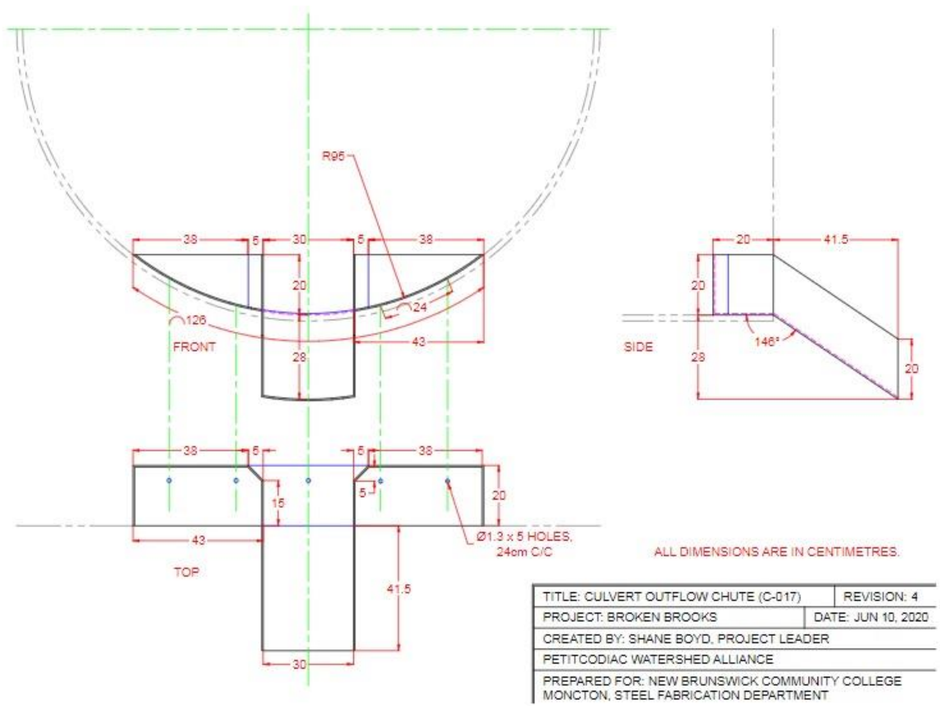

Figure 36: Front, top, and side views with dimensions of outflow chute for Culvert C-017

Dump Site Clean Up

Illegal dumping is a problem within the Pollett River watershed. As with much of rural New Brunswick, the woods are frequently viewed as an opportunity to abandon things. On an annual basis, the worst of it has tended to be tied to the Pollett River Run which until recent years was a big event each year the last weekend in April. Participants launch homemade boats in the midst of the spring freshet, and encouraged by a bit of alcohol, try their luck on the river. The traditional River Run began at Mapleton Bridge just below Elgin and ended in a mud bog at the takeout near the Sanitorium Rd. Bridge, where things often tended to get a bit out of hand (Figure 19). As a consequence, numerous bits and pieces of wrecked boats typically ended up scattered and abandoned yearly along the river, with the greatest density left near the takeout site. The debris left behind is a hazard or in the very least an eyesore for all other river users. Over the last several years steps have been taken by a loose coalition of organizations including the RCMP, DNR, DTI, Village of Petitcodiac, PWA and FFHR to discourage participants. Not being formally organized, the River Run continues today, but in a reduced form. The worst of the mud bog has ended (likely moved on elsewhere off the Pollett). Figure 37 provides an idea of what the clean-up of River Run debris along the Pollett was like in 2014

Figure 37: Examples of Pollett River Run Clean up from 2014

Opportunities for Future Restoration Activities

Restoration Framework –Stewardship Planning, Prioritization and Engagement

To address concerns within the watershed through an efficient use of finite resources (both human and financial), projects must be well prioritized, both in terms of the needs of the river, and those of the landowners on who's property the project is taking place. Fort Folly Habitat Recovery has developed a series of Stewardship Plans on a watershed by watershed basis within the Petitcodiac River system, of which this Pollett River Stewardship Plan is one. These plans provide a means of tackling the challenging task of identifying local problems, determining which ones warrant immediate attention, and determining how to proceed with them once chosen. This process is laid out in Figure 38 and Figure 39.

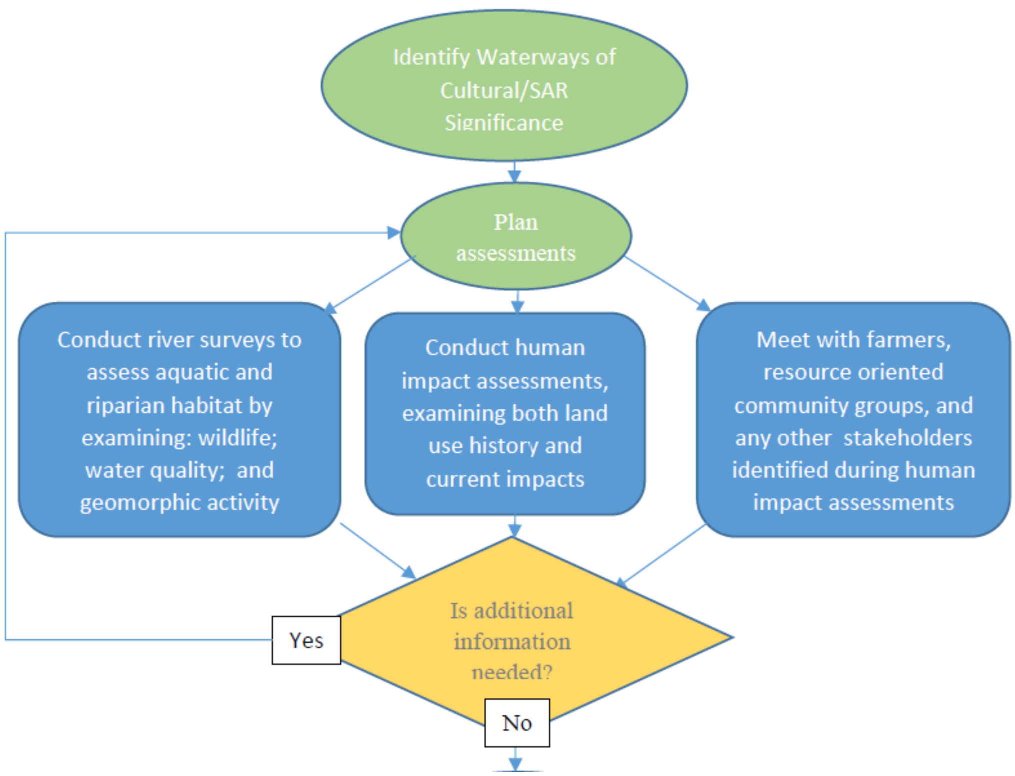

Figure 38: Stewardship Planning Process Part 1: Needs of the River

The field work that makes up the Third Level Assessment (Aquatic and Riparian Habitat Assessment) informs decision making by providing the wide context necessary to prioritize and target project selection. Without it, decisions about which project to undertake would be made without proper appreciation of how needs at a given site compare to those at other sites elsewhere in the system. At this point there is also an opportunity to ensure that efforts are well distributed across the watershed by including consideration of where previous projects have been done, to avoid focusing too much effort in just one area within too short a time period.

Applying such information, project selection can then proceed along the flowchart presented in Figure 39, where once identified, potential projects can be ranked according to their anticipated impact and viability. Viability is determined in part by the costs and benefits of the project, but is also dependent upon landowner interest, which comes from (to the extent practical) incorporation of landowner input into planning the project so that it is consistent with the landowner's needs.

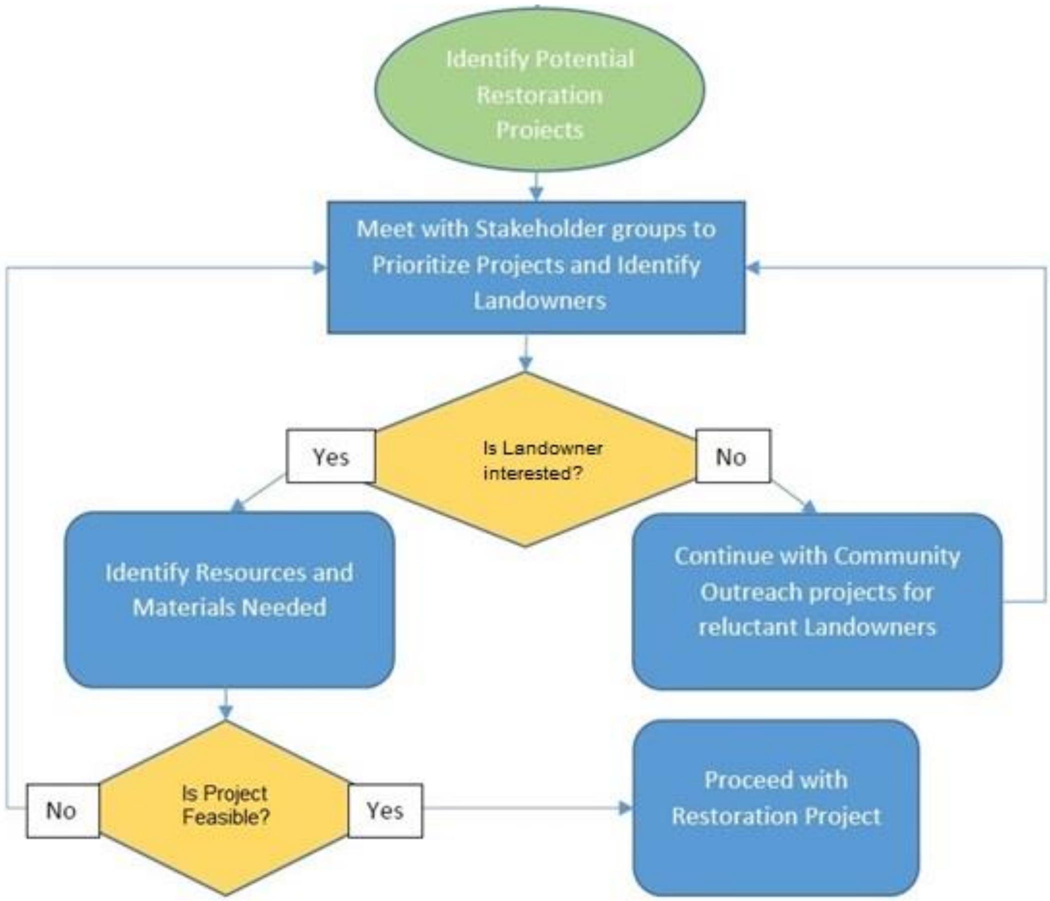

Figure 39: Stewardship Planning Process Part 2: Meeting Landowner Needs

Following this two-part selection process not only aids in decision making within the organization, doing so subsequently builds the case for any individual project when pursuing resources from outside the organization to undertake it, by providing the evidence to explain to others why it is necessary. This also creates further opportunities for outreach and engagement with landowners, through accessing and participating in existing social networks. Only once a project has been determined to be both worthwhile and feasible through this process should it then proceed to the design phase. In near term- following this process the next project that has been identified to undertake (in 2025) is a failing section of bank (Figure 40) located a short distance downstream of Elgin, near Mapleton Bridge.

Figure 40: Failing section of riverbank near Elgin planned for 2025 Bank Restoration Project

This site is higher up in the Pollett than previous projects (Figure 19), chosen precisely because that portion of the river has so far been underserved by bank stabilization efforts. It is important that such activities be well distributed through out the watershed both in terms of benefiting target species, and equitability of opportunity for landowners as well as generating public awareness. Beyond those considerations, the site warrants attention based upon its own merits given salmon redds detected there in 2020 (Figure 7) and the ranking of that reach (number 43 in Table 5) as “in adjustment” during the Rapid Geomorphic Assessments. The Primary Geomorphic process is degradation, and the secondary is aggradation, the latter of which is notable by the gravel bar in the foreground of Figure 40. Conversations with the landowner indicated significant interest on his part, as he had already had to move his house because of his failing bank. His barn (visible in Figure 40) remains near the river.

The site will be surveyed in the fall of 2024, to design a restoration plan to be implemented in the fall of 2025. That timeline is typical - required allow time to develop plans, line up funding, acquire permits and implement projects within the operational window defined by the permit (June 1st to September 30th) set to minimize negative impacts upon fish. The Province sets this work window to protect salmon by limiting such work to the summer between the point where salmon fry spawned the previous fall have emerged from their redds, and a point the next fall before adult salmon are spawning in the river (establishing the next set of redds). Beyond salmon, the presence of other threatened and endangered species in the watershed also means that such projects must be planned and implemented with awareness of these species. Fort Folly Habitat Recovery has developed project checklists (Appendix) based on species biology to provide guidelines to help avoid or minimize the risk of negative impacts.

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Appendix: SAR Species Checklists for Restoration Projects

Checklist for projects in Atlantic Salmon (*Salmo salar*) habitat

1). Determine if there are any obvious downstream natural or manmade barriers to fish passage (waterfalls, dams, perched culverts, etc) that could prevent salmon from accessing the site.
☐ Done Comment____

2). If manmade barriers are found, note them for possible future action, or, if practical, consider mitigating them as part of the current project.
☐ Done ☐ Does not apply Comment________________________________

3). Even where such barriers exist, electrofish or otherwise sample the site to confirm current presence or absence of salmon as part of project planning, prior to any modification of site.
☐ Done Comment____

4). If no salmon are found and the reason is determined to be a natural barrier, reconsider the need for the project. Perhaps the site should not be considered a priority unless reasons other than promotion of salmon are motivating factors, as resources might be better used elsewhere.
☐ Done ☐ Does not apply Comment________________________________

5). If no salmon are found at the site but there is no barrier to fish passage (manmade or natural) it is likely that this is a result of the declining population of wild salmon in the region. If salmon are found elsewhere on the river then treat the site as if it has salmon. If no salmon are found in that river then reevaluate the need for the project as resources might be better used elsewhere.
☐ Done ☐ Does not apply Comment________________________________

6). Plan project thoroughly and allow sufficient lead time to secure necessary permits and schedule work during optimal work conditions. This will help minimize the duration of in stream work, reduce negative impacts, and control costs.
☐ Done Comment____

7). In sites where salmon are found, observe an operating window of July 1st to September 30th to time any earth moving operations between the end of alevin emergence and the start of spawning.
☐ Done ☐ Does not apply Comment________________________________

8). In sites where salmon are found, always assume that juveniles and / or migrating adults are present while doing any work during the operating window allowed in item 7. The window indicates reduced sensitivity of fish, not their absence. Care must still be taken to minimize direct harm to fish during work.
☐ Done ☐ Does not apply Comment________________________________

9). Incorporate erosion and sediment control practices into work plan as laid out in Section 3 of DFO's Land Development guidelines for Protection of Aquatic Habitat (http://www.dfo-mpo.gc.ca/Library/165353.pdf)
☐ Done Comment____

10). Retain riparian vegetation to protect natural stream conditions and structure and promote stability of the bed and banks. Doing so maintains shade, water temperatures, dissolved oxygen, food supplies, organic debris, cover etc.
☐ Done Comment____

Checklist for projects in American Eel (*Anguilla rostrata*) habitat

1). Determine if there are any obvious downstream natural or manmade barriers to fish passage (waterfalls, dams, perched culverts, etc) that could prevent eels from accessing the site.
☐ Done Comment____

2). If manmade barriers are found, note them for possible future action, or, if practical, consider mitigating them as part of the current project.
☐ Done ☐ Does not apply Comment____________________________

3). Even where such barriers exist, electrofish or otherwise sample the site to confirm current presence or absence of eels as part of project planning, prior to any modification of site.
☐ Done Comment____

4). Evaluate and estimate quantity and quality of watershed upstream of site for value to eels to better understand and document potential impacts of any gain or loss of access
☐ Done Comment____

5). Where upstream habitat warrants it, ensure that project design will not create a barrier to eel passage when complete. The best means of maintaining unobstructed passage will be site and project specific, varying significantly between fords, dams, culverts etc.
☐ Done ☐ Does not apply Comment____________________________

6). If the project site is within 200 meters of the head of tide then time operations for July and August if possible in order to minimize risk of direct harm to elvers migrating upstream (May/June) and eels migrating downstream (September) that could be concentrated and sheltering amid substrates.
☐ Done ☐ Does not apply Comment____________________________

7). If the project site is more than 200 meters beyond the head of tide then if possible avoid operations during September in order to minimize risk of direct harm to eels migrating downstream that could be concentrated and sheltering amid substrates.
☐ Done ☐ Does not apply Comment____________________________

8). The primarily way that humans spread the swim bladder nematode (*Anguillicola crassus*) is by moving infected eels into unimpacted watersheds. Most restoration projects pose no risk of this. None the less, understand the nematode's lifecycle, and ensure that the project avoids spreading it.
☐ Done Comment____

Checklist For Projects in Wood Turtle (*Glyptemys insculpta*) habitat

1). Conduct series of 3 surveys of the site and surroundings at appropriate time of year (spring is best) to determine presence of turtles as part of project planning, prior to any modification of site.
☐ Done Comment ______________________________

2). In addition to looking for individual turtles, assess project site (and surrounding area) to identify turtle nesting sites (best done during nesting season (May/June) the prior year).
☐ Done Comment ______________________________

3). Consider value of site for turtles (if present) relative to other species: stream bank stabilization may benefit salmon, but harm turtles. On a non salmon bearing stream that is home to turtles, taking no action may be the best management.
☐ Done ☐ Does not apply Comment ______________________________

4). Be aware that shortly prior to nesting females concentrate in undisturbed sites adjacent to nest sites, so minimize impacts on the immediate surroundings of nest sites during nesting season.
☐ Done ☐ Does not apply Comment ______________________________

5). If turtles or nest sites are present then plan to conduct restoration activities at both time of year and time of day to try to avoid encounters with turtles.

Time of year	Stage	distance from water	habitat use	most active
Jan/Feb/Mar	hibernating	in pools	in stream	not active
Late Mar/Apr	pre nesting	100 m	aquatic	morning & late afternoon
May /Jun	nesting	3km +	terrestrial	morning & early evening
Jul/ Aug/Sep	post nesting	100 m	aquatic	morning
October	pre hibernation	100 m	aquatic	morning & late afternoon
Nov/Dec	hibernating	in pools	in stream	not active

☐ Done ☐ Does not apply Comment ______________________________

6). If turtles are present, do not stabilize or vegetate any sites that possess ALL of the following characteristics, as these may be nest sites:

a) full sun exposure to afternoon / evening sun (SW aspect)
b) slope less than 40 degrees (nests usually atleast 1.5 m above water surface)
c) sand or sand gravel substrate with little or no ground vegetation (>20% cover)

☐ Done ☐ Does not apply Comment ______________________________

7). If intervention on nesting sites is unavoidable, then mitigate:

- time work either prior to nesting or after hatching (either April or November) if possible, to avoid destroying existing nests
- create compensatory habitat (witch characteristics of item 6: a, b, & c) nearby

☐ Done ☐ Does not apply Comment ______________________________

8). If manipulating project site in turtle habit in July or August and air temps remain over 26° C, search directly affected portions of site for estivating turtles prior to beginning operations.
☐ Done ☐ Does not apply Comment ______________________________

9). Maintain access across finished project site to adjacent suitable nest sites- a low profile wood structure with sod cap is preferable to large rocks or other material that results in slippery surface
☐ Done ☐ Does not apply Comment ______________________________

10) If project has increased human access to site, protect nests with predator exclusion boxes, as human activity increases the density of nest predating species like raccoons and skunks.
☐ Done ☐ Does not apply Comment ______________________________

Checklist for projects in Brook Floater (*Alasmidonta varicosa*) habitat

1). Plan project thoroughly and allow sufficient lead time to carry out necessary site surveys, secure required permits and schedule work during optimal conditions.

☐ Done Comment ____

2) . Compare site to the Petitcodiac map of distribution and abundance of brook floater (https://www.biodiversitylibrary.org/item/108793#page/347/mode/1up) (Hanson and Locke 2001, Canadian Field Naturalist 115(2) 329-340). This habitat lies along the main stem of the Petitcodiac (above the head of tide), and the lower portions of the Little River, and the North River.

☐ Done ☐ Does not apply Comment ______________________________

3). If the site lies within the area identified in #2 then, prior to disturbing it, survey (snorkel or viewing buckets as conditions warrant) to determine if brook floater is present at the site or within 100 metres downstream. Ideal time is June to September (water levels low, turbidity minimal, light penetration best) to allow completion of the work before falling leaves obscure the river bottom in autumn.

☐ Done ☐ Does not apply Comment ______________________________

4). If surveys detect brook floaters at or near the site, then ensure that all subsequent survey work and subsequent long term monitoring (electrofishing, CABIN, etc.) is conducted in a manner consistent with such awareness in order to avoid or minimize impacts on brook floaters.

☐ Done ☐ Does not apply Comment ______________________________

5). If brook floaters detected near site then fording heavy equipment or carrying out in-stream work is problematic. Consult authorities (NB DELG, DFO) as part of WAWA process, and consider alternatives.

☐ Done ☐ Does not apply Comment ______________________________

6). During earthmoving activities with equipment working along the river bank, incorporate erosion and sediment control practices into work plan as laid out in Section 3 of DFO's Land Development guidelines for Protection of Aquatic Habitat (http://www.dfo-mpo.gc.ca/library/165353.pdf)

☐ Done Comment ____

7.) Retain and if possible enhance riparian vegetation, to protect natural stream conditions and promote the structure and stability of the bed and banks. A healthy riparian zone maintains shade, retains sediment, and filters nutrients keeping them out of aquatic ecosystems.

☐ Done Comment ____

8). If cattle are present, measures to protect newly planted vegetation by excluding cattle (i.e. fencing) will also protect brook floaters. Open access to streams by cattle can cause direct mortality to mussels by trampling of mussel beds and lead to habitat degradation through sedimentation and eutrophication.

☐ Done ☐ Does not apply Comment ______________________________